EXHIBIT 1002

AO 120 (Rev. 08/10)

TO: Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	**REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK**

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court for the Central District of California on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED 5/27/2022	U.S. DISTRICT COURT for the Central District of California
PLAINTIFF MITSUBISHI ELECTRIC CORPORATION and SISVEL INTERNATIONAL S.A.		DEFENDANT TCL COMMUNICATION TECHNOLOGY HOLDINGS LIMITED, TCT MOBILE INTERNATIONAL LIMITED, TCT MOBILE, INC., TCT MOBILE (US) INC., and TCT MOBIL

PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1 US 9,635,656 B2	4/25/2017	Mitsubishi Electric Corporation
2 US 9,713,068 B2	7/18/2017	Mitsubishi Electric Corporation
3 US 10,200,976 B2	2/5/2019	Mitsubishi Electric Corporation
4		
5		

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director **Copy 3—Upon termination of action, mail this copy to Director**
Copy 2—Upon filing document adding patent(s), mail this copy to Director **Copy 4—Case file copy**

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/587,726	04/25/2017	9635656	445600US20CONT	6371

22850 7590 04/05/2017
OBLON, MCCLELLAND, MAIER & NEUSTADT, L.L.P.
1940 DUKE STREET
ALEXANDRIA, VA 22314

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 0 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):

Miho Maeda, Tokyo, JAPAN;
MITSUBISHI ELECTRIC CORPORATION, Chiyoda-ku, JAPAN
Mitsuru Mochizuki, Tokyo, JAPAN;
Keiko Tada, Tokyo, JAPAN;
Yasushi Iwane, Tokyo, JAPAN;

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 USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

IR103 (Rev. 10/09)

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)

CUSTOMER NUMBER
22850

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.
14/587,726	12/31/2014	Miho Maeda	445600US20CONT	6371

TITLE OF INVENTION: DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$960	$0	$0	$960	03/16/2017

EXAMINER	ART UNIT	CLASS-SUBCLASS
CHENG, CHI TANG P	2463	370-437000

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 Oblon, McClelland,
2 Maier & Neustadt, L.L.P.
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: Mitsubishi Electric Corporation
(B) RESIDENCE: (CITY and STATE OR COUNTRY): Chiyoda-ku, JAPAN

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. Transmitted via EFS-Web.
- ☒ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number 15-0030 (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 — 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.
- ☐ Applicant asserting small entity status. See 37 CFR 1.27 — 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.
- ☐ Applicant changing to regular undiscounted fee 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 /Craig R. Feinberg/ Date 3/14/2017
Typed or printed name Craig R. Feinberg Registration No. 62,116

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

Electronic Patent Application Fee Transmittal					
Application Number:	14587726				
Filing Date:	31-Dec-2014				
Title of Invention:	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL				
First Named Inventor/Applicant Name:	Miho Maeda				
Filer:	Bradley Davis Lytle/Santiago Villalobos				
Attorney Docket Number:	445600US20CONT				
Filed as Large Entity					
Filing Fees for Utility under 35 USC 111(a)					
Description	**Fee Code**	**Quantity**	**Amount**	**Sub-Total in USD($)**	
Basic Filing:					
Pages:					
Claims:					
Miscellaneous-Filing:					
Petition:					
Patent-Appeals-and-Interference:					
Post-Allowance-and-Post-Issuance:					
UTILITY APPL ISSUE FEE	1501	1	960	960	

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**960**

Electronic Acknowledgement Receipt	
EFS ID:	28624586
Application Number:	14587726
International Application Number:	
Confirmation Number:	6371
Title of Invention:	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL
First Named Inventor/Applicant Name:	Miho Maeda
Customer Number:	22850
Filer:	Bradley Davis Lytle/Santiago Villalobos
Filer Authorized By:	Bradley Davis Lytle
Attorney Docket Number:	445600US20CONT
Receipt Date:	14-MAR-2017
Filing Date:	31-DEC-2014
Time Stamp:	14:46:43
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$960
RAM confirmation Number	031517INTEFSW14470300
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	445600USIF.pdf	1195834 2ba1f4eff253cb0b8cb4fd252d41a245473857bb	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30590 560cce441f3208a919e37db658c6abc270467c72	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	1226424		

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

22850 7590 12/16/2016
OBLON, MCCLELLAND, MAIER & NEUSTADT, L.L.P.
1940 DUKE STREET
ALEXANDRIA, VA 22314

EXAMINER
CHENG, CHI TANG P

ART UNIT	PAPER NUMBER
2463	

DATE MAILED: 12/16/2016

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/587,726	12/31/2014	Miho Maeda	445600US20CONT	6371

TITLE OF INVENTION: DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$960	$0	$0	$960	03/16/2017

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.

PTOL-85 (Rev. 02/11)

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)

22850 7590 12/16/2016
OBLON, MCCLELLAND, MAIER & NEUSTADT, L.L.P.
1940 DUKE STREET
ALEXANDRIA, VA 22314

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.
14/587,726	12/31/2014	Miho Maeda	445600US20CONT	6371

TITLE OF INVENTION: DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$960	$0	$0	$960	03/16/2017

EXAMINER	ART UNIT	CLASS-SUBCLASS
CHENG, CHI TANG P	2463	370-437000

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 — 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.
- ❑ Applicant asserting small entity status. See 37 CFR 1.27 — 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.
- ❑ Applicant changing to regular undiscounted fee 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. _____

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

Ex. 1002 - TCL Comm Tech Holdings Ltd.
TCL Comm Tech Holdings Ltd. v. Mitsubishi Electric Corp. - IPR2023-00957
Page 10

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/587,726	12/31/2014	Miho Maeda	445600US20CONT	6371

22850 7590 12/16/2016
OBLON, MCCLELLAND, MAIER & NEUSTADT, L.L.P.
1940 DUKE STREET
ALEXANDRIA, VA 22314

EXAMINER
CHENG, CHI TANG P

ART UNIT	PAPER NUMBER
2463	

DATE MAILED: 12/16/2016

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)

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. 14/587,726	Applicant(s) MAEDA ET AL.	
	Examiner PETER CHENG	Art Unit 2463	AIA (First Inventor to File) Status No

-- 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 *communication of 11/30/16*.
   ☐ 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 *2-4*. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   Certified copies:
   a) ☐ All b) ☐ Some *c) ☐ None of the:
   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

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

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

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

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

/PETER CHENG/
Primary Examiner, Art Unit 2463

Ex. 1002 - TCL Comm Tech Holdings Ltd.
TCL Comm Tech Holdings Ltd. v. Mitsubishi Electric Corp. - IPR2023-00957
Page 13

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14587726	MAEDA ET AL.
	Examiner	**Art Unit**
	PETER CHENG	2463

CPC- SEARCHED		
Symbol	**Date**	**Examiner**
h04l47/72,722,724,822,824,827	10/26/15, 8/25/16, 12/10/16	pc
h04w28/16,18,20,22,24,26	10/26/15, 8/25/16, 12/10/16	pc
h04w72/0406,0413,042,1278,1284,1289	10/26/15, 8/25/16, 12/10/16	pc
h04w74/002,004,006,0866,0883,0891	10/26/15, 8/25/16, 12/10/16	pc
h04w76/021	10/26/15, 8/25/16, 12/10/16	pc
h04j11/003	10/26/15, 8/25/16, 12/10/16	pc
h04l1/1671,1854,1858,0026	10/26/15, 8/25/16, 12/10/16	pc
h04l5/0007,0057	10/26/15, 8/25/16, 12/10/16	pc

CPC COMBINATION SETS - SEARCHED		
Symbol	**Date**	**Examiner**

US CLASSIFICATION SEARCHED			
Class	**Subclass**	**Date**	**Examiner**

US CLASSIFICATION SEARCHED			
Class	**Subclass**	**Date**	**Examiner**
370	436-9, 441-3, 458, 478-480, 498, 509, 522, 524, 527, 529, 537	10/26/15, 8/25/16, 12/10/16	pc

SEARCH NOTES		
Search Notes	**Date**	**Examiner**
inventors name search in PALM and EAST for double patenting	10/26/15, 12/10/16	pc
EAST search	10/26/15, 3/23/16, 8/25/16, 12/10/16	pc
h04l47/72,722,724,822,824,827 (see search history printout)	10/26/15, 8/25/16, 12/10/16	pc
h04w28/16,18,20,22,24,26 (see search history printout)	10/26/15, 8/25/16, 12/10/16	pc
h04w72/0406,0413,042,1278,1284,1289 (see search history printout)	10/26/15, 8/25/16, 12/10/16	pc
h04w74/002,004,006,0866,0883,0891 (see search history printout)	10/26/15, 8/25/16, 12/10/16	pc
h04w76/021(see search history printout)	10/26/15, 8/25/16, 12/10/16	pc
h04j11/003 (see search history printout)	10/26/15, 8/25/16, 12/10/16	pc
h04l1/1671,1854,1858,0026 (see search history printout)	10/26/15, 8/25/16, 12/10/16	pc
h04l5/0007,0057 (see search history printout)	10/26/15, 8/25/16, 12/10/16	pc
370/436-9, 441-3, 458, 478-480, 498, 509, 522, 524, 527, 529, 537 (see search history printout)	8/25/16, 12/10/16	pc

INTERFERENCE SEARCH			
US Class/ CPC Symbol	**US Subclass / CPC Group**	**Date**	**Examiner**
	Interference search - see search history printout	12/10/16	pc

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14587726	MAEDA ET AL.
	Examiner	**Art Unit**
	PETER CHENG	2463

CPC

Symbol					Type	Version
H04W		72	/	0413	F	2013-01-01
H04L		47	/	827	I	2013-01-01
H04W		74	/	002	I	2013-01-01
H04W		74	/	006	I	2013-01-01
H04W		72	/	1278	I	2013-01-01
H04W		72	/	1289	I	2013-01-01
H04W		74	/	004	I	2013-01-01
H04W		74	/	0883	I	2013-01-01
H04W		74	/	0891	I	2013-01-01
H04W		76	/	021	I	2013-01-01
H04W		28	/	18	I	2013-01-01
H04W		28	/	26	I	2013-01-01
H04W		28	/	16	I	2013-01-01
H04L		1	/	0026	A	2013-01-01
H04L		1	/	1671	I	2013-01-01
H04L		1	/	1854	I	2013-01-01
H04L		1	/	1858	I	2013-01-01
H04W		72	/	1284	I	2013-01-01
H04W		74	/	0866	A	2013-01-01
H04J		11	/	003	I	2013-01-01
H04L		5	/	0007	I	2013-01-01
H04L		5	/	0057	I	2013-01-01

CPC Combination Sets

Symbol					Type	Set	Ranking	Version
			/					
			/					

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 3	
/PETER CHENG/ Primary Examiner.Art Unit 2463 (Primary Examiner)	12/10/2016 (Date)	O.G. Print Claim(s) 2	O.G. Print Figure 1

U.S. Patent and Trademark Office

Part of Paper No. 20161210

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14587726	MAEDA ET AL.
	Examiner	**Art Unit**
	PETER CHENG	2463

US ORIGINAL CLASSIFICATION		INTERNATIONAL CLASSIFICATION	
CLASS	SUBCLASS	CLAIMED	NON-CLAIMED
370	437	H 0 4 J 3 / 16 (2006.01.01)	

CROSS REFERENCE(S)					
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)				

NONE (Assistant Examiner)	(Date)	Total Claims Allowed: 3	
/PETER CHENG/ Primary Examiner.Art Unit 2463 (Primary Examiner)	12/10/2016 (Date)	O.G. Print Claim(s) 2	O.G. Print Figure 1

U.S. Patent and Trademark Office

Part of Paper No. 20161210

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14587726	MAEDA ET AL.
	Examiner	**Art Unit**
	PETER CHENG	2463

☒ **Claims renumbered in the same order as presented by applicant** ☐ **CPA** ☐ **T.D.** ☐ **R.1.47**

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1														
1	2														
2	3														
3	4														

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 3	
/PETER CHENG/ Primary Examiner.Art Unit 2463 (Primary Examiner)	12/10/2016 (Date)	O.G. Print Claim(s) 2	O.G. Print Figure 1

U.S. Patent and Trademark Office Part of Paper No. 20161210

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	1045595	(mitsubishi).as. or (miho with maeda or mitsuru with mochizuki or keiko with tada or yasushi with iwane).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/12/10 17:52
L2	1	L1 and (("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3 or qualit$3 near3 (notification or notif$4)) same (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3) with (simultane$6 or concurren$4 or coin$1cid$4 or overlap$4 or collid$3 or collision)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/12/10 17:52
L4	22844	(370/436-439,441-443,458,478-480,498,509,522,524,527,529,537).CCLS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2016/12/10 17:58
L5	31	L4 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/12/10 17:58
L6	15210	h04l47/72,722,724,822,824,827.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/12/10 17:59
L7	14	L6 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/12/10 17:59
L8	54636	h04w28/16,18,20,22,24,26.cpc.	US-PGPUB; USPAT; USOCR; FPRS;	OR	ON	2016/12/10 17:59

			EPO; JPO; DERWENT; IBM_TDB			
L9	123	L8 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/12/10 17:59
L10	80354	h04w72/0406,0413,042,1278,1284,1289.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/12/10 17:59
L11	540	L10 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/12/10 17:59
L12	18113	h04w74/002,004,006,0866,0883,0891.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/12/10 17:59
L13	89	L12 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/12/10 17:59
L14	8644	h04w76/021.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/12/10 17:59
L15	11	L14 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/12/10 17:59
L16	1127	h04j11/003.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	ON	2016/12/10 17:59

			DERWENT; IBM_TDB			
L17	25	L16 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/12/10 17:59
L18	41087	h04l1/1671,1854,1858,0026.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/12/10 17:59
L19	379	L18 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/12/10 17:59
L20	47164	h04l5/0007,0057.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/12/10 18:00
L21	257	L20 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/12/10 18:00
L22	168	("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) with (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) with (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3) with (simultane$6 or concurren$4 or collid$3 or collision)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/12/10 18:01
L23	67	("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) with (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3) with (simultane$6 or concurren$4 or collid$3 or collision)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/12/10 18:04

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L3	12	(("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3 or qualit$3 near3 (notification or notif$4)) same (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3) with (simultane$6 or concurren$4 or coin$1cid$4 or overlap$4 or collid$3 or collision)).clm.	US-PGPUB; USPAT	OR	ON	2016/12/10 17:53

12/10/2016 6:14:51 PM
C:\Users\pcheng\Documents\EAST\Workspaces\14587726.wsp

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14587726	MAEDA ET AL.
	Examiner	**Art Unit**
	PETER CHENG	2463

✓	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	10/27/2015	03/23/2016	08/25/2016	12/10/2016					
	1	-	-	-	-					
1	2	✓	✓	✓	=					
2	3	✓	✓	✓	=					
3	4	✓	✓	✓	=					

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/587,726	12/31/2014	Miho Maeda	445600US20CONT	6371

22850 7590 12/06/2016
OBLON, MCCLELLAND, MAIER & NEUSTADT, L.L.P.
1940 DUKE STREET
ALEXANDRIA, VA 22314

EXAMINER
CHENG, CHI TANG P

ART UNIT	PAPER NUMBER
2463	

NOTIFICATION DATE	DELIVERY MODE
12/06/2016	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):

patentdocket@oblon.com
oblonpat@oblon.com
ahudgens@oblon.com

PTOL-90A (Rev. 04/07)

Applicant-Initiated Interview Summary	Application No.	Applicant(s)	
	14/587,726	MAEDA ET AL.	
	Examiner	Art Unit	
	PETER CHENG	2463	

All participants (applicant, applicant's representative, PTO personnel):

(1) *PETER CHENG*. (3)_____.

(2) *Zach Stern*. (4)_____.

Date of Interview: *28 November 2016*.

Type: ☒ Telephonic ☐ Video Conference
☐ Personal [copy given to: ☐ applicant ☐ applicant's representative]

Exhibit shown or demonstration conducted: ☐ Yes ☒ No.
If Yes, brief description: _____.

Issues Discussed ☐101 ☒112 ☐102 ☒103 ☐Others
(For each of the checked box(es) above, please describe below the issue and detailed description of the discussion)

Claim(s) discussed: *2-4*.

Identification of prior art discussed: *Varma*.

Substance of Interview
(For each issue discussed, provide a detailed description and indicate if agreement was reached. Some topics may include: identification or clarification of a reference or a portion thereof, claim interpretation, proposed amendments, arguments of any applied references etc...)

Applicant and examiner discussed outstanding rejections/objections in view of proposed claim amendments. The examiner indicated that the proposed amendments would overcome the 112-2nd indefiniteness rejections. There would appear to be support for the newly proposed amendments but a definitive determination will require a more comprehensive and in depth review of the specification. The examiner indicated that Varma might be applicable to reject the new limitation(s) but a stronger Section 103 rejection would likely require another reference. The obviousness double patenting rejection remains outstanding. No further agreements were reached .

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

☐ Attachment

/PETER CHENG/
Primary Examiner, Art Unit 2463

Summary of Record of Interview Requirements

Manual of Patent Examining Procedure (MPEP), Section 713.04, Substance of Interview Must be Made of Record
A complete written statement as to the substance of any face-to-face, video conference, or telephone interview with regard to an application must be made of record in the application whether or not an agreement with the examiner was reached at the interview.

Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews
Paragraph (b)

In every instance where reconsideration is requested in view of an interview with an examiner, a complete written statement of the reasons presented at the interview as warranting favorable action must be filed by the applicant. An interview does not remove the necessity for reply to Office action as specified in §§ 1.111, 1.135. (35 U.S.C. 132)

37 CFR §1.2 Business to be transacted in writing.
All business with the Patent or Trademark Office should be transacted in writing. The personal attendance of applicants or their attorneys or agents at the Patent and Trademark Office is unnecessary. The action of the Patent and Trademark Office will be based exclusively on the written record in the Office. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is disagreement or doubt.

The action of the Patent and Trademark Office cannot be based exclusively on the written record in the Office if that record is itself incomplete through the failure to record the substance of interviews.

It is the responsibility of the applicant or the attorney or agent to make the substance of an interview of record in the application file, unless the examiner indicates he or she will do so. It is the examiner's responsibility to see that such a record is made and to correct material inaccuracies which bear directly on the question of patentability.

Examiners must complete an Interview Summary Form for each interview held where a matter of substance has been discussed during the interview by checking the appropriate boxes and filling in the blanks. Discussions regarding only procedural matters, directed solely to restriction requirements for which interview recordation is otherwise provided for in Section 812.01 of the Manual of Patent Examining Procedure, or pointing out typographical errors or unreadable script in Office actions or the like, are excluded from the interview recordation procedures below. Where the substance of an interview is completely recorded in an Examiners Amendment, no separate Interview Summary Record is required.

The Interview Summary Form shall be given an appropriate Paper No., placed in the right hand portion of the file, and listed on the "Contents" section of the file wrapper. In a personal interview, a duplicate of the Form is given to the applicant (or attorney or agent) at the conclusion of the interview. In the case of a telephone or video-conference interview, the copy is mailed to the applicant's correspondence address either with or prior to the next official communication. If additional correspondence from the examiner is not likely before an allowance or if other circumstances dictate, the Form should be mailed promptly after the interview rather than with the next official communication.

The Form provides for recordation of the following information:
- Application Number (Series Code and Serial Number)
- Name of applicant
- Name of examiner
- Date of interview
- Type of interview (telephonic, video-conference, or personal)
- Name of participant(s) (applicant, attorney or agent, examiner, other PTO personnel, etc.)
- An indication whether or not an exhibit was shown or a demonstration conducted
- An identification of the specific prior art discussed
- An indication whether an agreement was reached and if so, a description of the general nature of the agreement (may be by attachment of a copy of amendments or claims agreed as being allowable). Note: Agreement as to allowability is tentative and does not restrict further action by the examiner to the contrary.
- The signature of the examiner who conducted the interview (if Form is not an attachment to a signed Office action)

It is desirable that the examiner orally remind the applicant of his or her obligation to record the substance of the interview of each case. It should be noted, however, that the Interview Summary Form will not normally be considered a complete and proper recordation of the interview unless it includes, or is supplemented by the applicant or the examiner to include, all of the applicable items required below concerning the substance of the interview.

A complete and proper recordation of the substance of any interview should include at least the following applicable items:
1) A brief description of the nature of any exhibit shown or any demonstration conducted,
2) an identification of the claims discussed,
3) an identification of the specific prior art discussed,
4) an identification of the principal proposed amendments of a substantive nature discussed, unless these are already described on the Interview Summary Form completed by the Examiner,
5) a brief identification of the general thrust of the principal arguments presented to the examiner,
   (The identification of arguments need not be lengthy or elaborate. A verbatim or highly detailed description of the arguments is not required. The identification of the arguments is sufficient if the general nature or thrust of the principal arguments made to the examiner can be understood in the context of the application file. Of course, the applicant may desire to emphasize and fully describe those arguments which he or she feels were or might be persuasive to the examiner.)
6) a general indication of any other pertinent matters discussed, and
7) if appropriate, the general results or outcome of the interview unless already described in the Interview Summary Form completed by the examiner.

Examiners are expected to carefully review the applicant's record of the substance of an interview. If the record is not complete and accurate, the examiner will give the applicant an extendable one month time period to correct the record.

Examiner to Check for Accuracy

If the claims are allowable for other reasons of record, the examiner should send a letter setting forth the examiner's version of the statement attributed to him or her. If the record is complete and accurate, the examiner should place the indication, "Interview Record OK" on the paper recording the substance of the interview along with the date and the examiner's initials.

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
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 14/587,726	Filing Date 12/31/2014	☐ 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

11/30/2016	(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))	* 3	Minus	** 20	= 0	x $80 =	0
Independent (37 CFR 1.16(h))	* 3	Minus	***3	= 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
GINA GARY

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.

DOCKET NO: 445600US20CONT

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF	:
MIHO MAEDA, ET AL.	: EXAMINER: CHENG, CHI TANG P
SERIAL NO: 14/587,726	:
FILED: DECEMBER 31, 2014	: GROUP ART UNIT: 2463
FOR: DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL	:

AMENDMENT UNDER 37 C.F.R. § 1.111

COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313

Commissioner:

In response to the Office Action dated August 31, 2016, please amend the above-identified application as follows:

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Remarks/Arguments begin on page 5 of this paper.

IN THE CLAIMS

Please amend the claims as follows:

Claim 1 (Canceled).

Claim 2 (Currently Amended): A data communication method which is implemented by a communication system, the method comprising:

transmitting data by a base station using an OFDM (Orthogonal Frequency Division Multiplexing) method as a downlink access method;

transmitting, by a mobile terminal, a quality notification signal for notifying downlink communication quality to said base station;

transmitting, by said mobile terminal, a scheduling request signal to said base station requesting allocation of radio resources from said base station before transmitting transmission data to said base station; and

performing, by said mobile terminal:

a quality notification process that includes transmitting said quality notification signal to said base station;

a scheduling request signal transmission process that includes transmitting said scheduling request signal to said base station;

a first control process that includes, when ~~there is no~~ the mobile terminal has not been allocated a radio resource ~~available~~ for transmitting said transmission data, transmitting said scheduling request signal to said base station; and

a second control process that includes, when said quality notification process coincides with said scheduling request signal transmission process, stopping said quality notification process during a time interval during which said mobile terminal transmits said scheduling request signal.

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Claim 3 (Currently Amended): A communications system comprising:

a base station configured to transmit data by using an OFDM (Orthogonal Frequency Division Multiplexing) method as a downlink access method; and

a mobile terminal configured to transmit a quality notification signal for notifying downlink communication quality to said base station, and to transmit a scheduling request signal with which to make a request for allocation of radio resources to said base station before transmitting transmission data to said base station,

wherein said mobile terminal includes:

a transmitter configured to transmit said quality notification signal to said base station, and to transmit said scheduling request signal to said base station; and

a controller configured to perform a first control process that includes, when ~~there is no~~ the mobile terminal has not been allocated a radio resource ~~available~~ for transmitting said transmission data, ~~enabling said transmitter to transmit~~ transmitting said scheduling request signal to said base station, and a second control process that includes, when a transmission of said quality notification signal coincides with that of said scheduling request signal in said transmitter, stopping transmitting said quality notification signal during a time interval during which said transmitter transmits said scheduling request signal.

Claim 4 (Currently Amended): A mobile terminal configured to:

transmit a quality notification signal for notifying downlink communication quality to a base station, and

transmit a scheduling request signal with which to make a request for allocation of radio resources to said base station before transmitting transmission data to said base station,

wherein said mobile terminal includes:

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a transmitter configured to transmit said quality notification signal to said base station, and to transmit said scheduling request signal to said base station; and

a controller configured to perform a first control process that includes, when ~~there is no~~ the mobile terminal has not been allocated a radio resource ~~available~~ for transmitting said transmission data, ~~enabling said transmitter to transmit~~ transmitting said scheduling request signal to said base station, and a second control process that includes, when a transmission of said quality notification signal coincides with that of said scheduling request signal in said transmitter, stopping transmitting said quality notification signal during a time interval during which said transmitter transmits said scheduling request signal.

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REMARKS/ARGUMENTS

Favorable reconsideration of this application, as presently amended and in light of the following discussion, is respectfully requested.

Claims 2-4 are pending in this application. Claims 2-4 are amended by the present response.

Amendments to the claims find support in the application as originally filed, at least at page 34, line 15, to page 35, line 15, page 66, lines 11-20, and Figs. 5, 31, and 32. Thus, no new matter is added.

In the outstanding Office Action, Claims 3 and 4 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite; Claims 2-4 were rejected under 35 U.S.C. § 112, first paragraph, as failing to satisfy the written description and enablement requirements; the Specification was objected to; Claims 2-4 were rejected on the grounds of nonstatutory double patenting as being unpatentable over Claim 1 of U.S. Patent 9,019,983 to Maeda in view of U.S. Publication 2014/0177444 to Varma; and Claims 2-4 were rejected under 35 U.S.C. § 103(a) as unpatentable over U.S. Patent 7,873,023 to Ihm et al. (hereinafter "Ihm") in view of U.S. Publication 2007/0054689 to Baker et al. (hereinafter "Baker") and Varma.

Initially, Applicant and Applicant's representative gratefully acknowledge the courtesy of an interview with Examiner Cheng on November 28, 2016. During the interview, rejections in the Office Action and differences between the claimed invention and the cited references were discussed. Based on the discussion, Examiner Cheng indicated the outstanding rejections appear to be overcome, pending further review of the cited references. Comments and claim amendments discussed during the interview are reiterated herein.

As discussed during the interview, amended Claims 3 and 4 clearly recite the claimed inventions.

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Amended Claim 3 recites, in part, a controller configured to perform a first control process that includes, when the mobile terminal has not been allocated a radio resource for transmitting the transmission data, transmitting a scheduling request signal to the base station. Claim 4 is similarly amended.

Thus, amended Claims 3 and 4 omit the word "enabling" questioned by the Office Action, and the amended claims clearly recite the invention. Therefore, the indefiniteness rejection should be withdrawn.

In addition, as discussed during the interview, the written description and enablement rejections of Claims 2-4 are overcome by the present amendment.

Amended Claim 2 is directed to a data communication method that includes, in part, a first control process that includes, when the mobile terminal has not been allocated a radio resource for transmitting said transmission data, transmitting said scheduling request signal to said base station.

As explained by way of non-limiting example in Applicant's Specification at page 66, lines 11-20:

> The mobile terminal, in ST3204, judges whether the mobile terminal has received "uplink data resource allocation (Uplink Data Resource Allocation)" from the base station. That is, the mobile terminal judges whether the mobile terminal has received uplink transmission allocation from the base station.
>
> When, in ST3204, has received uplink transmission allocation, the mobile terminal advances to ST3205. In contrast, when has not received uplink transmission allocation, the mobile terminal returns to ST3202. This step corresponds to ST3104 in Fig. 31.

Thus, according to this example, when the mobile terminal "has not received uplink transmission allocation" (i.e., when the mobile terminal has not been allocated a radio resource) the mobile terminal returns to step ST3202 in Fig. 32, where it transmits the scheduling request (i.e., transmitting said scheduling request signal to said base station).

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Furthermore, as discussed during the interview, the examples of Figs. 31 and 32 correspond to sequence and flow diagrams, respectively, in a case of an allocation that is related to the "first control process." For example, the Specification at paragraph [0101] describes embodiment 3 as follows (emphasis added):

> [0101]
>
> Each of the first and ***second examples of the setting of a scheduling request signal SR*** which are explained above ***can also be used in any one of Embodiment 1***, Embodiment 6, Embodiment 7, Embodiment 8, Embodiment 9, and Embodiment 10.
>
> Furthermore, in a case in which the mobile terminal does not have to transmit an Ack/Nack and/or a CQI, but has to transmit only a scheduling request signal, ***the mobile terminal does not transmit any information about*** the Ack/Nack and ***the CQI*** by using the Ack/Nack exclusive channel, ***but can transmit only the scheduling request*** by using the Ack/Nack exclusive channel.

Thus, as explained the cite portion above, the "second example of the setting of a scheduling request signal SR" is related to the "first control process" as explained in Embodiment 3, e.g. paragraphs [0091-0092, 0094] of the Specification with reference to Figs. 31/32.

Furthermore, the "second control process" is explained in Embodiment 1, e.g. paragraph [0042] of the Specification.

Consequently, from the above-mentioned disclosure, it is clear that the connection between Figs. 31/32 (Embodiment 3) related to the "first control process" and the "second control process" (Embodiment 1) are fully supported by the original Specification.

Therefore, as discussed during the interview, the Specification clearly describes an embodiment of the claimed invention, and that a person having ordinary skill in the art would have been able to make the claimed invention without undue experimentation. Thus, the written description and enablement rejections should be withdrawn.

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In addition, as discussed during the interview, the objection to the Specification is rendered moot by the claim amendments discussed above. Therefore, it is respectfully requested that objection also be withdrawn.

Furthermore, Applicant respectfully requests the nonstatutory obviousness-type double patenting rejection be held in abeyance until allowable subject matter in the claims is acknowledged by the Office.

In addition, as discussed during the interview, amended Claims 2-4 are believed to patentably define over Ihm in view of Baker and Varma.

Amended Claim 2 is directed to a data communication method that includes, in part, a first control process that includes, when the mobile terminal has not been allocated a radio resource for transmitting the transmission data, transmitting the scheduling request signal to the base station.

As discussed during the interview, Ihm in view of Baker and Varma fails to teach or suggest all the features of any of the independent claims. For example, Ihm in view of Baker and Varma fails to teach or suggest a first control process that includes, when the mobile terminal has not been allocated a radio resource for transmitting the transmission data, transmitting the scheduling request signal to the base station.

As noted in the Office Action at page 13, Ihm in view of Baker fails to disclose the claimed first control process.

In addition, Applicant respectfully traverses the assertion in the Office Action at page 15 that it would have been obvious to obtain that missing claimed feature from the disclosure of Varma because "when such upstream data arrives at the CPE/UE, ***there is no available resource/ timeslot/ bandwidth to send such upstream data, and in response to this circumstance***, the CPE/UE sends the REQ to the BSC" (emphasis added).

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However, Applicant respectfully submits that the disclosure of Varma fails to support that conclusion. According to Varma at paragraphs [0049]-[0050] (emphasis added): "Upon arrival of data to be sent as upstream data, the state machine transitions to ***deferring state*** 21. … In ***deferring state*** 21, CPE 13 sends a REQ message to BSC 12." Thus, according to the teaching of Varma, the CPE/UE ***detects its deferring state***, and then sends a REQ message to the BSC ***based on the detection result***. Accordingly, Applicant respectfully submits that in view of that disclosure of Varma, a person having ordinary skill in the art would ***not*** have obtained the claimed invention of transmitting the scheduling request signal to the base station when the mobile terminal has ***not been allocated a radio resource***.

Accordingly, as discussed during the interview, Ihm in view of Baker and Varma fails to teach or suggest "a first control process that includes, when the mobile terminal has not been allocated a radio resource for transmitting said transmission data, transmitting said scheduling request signal to said base station," as recited by amended Claim 2.

In addition, as discussed during the interview, Ihm in view of Baker and Varma fails to teach or suggest "a controller configured to perform a first control process that includes, when the mobile terminal has not been allocated a radio resource for transmitting said transmission data, transmitting said scheduling request signal to said base station," as recited by amended Claim 3, and as similarly required by amended Claim 4.

Accordingly, Applicant respectfully submits that Claims 2-4 are allowable.

Consequently, in light of the above discussion and the present amendment, this application is believed to be in condition for allowance, and an early and favorable action to that effect is respectfully requested.

Respectfully Submitted,

OBLON, McCLELLAND,
MAIER & NEUSTADT, L.L.P.

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Ex. 1002 - TCL Comm Tech Holdings Ltd.
TCL Comm Tech Holdings Ltd. v. Mitsubishi Electric Corp. - IPR2023-00957
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Electronic Acknowledgement Receipt	
EFS ID:	27654553
Application Number:	14587726
International Application Number:	
Confirmation Number:	6371
Title of Invention:	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL
First Named Inventor/Applicant Name:	Miho Maeda
Customer Number:	22850
Filer:	Bradley Davis Lytle/Christopher Evans
Filer Authorized By:	Bradley Davis Lytle
Attorney Docket Number:	445600US20CONT
Receipt Date:	30-NOV-2016
Filing Date:	31-DEC-2014
Time Stamp:	16:14:28
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		445600USresponse.pdf	378545 74866c5d553657d3577004fa0175b723519e333e	yes	11

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Miscellaneous Incoming Letter	1	1
	Amendment/Req. Reconsideration-After Non-Final Reject	2	2
	Claims	3	5
	Applicant Arguments/Remarks Made in an Amendment	6	11

Warnings:

Information:

Total Files Size (in bytes):	378545

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

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

<u>New International Application Filed with the USPTO as a Receiving Office</u>
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.

Docket No. 445600US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

INVENTOR(S) Miho MAEDA, et al.

SERIAL NO: 14/587,726 ART UNIT: 2463

FILING DATE: December 31, 2014 EXAMINER: CHENG, CHI TANG P

FOR: DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL

FEE TRANSMITTAL

■ No additional fee is required

☐ Small entity status of this application under 37 C.F.R. §1.9 and §1.27 is claimed.

☐ Track 1 Prioritized Examination

The Fee has been calculated as shown below:

FOR	NUMBER FILED	NUMBER EXTRA	RATE	CALCULATIONS
TOTAL CLAIMS	3 - 20 =	0	x $80 =	$ 0.00
INDEPENDENT CLAIMS	3 - 3 =	0	x $420 =	$ 0.00
☐ MULTIPLE DEPENDENT CLAIMS (If applicable)			+ $780 =	$0.00
☐ LATE FILING OF DECLARATION			+ $140 =	$0.00
☐ NON-ELECTRONIC FILING FEE			+ $400 =	$0.00
			BASIC FEES	$0.00
			TOTAL OF ABOVE CALCULATIONS	$ 0.00
☐ REDUCTION BY 50% FOR FILING BY SMALL ENTITY				$0.00
☐ FILING IN NON-ENGLISH LANGUAGE			+ $140 =	$0.00
			TOTAL	$ 0.00

☐ Please charge Deposit Account No. **15-0030** in the amount of _____

☐ Credit card payment is being made online (if electronically filed), or is attached hereto (if paper filed), in the amount of _____.

■ The Director is hereby authorized to charge any additional fees which may be required for the papers being filed herewith and for which no payment is enclosed herewith, or credit any overpayment to Deposit Account No. **15-0030**, with the **EXCEPTION** of deficiencies in fees for multiple dependent claims in new applications.

■ If these papers are not considered timely filed by the Patent and Trademark Office, then a petition is hereby made under 37 C.F.R. §1.136, and any additional fees required under 37 C.F.R. §1.136 for any necessary extension of time may be charged to Deposit Account No. 15-0030.

Submitted by: /Zachary S. Stern/

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/587,726	12/31/2014	Miho Maeda	445600US20CONT	6371

22850 7590 08/31/2016
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EXAMINER
CHENG, CHI TANG P

ART UNIT	PAPER NUMBER
2463	

NOTIFICATION DATE	DELIVERY MODE
08/31/2016	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):

patentdocket@oblon.com
oblonpat@oblon.com
ahudgens@oblon.com

PTOL-90A (Rev. 04/07)

Office Action Summary	Application No. 14/587,726	Applicant(s) MAEDA ET AL.	
	Examiner PETER CHENG	Art Unit 2463	AIA (First Inventor to File) Status No

-- 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 7/28/16.

☐ 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) 2-4 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) 2-4 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: _____.

1. The present application is being examined under the pre-AIA first to invent provisions.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 7/28/16 has been entered.

Claim Rejections - 35 USC § 112

1. The following is a quotation of 35 U.S.C. 112(b):
(b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:
The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. **Claims 3 and 4** are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly

claim the subject matter which the inventor or a joint inventor, or for pre-AIA the applicant regards as the invention.

The recitation "enabling the transmitter to transmit …" is indefinite because the word "enabling" renders the feature of the transmitter transmitting potentially optional and not required, thus raising the question of whether or not this entire limitation should be given patentably weight.

3. The following is a quotation of the first paragraph of 35 U.S.C. 112(a):

> (a) IN GENERAL.—The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor or joint inventor of carrying out the invention.

The following is a quotation of the first paragraph of pre-AIA 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. **Claims 2-4** are rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor or a joint inventor, or for pre-AIA the inventor(s), at the time the application was filed, had possession of the claimed invention.

The limitation “a first control process that includes, when there is no radio resource available for transmitting said transmission data, transmitting said scheduling request signal to said base station” does not appear to have sufficient support in the original disclosure to convey possession. The paragraphs cited by Applicant for support, i.e., paragraphs 82, 91 and 94, merely disclose repeatedly waiting and transmitting the "scheduling request" signal. There is no mention of performing this action in the scenario "when there is no radio resource available for transmitting said transmission data”.

5. **Claims 2-4** are rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

The limitation “a first control process that includes, when there is no radio resource available for transmitting said transmission data, transmitting said scheduling request signal to said base station” does not appear to have sufficient support in the original disclosure to enable an ordinary artisan to practice the invention. The paragraphs cited by Applicant for support, i.e., paragraphs 82, 91 and 94, merely disclose repeatedly waiting and transmitting the "scheduling request" signal. There is no mention of performing this action in the scenario

"when there is no radio resource available for transmitting said transmission data".

The Specification does not teach one of ordinary skill in the art how to make and use the full scope of the claimed invention without "undue experimentation." MPEP 2161.01(III). In considering the "Wands" factors, it is determined that based on (i) the broadness of the claim language of claims 1 and 11; (ii) the nature of the invention; (iii) the state of the prior art; (iv) the level of one of ordinary skill; (v) the amount of direction provided by the inventor, which is minimal with regard to the limitation above; (vi) the non-existence of working examples; and (vii) the considerable quantity of experimentation needed to make or use the invention based on the content of the disclosure, the Specification does not enable one of ordinary skill in the art to practice the limitation set forth above.

Specification

6. The specification is objected to as failing to provide proper antecedent basis for the claimed subject matter. See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Correction of the following is required:

The limitation "a first control process that includes, when there is no radio resource available for transmitting said transmission data, transmitting said scheduling request signal to said base station" does not appear to have sufficient support in the original disclosure; there does not appear to be support that would provide the requisite

proper antecedent basis. The paragraphs cited by Applicant for support, i.e., paragraphs 82, 91 and 94, merely disclose repeatedly waiting and transmitting the "scheduling request" signal. There is no mention of performing this action in the scenario "when there is no radio resource available for transmitting said transmission data".

Double Patenting

1. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the claims at issue are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); In re Vogel, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the reference application or patent either is shown to

be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. See MPEP § 717.02 for applications subject to examination under the first inventor to file provisions of the AIA as explained in MPEP § 2159. See MPEP §§ 706.02(l)(1) - 706.02(l)(3) for applications not subject to examination under the first inventor to file provisions of the AIA. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO Internet website contains terminal disclaimer forms which may be used. Please visit www.uspto.gov/forms/. The filing date of the application in which the form is filed determines what form (e.g., PTO/SB/25, PTO/SB/26, PTO/AIA/25, or PTO/AIA/26) should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to http://www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

1. **Claims 2-4** are rejected on the ground of nonstatutory double patenting as being unpatentable over claim 1 of U.S. Patent No. 9019983 to Maeda, in view of U.S. Patent Publication No. 2014/0177444 A1 to Varma.

2. **As to claim 2,** claim 1 of Maeda discloses a data communication method which is implemented by a communication system, the method comprising:

transmitting data by a base station using an OFDM (Orthogonal Frequency Division Multiplexing) method as a downlink access method (claim 1);

transmitting, by a mobile terminal, a quality notification signal for notifying downlink communication quality to said base station (claim 1);

transmitting, by said mobile terminal, a scheduling request signal to said base station requesting allocation of radio resources from said base station before transmitting transmission data to said base station (claim 1); and

performing, by said mobile terminal:

a quality notification process that includes transmitting said quality notification signal to said base station (claim 1: “a response signal transmission process …”);

a scheduling request signal transmission process that includes transmitting said scheduling request signal to said base station (claim 1: “a scheduling request signal transmission process …”); and

a second control process that includes, when said quality notification process coincides with said scheduling request signal transmission process, stopping said quality notification process during a time interval during which said mobile terminal transmits said scheduling request signal (claim 1: “a control process of …”).

Varma discloses a first control process that includes, when there is no radio resource available for transmitting said transmission data, transmitting said scheduling request signal to said base station (first see, e.g., paragraphs 4-6, disclosing a time-division multiple access TDMA/TDD environment in which a CPE/user-terminal/UE in an area covered by a "base station controller BSC in a cell" sends a "short request (REQ) message“ to the BSC, which then sends a “grant of a data slot for use by the CPE”, thus teaching that the REQ is an embodiment of a "scheduling request to said base station"

since in this TDMA/TDD system, the granting of a data slot for use by the CPE teaches a scheduling in the time domain of a time for the UE to transmit upstream data; paragraph 7, teaching that allocation and usage of time/data slots is directly linked to bandwidth; paragraphs 6, 38, 47-53 and claim 6, teaching that “upon arrival of data to be sent as upstream data” at the CPE/UE, the CPE/UE will enter into "deferring state” in which the CPE/UE will send REQ to the BSC requesting timeslot/bandwidth grant, where such CPE/UE will not send such data upstream until a grant in response to the REQ is received, thus teaching to an ordinary artisan that when such upstream data arrives at the CPE/UE, there is no available resource/timeslot/bandwidth to send such upstream data, and in response to this circumstance, the CPE/UE sends the REQ to the BSC, i.e., "transmitting said scheduling request signal to said base station”, teaching this limitation, further see claim 6, which provides a concise synopsis of this teaching).

At the time of invention, it would have been obvious to a person of ordinary skilled in the art to utilize the teachings disclosed by Varma, in conjunction with and/or to modify Maeda, to teach the limitations recited in this claim. In particular, since both Varma and Maeda disclose scheduling request signal, in light of this commonality, one of ordinary skill in the art would have deemed it obvious to modify or combine Maeda’s teachings with Varma’s teaching of transmitting a scheduling request to the base station when there is no radio resource available, to teach the claimed invention. The suggestion/motivation would have been to provide an improved method of scheduling controlling signaling in the uplink direction (Maeda, claim 1; Varma, paragraphs 1-17 and Fig. 2). Furthermore, please note that with regard to the claimed invention, all of

the claimed elements have been shown to be known or disclosed in Maeda and Varma, and one skilled in the art could have combined the elements as claimed by known methods with no change in their respective functions and the combination would have yielded predictable results to one of ordinary skill in the art.

1. **As to claims 3 and 4,** see rejection for claim 2 above.

Response to Arguments

1. Applicant's arguments drawn to the Section 103 rejections have been fully considered but they are either moot or unpersuasive.

Applicant's arguments directed to the references Ihm and Baker are not persuasive because they allege that each of Ihm or Baker individually is insufficient to teach certain limitations or features. However, as established in the rejection, these limitations or features at issue are rejected by a combination of Ihm and Baker, not Ihm or Baker alone.

With respect to the new limitation "a first control process …", this limitation is rejected by Varma, thus rendering Applicant's arguments moot. Please see rejection below for details.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. **Claims 2-4** are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 7,873,023 B2 to Ihm et al., further in view of U.S. Patent Publication No. 2007/0054689 A1 to Baker et al., further in view of U.S. Patent Publication No. 2014/0177444 A1 to Varma.

3. **As to claim 2**, Ihm discloses a data communication method which is implemented by a communication system, the method comprising:

transmitting data by a base station using an OFDM (Orthogonal Frequency Division Multiplexing) method as a downlink access method (col. 1, lines 20-30, disclosing OFDM system);

transmitting, by a mobile terminal, a quality notification signal for notifying downlink communication quality to said base station (Fig. 3 and cols. 1 and 4, col. 5, lines 11-34, “transmit feedback information S31 and S32");

transmitting, by said mobile terminal, a scheduling request signal to said base station requesting allocation of radio resources from said base station before transmitting transmission data to said base station (Fig. 3 and cols. 1 and 4, col. 5, lines 11-34, “transmit indicator flag S33", wherein such “indicator flag” teaches “scheduling request signal”); and

performing, by said mobile terminal:

a quality notification process that includes transmitting said quality notification signal to said base station (Fig. 3 and cols. 1 and 4, col. 5, lines 11-34, “transmit feedback information S31 and S32");

a scheduling request signal transmission process that includes transmitting said scheduling request signal to said base station (Fig. 3 and cols. 1 and 4, col. 5, lines 11-34, “transmit indicator flag S33", wherein such “indicator flag” teaches “scheduling request signal”); and

a control process of regulating said scheduling request signal transmission and said quality notification process during a time interval during which said mobile terminal transmits said scheduling request signal (Fig. 3 and cols. 1 and 4, col. 5, lines 11-34, disclosing that on a "CQICH"/”fast feedback channel” that is normally used to transmit [periodic, see steps S31 and S32] channel quality indicator CQI feedback information such as the "cqi feedback headers" in Fig. 2, the transmission of such cqi information normally through the cqich as in S31/S32 teaching "said quality notification process", when a "uplink resource allocation" request message is required to be sent by the mobile station, an "indicator flag" is sent on such CQICH/”fast feedback channel” in place of the regular CQI information, the sending of such “indicator flag” teaching “said scheduling request signal transmission”; thus teaching to an ordinary artisan that during the time duration(s) for processing and transmitting such "indicator flag" through the CQICH/”fast feedback channel” [such time duration(s) teaching the recited “time interval during which said mobile terminal transmits said scheduling request signal”], the CQICH/”fast feedback channel” is not transmitting/feeding-back/processing CQI information, i.e., the “quality notification process” during such time duration(s) is “stop[ped]”, thus teaching an embodiment of this limitation pursuant to the broadest reasonable interpretation of the claim terms).

Ihm does not explicitly disclose “a second control process that includes, when said quality notification process coincides with another signal transmission process, stopping said quality notification process during a time interval during which said mobile terminal transmits said another signal”.

Baker discloses a second control process that includes, when said quality notification process coincides with another signal transmission process, stopping said quality notification process during a time interval during which said mobile terminal transmits said another signal (Figs. 2B/D/E/F and paragraph 2, disclosing the mobile station sending to the base station "channel quality information" CQI, i.e., the recited “quality notification process” in particular time intervals; paragraph 61, disclosing for example, “there may be a requirement to interrupt the transmission of CQI reports [by the mobile station] while the mobile station transmits another signal”, thus teaching that the transmission of CQI, i.e., “quality notification process", is stopped/suspended "while the mobile station transmits another signal" [teaching “when said quality notification process coincides with another signal transmission process" in reference to claim 2, and “when a transmission of said quality notification signal coincides with that of another signal" in reference to claim 3], teaching this limitation).

At the time of invention, it would have been obvious to a person of ordinary skilled in the art to utilize the teachings disclosed by Baker, in conjunction with and/or to modify the teachings disclosed by Ihm, to teach the limitations recited in this claim. In particular, since Ihm discloses scheduling request signal, wherein such scheduling request signal is not preempted by the quality notification signal, such scheduling

request signal in Ihm may correspond to and be analogous to the "another signal" disclosed in Baker that interrupts CQI transmission [since both signals share the common characteristic of not being preempted/interrupted by the corresponding quality notification signal], so that the teachings of Ihm and Baker discussed above are combinable and can modify each other to teach "a second control process that includes, when said quality notification process coincides with said scheduling request signal transmission process, stopping said quality notification process during a time interval during which said mobile terminal transmits said scheduling request signal" recited in claim 2, and "a controller configured to perform a second control process that includes, when a transmission of said quality notification signal coincides with that of said scheduling request signal in said transmitter, stop transmitting said quality notification signal during a time interval during which said transmitter transmits said scheduling request signal" recited in claim 3. The suggestion/motivation would have been to provide an improved method of scheduling controlling signaling in the uplink direction (Baker, paragraphs 1-14 and 61; Ihm, cols. 1-3). Furthermore, note that with regard to the claimed invention with respect to the limitations above, all of the claimed elements have been shown to be known or disclosed in Ihm and Baker, and one skilled in the art could have combined the elements as claimed by known methods with no change in their respective functions and the combination would have yielded predictable results to one of ordinary skill in the art at the time of the invention.

Ihm and Baker do not explicitly disclose a first control process that includes, when there is no radio resource available for transmitting said transmission data, transmitting said scheduling request signal to said base station.

Varma discloses a first control process that includes, when there is no radio resource available for transmitting said transmission data, transmitting said scheduling request signal to said base station (first see, e.g., paragraphs 4-6, disclosing a time-division multiple access TDMA/TDD environment in which a CPE/user-terminal/UE in an area covered by a "base station controller BSC in a cell" sends a "short request (REQ) message“ to the BSC, which then sends a “grant of a data slot for use by the CPE”, thus teaching that the REQ is an embodiment of a "scheduling request to said base station" since in this TDMA/TDD system, the granting of a data slot for use by the CPE teaches a scheduling in the time domain of a time for the UE to transmit upstream data; paragraph 7, teaching that allocation and usage of time/data slots is directly linked to bandwidth; paragraphs 6, 38, 47-53 and claim 6, teaching that “upon arrival of data to be sent as upstream data” at the CPE/UE, the CPE/UE will enter into "deferring state” in which the CPE/UE will send REQ to the BSC requesting timeslot/bandwidth grant, where such CPE/UE will not send such data upstream until a grant in response to the REQ is received, thus teaching to an ordinary artisan that when such upstream data arrives at the CPE/UE, there is no available resource/timeslot/bandwidth to send such upstream data, and in response to this circumstance, the CPE/UE sends the REQ to the BSC, i.e., "transmitting said scheduling request signal to said base station”, teaching this limitation, further see claim 6, which provides a concise synopsis of this teaching).

At the time of invention, it would have been obvious to a person of ordinary skilled in the art to utilize the teachings disclosed by Varma, in conjunction with and/or to modify the teachings of Ihm and Baker above, to teach the limitations recited in this claim. In particular, since both Varma and Ihm disclose scheduling request signal, in light of this commonality, one of ordinary skill in the art would have deemed it obvious to modify or combine the combination of Ihm and Baker above with Varma's teaching of transmitting a scheduling request to the base station when there is no radio resource available, to teach the claimed invention. The suggestion/motivation would have been to provide an improved method of scheduling controlling signaling in the uplink direction (Baker, paragraphs 1-14 and 61; Ihm, cols. 1-3; Varma, paragraphs 1-17 and Fig. 2). Furthermore, please note that with regard to the claimed invention, all of the claimed elements have been shown to be known or disclosed in Ihm, Baker and Varma, and one skilled in the art could have combined the elements as claimed by known methods with no change in their respective functions and the combination would have yielded predictable results to one of ordinary skill in the art at the time of the invention.

1. **As to claim 3**, please see rejection for claim 2.
2. **As to claim 4**, please see rejection for claim 2.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to PETER CHENG whose telephone number is (571)272-9021. The examiner can normally be reached on M-Th, 8:00AM - 5:00PM (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Rinehart can be reached on 571-272-3632. 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.

/PETER CHENG/
Primary Examiner, Art Unit 2463

Notice of References Cited	Application/Control No. 14/587,726	Applicant(s)/Patent Under Reexamination MAEDA ET AL.	
	Examiner PETER CHENG	Art Unit 2463	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-2014/0177444 A1	06-2014	Varma; Subir	H04W72/0446	370/236
	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	
	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.

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14587726	MAEDA ET AL.
	Examiner	**Art Unit**
	PETER CHENG	2463

✓	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	10/27/2015	03/23/2016	08/25/2016						
	1	-	-	-						
	2	✓	✓	✓						
	3	✓	✓	✓						
	4	✓	✓	✓						

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S346	1792	(schedul$3 or resourc$3) near5 request$4 with expir$5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/23 14:23
S347	109	(schedul$3 or resourc$3) near5 request$4 near11 (leas$3 or band$1width$3 or reserv$5) near5 expir$5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/23 14:23
S348	76	(schedul$3 or grant$3) near3 request$4 near11 (leas$3 or band$1width$3 or reserv$5) near5 expir$5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/23 14:30
S349	36	schedul$3 near3 request$4 near15 (leas$3 or band$1width$3 or reserv$5) near3 expir$5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/23 14:55
S350	19	(time$3slot$4 or schedul$3) near3 request$4 near16 (band$1width$3 or reserv$5 or allocat$3) near3 expir$5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/23 15:08
S351	52	(time$3slot$4 or schedul$3) near3 request$4 same (band$1width$3 or reserv$5 or allocat$3) near5 (exhaust$4 or expir$5)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/23 15:10
S352	3	time$3slot$4 same (resource or allocat$3 or schedul$3) near3 request$4 with (reserv$5 or allocat$3) near5 expir$5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/23 16:12
S353	1	time$3slot$4 with (resource or allocat$3 or	US-PGPUB;	OR	ON	2016/08/23

		schedul$3) same request$4 near9 (reserv$5 or allocat$3) near5 expir$5	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			16:14
S354	2	time$3slot$4 near5 schedul$3 near5 request$4 with (in$1sufficient$3 or un$1available or expir$5)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/23 16:17
S355	2	time$3slot$4 near5 schedul$3 near5 request$4 with (in$1sufficient$3 or un$1available or expir$5 or elaps$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/23 16:19
S356	22777	(370/436-439,441-443,458,478-480,498,509,522,524,527,529,537).CCLS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2016/08/24 18:53
S357	31	S356 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/24 18:53
S358	14464	h04l47/72,722,724,822,824,827.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/24 18:53
S359	11	S358 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/24 18:53
S360	51044	h04w28/16,18,20,22,24,26.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/24 18:53
S361	119	S360 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or	US-PGPUB; USPAT; USOCR; FPRS;	OR	ON	2016/08/24 18:53

		N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	EPO; JPO; DERWENT; IBM_TDB			
S362	66833	h04w72/0406,0413,042,1278,1284,1289.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/24 18:53
S363	480	S362 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/24 18:53
S364	15580	h04w74/002,004,006,0866,0883,0891.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/24 18:53
S365	75	S364 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/24 18:53
S366	7072	h04w76/021.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/24 18:54
S367	8	S366 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/24 18:54
S368	979	h04j11/003.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/24 18:54
S369	21	S368 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	ON	2016/08/24 18:54

		(pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	DERWENT; IBM_TDB			
S370	37133	h04l1/1671,1854,1858,0026.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/24 18:54
S371	345	S370 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/24 18:54
S372	41343	h04l5/0007,0057.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/24 18:54
S373	228	S372 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/24 18:54
S374	1017942	(mitsubishi).as. or (miho with maeda or mitsuru with mochizuki or keiko with tada or yasushi with iwane).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/24 18:55
S375	1	S374 and (("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3 or qualit$3 near3 (notification or notif$4)) same (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3) with (simultane$6 or concurren$4 or coin$1cid$4 or overlap$4)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/08/24 18:55

EAST Search History (Interference)

<This search history is empty>

8/24/2016 7:04:37 PM
C:\Users\pcheng\Documents\EAST\Workspaces\14587726.wsp

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14587726	MAEDA ET AL.
	Examiner	**Art Unit**
	PETER CHENG	2463

CPC- SEARCHED

Symbol	Date	Examiner
h04l47/72,722,724,822,824,827	10/26/15, 8/25/16	pc
h04w28/16,18,20,22,24,26	10/26/15, 8/25/16	pc
h04w72/0406,0413,042,1278,1284,1289	10/26/15, 8/25/16	pc
h04w74/002,004,006,0866,0883,0891	10/26/15, 8/25/16	pc
h04w76/021	10/26/15, 8/25/16	pc
h04j11/003	10/26/15, 8/25/16	pc
h04l1/1671,1854,1858,0026	10/26/15, 8/25/16	pc
h04l5/0007,0057	10/26/15, 8/25/16	pc

CPC COMBINATION SETS - SEARCHED

Symbol	Date	Examiner

US CLASSIFICATION SEARCHED

Class	Subclass	Date	Examiner
370	436-9, 441-3, 458, 478-480, 498, 509, 522, 524, 527, 529, 537	10/26/15, 8/25/16	pc

SEARCH NOTES

Search Notes	Date	Examiner
inventors name search in PALM and EAST for double patenting	10/26/15	pc
EAST search	10/26/15, 3/23/16, 8/25/16	pc

SEARCH NOTES		
Search Notes	**Date**	**Examiner**
h04l47/72,722,724,822,824,827 (see search history printout)	10/26/15, 8/25/16	pc
h04w28/16,18,20,22,24,26 (see search history printout)	10/26/15, 8/25/16	pc
h04w72/0406,0413,042,1278,1284,1289 (see search history printout)	10/26/15, 8/25/16	pc
h04w74/002,004,006,0866,0883,0891 (see search history printout)	10/26/15, 8/25/16	pc
h04w76/021(see search history printout)	10/26/15, 8/25/16	pc
h04j11/003 (see search history printout)	10/26/15, 8/25/16	pc
h04l1/1671,1854,1858,0026 (see search history printout)	10/26/15, 8/25/16	pc
h04l5/0007,0057	10/26/15, 8/25/16	pc
370/436-9, 441-3, 458, 478-480, 498, 509, 522, 524, 527, 529, 537 (see search history printout)	8/25/16	pc

INTERFERENCE SEARCH			
US Class/ CPC Symbol	**US Subclass / CPC Group**	**Date**	**Examiner**

Docket No.: 445600US20CONT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF: Miho MAEDA, et al.
SERIAL NO: 14/587,726 GAU: 2463
FILED: December 31, 2014 EXAMINER: CHENG, CHI TANG P
FOR: DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL

REQUEST FOR CONTINUED EXAMINATION (RCE) TRANSMITTAL

COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313

Commissioner:

This is a Request for Continued Examination (RCE) under 37 C.F.R. §1.114 of the above-identified application.

Submission required under 37 C.F.R. §1.114

Previously Submitted:
- ☐ Consider the amendment(s)/reply under 37 C.F.R. §1.116 previously filed on
- ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on

Enclosed:
- ■ Amendment/Reply
- ☐ Information Disclosure Statement (IDS)
- ☐ Track 1 Prioritized Examination
- ■ Other: Petition for Extension of Time

FEES	RATE	CALCULATIONS
☐ Suspension of action on the above-identified application is requested under 37 C.F.R. §1.103(c) for a period of months.	$140.00	$0.00
■ RCE Fee required under 37 C.F.R. §1.17(e) - **1st request**	$1,200.00	$1,200.00
■ **A ONE MONTH EXTENSION OF TIME IS REQUESTED**		$200.00
☐		$0.00
TOTAL OF ABOVE CALCULATIONS:		$1,400.00
☐ REDUCTION BY 50% FOR FILING AS SMALL ENTITY		$0.00
TOTAL:		$1,400.00

■ Credit card payment is being made online (if electronically filed), or is attached hereto (if paper filed), in the amount of **$1,400.00.**

■ Please charge any additional Fees for the papers being filed herewith and for which no payment is enclosed herewith, or credit any overpayment to Deposit Account No. **15-0030**.

■ If these papers are not considered timely filed by the Patent and Trademark Office, then a petition is hereby made under 37 CFR 1.136, and any additional fees required under 37 CFR 1.136 for any necessary extension of time may be charged to Deposit Account No. **15-0030**.

Respectfully Submitted,

OBLON, McCLELLAND,
MAIER & NEUSTADT, L.L.P.

/Aldo Martinez/

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Docket No. 445600US20CONT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF: Miho MAEDA, et al.

SERIAL NO:	14/587,726	GAU:	2463
FILED:	December 31, 2014	EXAMINER:	CHENG, CHI TANG P
FOR:	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL		

REQUEST FOR EXTENSION OF TIME
UNDER 37 C.F.R. 1.136

COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313

Commissioner:

It is hereby requested that a **one** month extension of time be granted to July 31, 2016 for

☐ filing a response to the Official Action dated:

☐ responding to the requirements in the Notice of Allowability dated:

☐ responding to the Notice to File Missing Parts of Application dated:

■ filing a Request for Continued Examination (RCE). A timely response to the final rejection is filed herewith.

☐ filing an Appeal Brief. A Notice of Appeal was filed on:

☐ Applicant claims small entity status. See 37 CFR 1.27.

The required fee of $200.00 is being made by credit card payment online (if electronically filed), or is attached hereto (if paper filed), and any further charges may be made against the Attorney of Record's Deposit Account No. **15-0030**.

Respectfully Submitted,

OBLON, McCLELLAND,
MAIER & NEUSTADT, L.L.P.

/Aldo Martinez/

Eckhard H. Kuesters
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DOCKET NO: 445600US20CONT

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF	:
MIHO MAEDA, ET AL.	: EXAMINER: CHENG, CHI TANG P
SERIAL NO: 14/587,726	:
FILED: DECEMBER 31, 2014	: GROUP ART UNIT: 2463
FOR: DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL	:

AMENDMENT UNDER 37 C.F.R. § 1.114

COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313

Commissioner:

In response to the Office Action dated March 3, 2016 and the Advisory Action dated July 12, 2016, please amend the above-identified application as follows:

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Remarks/Arguments begin on page 5 of this paper.

IN THE CLAIMS

Please amend the claims as follows:

Claim 1 (Canceled).

Claim 2 (Currently Amended): A data communication method which is implemented by a communication system, the method comprising:

transmitting data by a base station using an OFDM (Orthogonal Frequency Division Multiplexing) method as a downlink access method;

transmitting, by a mobile terminal, a quality notification signal for notifying downlink communication quality to said base station;

transmitting, by said mobile terminal, a scheduling request signal to said base station requesting allocation of radio resources from said base station before transmitting transmission data to said base station; and

performing, by said mobile terminal:

a quality notification process that includes transmitting said quality notification signal to said base station;

a scheduling request signal transmission process that includes transmitting said scheduling request signal to said base station;

<u>a first control process that includes, when there is no radio resource available for transmitting said transmission data, transmitting said scheduling request signal to said base station;</u> and

a <u>second</u> control process that includes, when said quality notification process coincides with said scheduling request signal transmission process, stopping said quality notification process during a time interval during which said mobile terminal transmits said scheduling request signal.

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Claim 3 (Currently Amended): A communications system comprising:

a base station configured to transmit data by using an OFDM (Orthogonal Frequency Division Multiplexing) method as a downlink access method; and

a mobile terminal configured to transmit a quality notification signal for notifying downlink communication quality to said base station, and to transmit a scheduling request signal with which to make a request for allocation of radio resources to said base station before transmitting transmission data to said base station,

wherein said mobile terminal includes:

a transmitter configured to transmit said quality notification signal to said base station, and to transmit said scheduling request signal to said base station; and

a controller configured to perform a first control process that includes, when there is no radio resource available for transmitting said transmission data, enabling said transmitter to transmit said scheduling request signal to said base station, and a second control process that includes, when a transmission of said quality notification signal coincides with that of said scheduling request signal in said transmitter, ~~stop~~ stopping transmitting said quality notification signal during a time interval during which said transmitter transmits said scheduling request signal.

Claim 4 (Currently Amended): A mobile terminal configured to:

transmit a quality notification signal for notifying downlink communication quality to a base station, and

transmit a scheduling request signal with which to make a request for allocation of radio resources to said base station before transmitting transmission data to said base station,

wherein said mobile terminal includes:

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a transmitter configured to transmit said quality notification signal to said base station, and to transmit said scheduling request signal to said base station; and

a controller configured to perform a first control process that includes, when there is no radio resource available for transmitting said transmission data, enabling said transmitter to transmit said scheduling request signal to said base station, and a second control process that includes, when a transmission of said quality notification signal coincides with that of said scheduling request signal in said transmitter, ~~stop~~ stopping transmitting said quality notification signal during a time interval during which said transmitter transmits said scheduling request signal.

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REMARKS/ARGUMENTS

Favorable reconsideration of this application, as presently amended and in light of the following discussion, is respectfully requested.

Claims 2-4 are pending in this application. Claims 2-4 are amended by the present response.

Amendments to the claims find support in the application as originally filed, at least at paragraphs [0082], [0091], and [0094]. Thus, no new matter is added.

In the outstanding Office Action, Claims 2-4 were rejected on the grounds of nonstatutory double patenting as being unpatentable over Claim 1 of U.S. Patent 9,019,983 to Maeda; Claims 2-4 were rejected under 35 U.S.C. § 103(a) as unpatentable over U.S. Patent 7,873,023 to Ihm et al. (hereinafter "Ihm") in view of U.S. Publication 2007/0054689 to Baker et al. (hereinafter "Baker"). The outstanding Advisory Action indicates Applicant's previously filed Request for Reconsideration was not persuasive.

Applicant respectfully requests the nonstatutory obviousness-type double patenting rejection be held in abeyance until allowable subject matter in the claims is acknowledged by the Office.

In addition, Applicant respectfully traverses the rejection of Claims 2-4 as unpatentable over Ihm in view of Baker, with respect to the amended claims.

Amended Claim 2 is directed to a data communication method that includes, in part, transmitting, by a mobile terminal, transmission data to a base station. The method also includes a quality notification process that includes transmitting a quality notification signal and a scheduling request signal to a base station.

The method further includes a first control process that includes, when there is no radio resource available for transmitting the transmission data, transmitting the scheduling request signal to the base station, and a second control process that includes, when the quality

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notification process coincides with the scheduling request signal transmission process, stopping the quality notification process during a time interval during which the mobile terminal transmits the scheduling request signal.

Applicant's Specification provides a non-limiting example, in embodiment 3:

> Furthermore, ***an uplink scheduling request signal SR*** has a value which is defined as follows: "with request = ('1')" and "without request = ('0')", as mentioned above. However, the definition is not limited to this example, and, for example, an uplink scheduling request signal SR can alternatively have a value which is defined as follows: "with request = ('0')" and "without request = ('1')". ***Further speaking, an uplink scheduling request signal SR has only to show the presence or absence of an uplink scheduling request.***
>
> There can be considered the two following examples of the setting of the value of this bit.[1]

In addition, according to this example:

> In the second example of the setting, when not receiving any uplink scheduling request signal SR, the base station always transmits 0, like in the case of the first example of the setting. In contrast, in the flow chart of Fig. 8, ***when the mobile terminal transmits an uplink scheduling request signal SR, the mobile terminal continues transmitting the information indicating "the presence of a request (= '1')" until "Uplink Data Resource Allocation" is transmitted thereto from the base station, and, after receiving "Uplink Data Resource Allocation", the mobile terminal transmits the information indicating "the absence of a request (= '0')"***.[2]

Additionally, Applicant's Specification explains:

> ***The mobile terminal, in ST3204, judges whether the mobile terminal has received "uplink data resource allocation (Uplink Data Resource Allocation)" from the base station. That is, the mobile terminal judges whether the mobile terminal has received uplink transmission allocation from the base station.***
>
> ***When, in ST3204, has received uplink transmission allocation, the mobile terminal advances to ST3205. In contrast, when has not received uplink transmission***

[1] Specification at page 57, lines 13-23 (emphasis added).
[2] Specification at page 62, lines 15-25 (emphasis added).

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> ***allocation, the mobile terminal returns to ST3202. This step corresponds to ST3104 in Fig. 31.***
>
> ***The mobile terminal, in ST3205, sets up information indicating the absence of an uplink scheduling request (UL Scheduling request= "0" currently allocated to LB1 in Fig. 14) in the Ack/Nack exclusive channel***. This step corresponds to ST3105 in Fig. 31.
>
> The mobile terminal, in ST3206, transmits uplink data according to the allocation from the base station.[3]

Applicant respectfully submits that Ihm in view of Baker fails to teach or suggest all the features of any of the independent claims. For example, Applicant respectfully submits that Ihm in view of Baker fails to teach or suggest a first control process that includes, when there is no radio resource available for transmitting the transmission data, transmitting the scheduling request signal to the base station. In addition, Ihm in view of Baker fails to teach or suggest a second control process that includes, when the quality notification process coincides with the scheduling request signal transmission process, stopping the quality notification process during a time interval during which the mobile terminal transmits the scheduling request signal.

As discussed in Applicant's previous response, Ihm indicates that a mobile station (i.e., MS) may request an uplink resource (i.e., transmit a scheduling request signal), and the mobile station may also send feedback information to the base station (i.e., transmitting a quality notification signal). However, Ihm is silent regarding any control processor or controller that ***stops*** a quality notification process that transmits the quality notification signal when the mobile terminal transmits the scheduling request signal.

Furthermore, Applicant respectfully submits that Ihm also fails to teach or suggest a first control process that includes, when there is no radio resource available for transmitting the transmission data, transmitting the scheduling request signal to the base station.

[3] Specification at page 63, line 24, to page 64, line 10, emphasis added.

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Baker describes a radio communication system having a downlink channel for transmission from a base station to a mobile station, and an uplink channel for transmissions from the mobile station to the base station.[4] Since there is only one uplink channel in Baker's communication system, a CQI reporting process may be interrupted "while the mobile station transmits another signal."[5] However, Baker fails to teach or suggest the claimed first and second control processes. In particular, Baker fails to teach or suggest a first control process that includes transmitting the scheduling request signal to the base station when there is no radio resource available for transmitting the transmission data, and a second control process that includes stopping the quality notification process during a time interval during which the mobile terminal transmits the scheduling request signal when the quality notification process coincides with the scheduling request signal transmission process.

Accordingly, Applicant respectfully submits that Ihm in view of Baker fails to teach or suggest "a first control process that includes, when there is no radio resource available for transmitting said transmission data, transmitting said scheduling request signal to said base station; and a second control process that includes, when said quality notification process coincides with said scheduling request signal transmission process, stopping said quality notification process during a time interval during which said mobile terminal transmits said scheduling request signal," as recited by amended Claim 2.

In addition, Applicant respectfully submits that Ihm in view of Baker fails to teach or suggest "a controller configured to perform a first control process that includes, when there is no radio resource available for transmitting said transmission data, enabling said transmitter to transmit said scheduling request signal to said base station, and a second control process that includes, when a transmission of said quality notification signal coincides with that of said scheduling request signal in said transmitter, stop stopping transmitting said quality

[4] Baker at paragraph [0002].
[5] Baker at paragraphs [0007] and [0061].

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notification signal during a time interval during which said transmitter transmits said scheduling request signal," as recited by amended Claim 3, and as similarly required by amended Claim 4.

Accordingly, Applicant respectfully submits that Claims 2-4 are allowable.

Consequently, in light of the above discussion and the present amendment, this application is believed to be in condition for allowance, and an early and favorable action to that effect is respectfully requested.

Respectfully Submitted,

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Electronic Patent Application Fee Transmittal	
Application Number:	14587726
Filing Date:	31-Dec-2014
Title of Invention:	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL
First Named Inventor/Applicant Name:	Miho Maeda
Filer:	Bradley Davis Lytle/Karen Hieronymus
Attorney Docket Number:	445600US20CONT

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension - 1 month with $0 paid	1251	1	200	200
Miscellaneous:				
Request for Continued Examination	1801	1	1200	1200
		Total in USD ($)		**1400**

Electronic Acknowledgement Receipt	
EFS ID:	26484030
Application Number:	14587726
International Application Number:	
Confirmation Number:	6371
Title of Invention:	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL
First Named Inventor/Applicant Name:	Miho Maeda
Customer Number:	22850
Filer:	Bradley Davis Lytle/Karen Hieronymus
Filer Authorized By:	Bradley Davis Lytle
Attorney Docket Number:	445600US20CONT
Receipt Date:	28-JUL-2016
Filing Date:	31-DEC-2014
Time Stamp:	15:09:30
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$1400
RAM confirmation Number	1601
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		445600USRCEEOTAMD.pdf	408754 e89709023c0d5d54cec9d61216822a4300def9b6	yes	11

Multipart Description/PDF files in .zip description

Document Description	Start	End
Request for Continued Examination (RCE)	1	1
Extension of Time	2	2
Amendment Submitted/Entered with Filing of CPA/RCE	3	3
Claims	4	6
Applicant Arguments/Remarks Made in an Amendment	7	11

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	32457 e4730f6af8b352226a83afce222ed0966782d3f9	no	2

Warnings:

Information:

Total Files Size (in bytes):	441211

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.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/587,726	12/31/2014	Miho Maeda	445600US20CONT	6371

22850 7590 07/12/2016
OBLON, MCCLELLAND, MAIER & NEUSTADT, L.L.P.
1940 DUKE STREET
ALEXANDRIA, VA 22314

EXAMINER
CHENG, CHI TANG P

ART UNIT	PAPER NUMBER
2463	

NOTIFICATION DATE	DELIVERY MODE
07/12/2016	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):

patentdocket@oblon.com
oblonpat@oblon.com
ahudgens@oblon.com

PTOL-90A (Rev. 04/07)

Advisory Action Before the Filing of an Appeal Brief	**Application No.** *14/587,726*	**Applicant(s)** MAEDA ET AL.	
	Examiner PETER CHENG	**Art Unit** 2463	**AIA (First Inventor to File) Status** No

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

THE REPLY FILED 30 June 2016 FAILS TO PLACE THIS APPLICATION IN CONDITION FOR ALLOWANCE.

NO NOTICE OF APPEAL FILED

1. ☒ The reply was filed after a final rejection. No Notice of Appeal has been filed. To avoid abandonment of this application, applicant must timely file one of the following replies: (1) an amendment, affidavit, or other evidence, which places the application in condition for allowance;

(2) a Notice of Appeal (with appeal fee) in compliance with 37 CFR 41.31; or (3) a Request for Continued Examination (RCE) in compliance with 37 CFR 1.114 if this is a utility or plant application. Note that RCEs are not permitted in design applications. The reply must be filed within one of the following time periods:

a) ☒ The period for reply expires 3 months from the mailing date of the final rejection.

b) ☐ The period for reply expires on: (1) the mailing date of this Advisory Action; or (2) the date set forth in the final rejection, whichever is later. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of the final rejection.

c) ☐ A prior Advisory Action was mailed more than 3 months after the mailing date of the final rejection in response to a first after-final reply filed within 2 months of the mailing date of the final rejection. The current period for reply expires months from the mailing date of *the prior Advisory Action* or SIX MONTHS from the mailing date of the final rejection, whichever is earlier.

Examiner Note: If box 1 is checked, check either box (a), (b) or (c). ONLY CHECK BOX (b) WHEN THIS ADVISORY ACTION IS THE FIRST RESPONSE TO APPLICANT'S FIRST AFTER-FINAL REPLY WHICH WAS FILED WITHIN TWO MONTHS OF THE FINAL REJECTION. ONLY CHECK BOX (c) IN THE LIMITED SITUATION SET FORTH UNDER BOX (c). See MPEP 706.07(f).

Extensions of time may be obtained under 37 CFR 1.136(a). The date on which the petition under 37 CFR 1.136(a) and the appropriate extension fee have been filed is the date for purposes of determining the period of extension and the corresponding amount of the fee. The appropriate extension fee under 37 CFR 1.17(a) is calculated from: (1) the expiration date of the shortened statutory period for reply originally set in the final Office action; or (2) as set forth in (b) or (c) above, if checked. Any reply received by the Office later than three months after the mailing date of the final rejection, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

NOTICE OF APPEAL

2. ☐ The Notice of Appeal was filed on _____. A brief in compliance with 37 CFR 41.37 must be filed within two months of the date of filing the Notice of Appeal (37 CFR 41.37(a)), or any extension thereof (37 CFR 41.37(e)), to avoid dismissal of the appeal. Since a Notice of Appeal has been filed, any reply must be filed within the time period set forth in 37 CFR 41.37(a).

AMENDMENTS

3. ☐ The proposed amendments filed after a final rejection, but prior to the date of filing a brief, will not be entered because

a) ☐ They raise new issues that would require further consideration and/or search (see NOTE below);

b) ☐ They raise the issue of new matter (see NOTE below);

c) ☐ They are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal; and/or

d) ☐ They present additional claims without canceling a corresponding number of finally rejected claims.

NOTE: _____. (See 37 CFR 1.116 and 41.33(a)).

4. ☐ The amendments are not in compliance with 37 CFR 1.121. See attached Notice of Non-Compliant Amendment (PTOL-324).

5. ☐ Applicant's reply has overcome the following rejection(s): _____.

6. ☐ Newly proposed or amended claim(s) _____ would be allowable if submitted in a separate, timely filed amendment canceling the non-allowable claim(s).

7. ☐ For purposes of appeal, the proposed amendment(s): (a) ☐ will not be entered, or (b) ☐ will be entered, and an explanation of how the new or amended claims would be rejected is provided below or appended.

AFFIDAVIT OR OTHER EVIDENCE

8. ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

9. ☐ The affidavit or other evidence filed after final action, but before or on the date of filing a Notice of Appeal will not be entered because applicant failed to provide a showing of good and sufficient reasons why the affidavit or other evidence is necessary and was not earlier presented. See 37 CFR 1.116(e).

10. ☐ The affidavit or other evidence filed after the date of filing the Notice of Appeal, but prior to the date of filing a brief, will not be entered because the affidavit or other evidence failed to overcome all rejections under appeal and/or appellant fails to provide a showing of good and sufficient reasons why it is necessary and was not earlier presented. See 37 CFR 41.33(d)(1).

11. ☐ The affidavit or other evidence is entered. An explanation of the status of the claims after entry is below or attached.

REQUEST FOR RECONSIDERATION/OTHER

12. ☒ The request for reconsideration has been considered but does NOT place the application in condition for allowance because: See Continuation Sheet.

13. ☐ Note the attached Information *Disclosure Statement*(s). (PTO/SB/08) Paper No(s). _____

14. ☐ Other: _____.

STATUS OF CLAIMS

15. The status of the claim(s) is (or will be) as follows:

Claim(s) allowed: .

Claim(s) objected to: .

Claim(s) rejected: 2-4.

Claim(s) withdrawn from consideration: .

/PETER CHENG/
Primary Examiner, Art Unit 2463

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Page 84

Continuation of 12. does NOT place the application in condition for allowance because: Applicant takes issue with the reference Baker because the “another signal” disclosed in Baker is allegedly insufficient to teach the claim term "scheduling request signal”. Applicant’s arguments on pages 2-4 attempt to show this alleged defect by highlighting the characteristics of the disclosed “another signal” that differentiate it from the claimed "scheduling request signal". However, this is unpersuasive. The Office Action is explicit in stating that the claim term "scheduling request signal” is taught by the reference Ihm, not Baker, thus significantly reducing the relevance of the characteristic differences between the disclosed “another signal” and “scheduling request signal". Baker was cited as teaching certain features that relate to stopping a quality notification process when it coincides with another signal transmission process, not the specific claim term of "scheduling request signal".

Applicant further takes issue with the reference Ihm by noting that "in Fig. 3 of Ihm, there is no overlap between each of the transmission periods S31 to S35 (in particular between S31/S32 and S33).” This is not persuasive. As mentioned above, the claim features relating to a process coinciding with another process, which appear to be the claim features Applicant is alluding with the argument, are rejected by the reference Baker, not Ihm. Since Ihm is not cited as teaching such "overlap", Applicant's arguments as to the alleged defects of Ihm are unpersuasive.

Applicant further challenges the combinability of Ihm and Baker by noting that "the ‘transmit indication flag S33’ in Fig.3 of Ihm is [] also different from ‘another signal’ of Baker”. Applicant appears to be arguing that the "transmit indicator flag S33” disclosed in Ihm and cited for the claimed “scheduling request signal” in the office action, is required to be substantially similar to the "another signal" disclosed in Baker, in order for the two references to be combinable. However, this argument would not be in accord with the prevailing guidance on combinability, mainly because it is an example of the "bodily incorporation" type of argument. The test for obviousness is not whether the features of a secondary reference may be bodily incorporated into the structure of the primary reference; nor is it that the claimed invention must be expressly suggested in any one or all of the references. Rather, the test is what the combined teachings of the references would have suggested to those of ordinary skill in the art. See In re Keller, 642 F.2d 413, 208 USPQ 871 (CCPA 1981). In the final rejection, a case for combinability was set forth supported by ample suggestion and motivation to combine, noting a correspondence that involves Baker’s "another signal". Pursuant to the judicial guidance above, this is a sufficient showing of combinability for a final rejection.

Ex. 1002 - TCL Comm Tech Holdings Ltd.
TCL Comm Tech Holdings Ltd. v. Mitsubishi Electric Corp. - IPR2023-00957
Page 85

DOCKET NO: 445600US20CONT

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF	:
MIHO MAEDA, ET AL.	: EXAMINER: CHENG, CHI TANG P
SERIAL NO: 14/587,726	:
FILED: DECEMBER 31, 2014	: GROUP ART UNIT: 2463
FOR: DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL	:

REQUEST FOR RECONSIDERATION

COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313

Commissioner:

In response to the Office Action dated March 31, 2016, Applicant requests reconsideration of the above-identified application in view of the following remarks.

Remarks/Arguments begin on page 2 of this paper.

OK TO ENTER: /P.C./

07/06/2016

DOCKET NO: 445600US20CONT

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF	:
MIHO MAEDA, ET AL.	: EXAMINER: CHENG, CHI TANG P
SERIAL NO: 14/587,726	:
FILED: DECEMBER 31, 2014	: GROUP ART UNIT: 2463
FOR: DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL	:

REQUEST FOR RECONSIDERATION

COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313

Commissioner:

In response to the Office Action dated March 31, 2016, Applicant requests reconsideration of the above-identified application in view of the following remarks.

Remarks/Arguments begin on page 2 of this paper.

REMARKS/ARGUMENTS

Favorable reconsideration of this application in light of the following discussion is respectfully requested.

Claims 2-4 are pending in this application. No claims are amended, canceled, or added by the present response.

In the outstanding Office Action, Claims 2-4 were rejected on the grounds of nonstatutory double patenting as being unpatentable over Claim 1 of U.S. Patent 9,019,983 to Maeda; and Claims 2-4 were rejected under 35 U.S.C. § 103(a) as unpatentable over U.S. Patent 7,873,023 to Ihm et al. (hereinafter "Ihm") in view of U.S. Publication 2007/0054689 to Baker et al. (hereinafter "Baker").

Applicant respectfully requests the nonstatutory obviousness-type double patenting rejection be held in abeyance until allowable subject matter in the claims is acknowledged by the Office.

In addition, Applicant respectfully traverses the rejection of Claims 2-4 as unpatentable over Ihm in view of Baker.

Baker describes an operation as follows:

> There is a requirement to permit ***interruptions in the power control process***, for example, ***to enable the mobile station to make measurements on other channels in preparation for handover to another system***.[1]

Baker further explains:

> Instead of the power control loop being interrupted, ***the interruption may be to the CQI reporting process***. For example, there may be a requirement to interrupt the transmission of CQI reports while the mobile station transmits ***another signal***.[2]

[1] Baker at paragraph [0006], emphasis added.
[2] Baker at paragraph [0061], emphasis added.

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However, Applicant respectfully traverses the apparent interpretation presented in the Office Action that considers Baker's "another signal" to be the claimed "scheduling request signal."

As mentioned above, Baker's paragraph [0061] starts to describe "***the interruption in the CQI reporting process***," and thus the preceding paragraphs [0006]-[0060] are understood to describe the "***interruptions in the power control process***" (or the interruptions in the "power control loop").

In particular, referring to Baker's Fig. 2 and paragraphs [0029-0046], during the period of "TPC (Transmit Power Control) interruption," there are neither "TPC commands" nor "CQI reports." Thus, this means that both the transmit power control process and the CQI reporting process are interrupted during the described period of "TPC interruption." Namely, both "TPC commands" and "CQI reports" of Baker are transmitted during a period except for the period of "TPC interruption." Furthermore, there is ***no*** interruption between "TPC commands" and "CQI reports," and both "TPC commands" and "CQI reports" can be transmitted ***at the same time***.

On the other hand, referring to Baker's paragraph [0061] and following paragraphs, Baker does not describe details concerning the ***interruption in CQI reporting process***. However, referring to the preceding paragraphs before paragraph [0061], a person having ordinary skill in the art would have interpreted Baker's system to function, as follows.

In particular, such an ordinarily skilled person would understand Baker to teach that the period of CQI interruption should occur in order "to enable the mobile station could make measurement on other channels in preparation for handover to another system."[3] And, during the period of CQI interruption, transmission of both "CQI reports" and "TPC commands" should be interrupted. Namely, both "CQI reports" and "TPC commands" should be

[3] Baker at paragraph [0006].

Ex. 1002 - TCL Comm Tech Holdings Ltd.
TCL Comm Tech Holdings Ltd. v. Mitsubishi Electric Corp. - IPR2023-00957
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transmitted during a period except for the period of CQI interruption. Furthermore, according to the description of Baker, there should be ***no*** interruption between "CQI reports" and "TPC commands," and ***both*** the "CQI reports" and "TPC commands" of Baker may/could be transmitted ***at the same time***.

Therefore, "another signal" described in Baker's paragraph [0061] means the signal "to enable the mobile station to make measurements on other channels in preparation for handover to another system," but not "TPC commands" evidently.

In contrast to Baker, the claimed "scheduling request signal" may be transmitted from the mobile terminal to the base station in order to request allocation of radio resources, and thus this signal would be similar to "TPC commands" of Baker. In other words, the claimed "scheduling request signal" ***cannot*** be "another signal" of Baker, i.e. the signal "to enable the mobile station to make measurements on other channels in preparation for handover to another system" as mentioned above.

Consequently, even if the skilled person combined Baker with Ihm, such a combination would not arrive at the claimed invention, at least because the "transmit indication flag S33" in Fig.3 of Ihm is not also different from "another signal" of Baker. Further, in Fig. 3 of Ihm, there is no overlap between each of the transmission periods S31 to S35 (in particular between S31/S32 and S33).

Accordingly, Applicant respectfully submits that Claims 2-4 are allowable.

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Page 90

Consequently, in light of the above discussion, the present application is believed to be in condition for formal allowance and an early and favorable action to that effect is requested.

Respectfully Submitted,

OBLON, McCLELLAND,
MAIER & NEUSTADT, L.L.P.

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Ex. 1002 - TCL Comm Tech Holdings Ltd.
TCL Comm Tech Holdings Ltd. v. Mitsubishi Electric Corp. - IPR2023-00957
Page 91

Electronic Acknowledgement Receipt	
EFS ID:	26225059
Application Number:	14587726
International Application Number:	
Confirmation Number:	6371
Title of Invention:	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL
First Named Inventor/Applicant Name:	Miho Maeda
Customer Number:	22850
Filer:	Bradley Davis Lytle/Karen Hieronymus
Filer Authorized By:	Bradley Davis Lytle
Attorney Docket Number:	445600US20CONT
Receipt Date:	30-JUN-2016
Filing Date:	31-DEC-2014
Time Stamp:	13:54:53
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		445600USRR.pdf	774415 6594cfe331f4cdebc9dcd2c101b90149d58c824a	yes	6

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Miscellaneous Incoming Letter	1	1
	Amendment/Req. Reconsideration-After Non-Final Reject	2	2
	Applicant Arguments/Remarks Made in an Amendment	3	6

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New Applications Under 35 U.S.C. 111
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OBLON

Docket No.: 445600US20CONT

ATTORNEYS AT LAW

COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313

RE: Application Serial No.: 14/587,726
Applicants: Miho MAEDA, et al.
Filing Date: December 31, 2014
For: DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL
Group Art Unit: 2463
Examiner: CHENG, CHI TANG P

Commissioner:

Attached hereto for filing are the following papers:

REQUEST FOR RECONSIDERATION

Credit card payment is being made online (if electronically filed), or is attached hereto (if paper filed), in the amount of **$0.00** to cover any required fees. In the event any variance exists between the amount enclosed and the Patent Office charges for filing the above-noted documents, including any fees required under 37 C.F.R. 1.136 for any necessary Extension of Time to make the filing of the attached documents timely, please charge or credit the difference to our Deposit Account No. **15-0030**. Further, if these papers are not considered timely filed, then a petition is hereby made under 37 C.F.R. 1.136 for the necessary extension of time.

Respectfully submitted,

OBLON, McCLELLAND,
MAIER & NEUSTADT, L.L.P.

Eckhard H. Kuesters
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/587,726	12/31/2014	Miho Maeda	445600US20CONT	6371

22850 7590 03/31/2016
OBLON, MCCLELLAND, MAIER & NEUSTADT, L.L.P.
1940 DUKE STREET
ALEXANDRIA, VA 22314

EXAMINER
CHENG, CHI TANG P

ART UNIT	PAPER NUMBER
2463	

NOTIFICATION DATE	DELIVERY MODE
03/31/2016	ELECTRONIC

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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):

patentdocket@oblon.com
oblonpat@oblon.com
ahudgens@oblon.com

PTOL-90A (Rev. 04/07)

Office Action Summary	Application No. 14/587,726	Applicant(s) MAEDA ET AL.	
	Examiner PETER CHENG	Art Unit 2463	AIA (First Inventor to File) Status No

-- 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 2/3/16.

☐ 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) 2-4 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) 2-4 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: _____.

1. The present application is being examined under the pre-AIA first to invent provisions.

DETAILED ACTION

Double Patenting

1. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the claims at issue are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); In re Vogel, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the reference application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of

activities undertaken within the scope of a joint research agreement. See MPEP § 717.02 for applications subject to examination under the first inventor to file provisions of the AIA as explained in MPEP § 2159. See MPEP §§ 706.02(l)(1) - 706.02(l)(3) for applications not subject to examination under the first inventor to file provisions of the AIA. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO Internet website contains terminal disclaimer forms which may be used. Please visit www.uspto.gov/forms/. The filing date of the application in which the form is filed determines what form (e.g., PTO/SB/25, PTO/SB/26, PTO/AIA/25, or PTO/AIA/26) should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to http://www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

2. **Claims 2-4** are rejected on the ground of nonstatutory double patenting as being unpatentable over claim 1 of U.S. Patent No. 9019983 to Maeda. Although the claims at issue are not identical, they are not patentably distinct from each other.

3. **As to claim 2,** claim 1 of Maeda discloses a data communication method which is implemented by a communication system, the method comprising:

transmitting data by a base station using an OFDM (Orthogonal Frequency Division Multiplexing) method as a downlink access method (claim 1);

transmitting, by a mobile terminal, a quality notification signal for notifying downlink communication quality to said base station (claim 1);

transmitting, by said mobile terminal, a scheduling request signal to said base station requesting allocation of radio resources from said base station before transmitting transmission data to said base station (claim 1); and

performing, by said mobile terminal:

a quality notification process that includes transmitting said quality notification signal to said base station (claim 1: “a response signal transmission process …”);

a scheduling request signal transmission process that includes transmitting said scheduling request signal to said base station (claim 1: “a scheduling request signal transmission process …”); and

a control process that includes, when said quality notification process coincides with said scheduling request signal transmission process, stopping said quality notification process during a time interval during which said mobile terminal transmits said scheduling request signal (claim 1: “a control process of …”).

1. **As to claims 3 and 4,** see rejection for claim 2 above.

Response to Arguments

1. The IDS submitted 2/3/16 has been considered.
2. The Section 112 rejection has been withdrawn.
3. Please note that the claim amendments, e.g., deletion of "timing" and “unit”, have changed the claim scope of each of the claims.
4. Applicant's arguments drawn to the Section 103 rejections have been fully considered but they are not moot in light of the new grounds of rejection set forth below.

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. **Claims 2-4** are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 7,873,023 B2 to Ihm et al., further in view of U.S. Patent Publication No. 2007/0054689 A1 to Baker et al.

3. **As to claim 2**, Ihm discloses a data communication method which is implemented by a communication system, the method comprising:

transmitting data by a base station using an OFDM (Orthogonal Frequency Division Multiplexing) method as a downlink access method (col. 1, lines 20-30, disclosing OFDM system);

transmitting, by a mobile terminal, a quality notification signal for notifying downlink communication quality to said base station (Fig. 3 and cols. 1 and 4, col. 5, lines 11-34, “transmit feedback information S31 and S32");

transmitting, by said mobile terminal, a scheduling request signal to said base station requesting allocation of radio resources from said base station before transmitting transmission data to said base station (Fig. 3 and cols. 1 and 4, col. 5, lines 11-34, “transmit indicator flag S33", wherein such “indicator flag” teaches “scheduling request signal”); and

performing, by said mobile terminal:

a quality notification process that includes transmitting said quality notification signal to said base station (Fig. 3 and cols. 1 and 4, col. 5, lines 11-34, “transmit feedback information S31 and S32");

a scheduling request signal transmission process that includes transmitting said scheduling request signal to said base station (Fig. 3 and cols. 1 and 4, col. 5, lines 11-34, “transmit indicator flag S33", wherein such “indicator flag” teaches “scheduling request signal”); and

a control process of regulating said scheduling request signal transmission and said quality notification process during a time interval during which said mobile terminal transmits said scheduling request signal (Fig. 3 and cols. 1 and 4, col. 5, lines 11-34, disclosing that on a "CQICH"/”fast feedback channel” that is normally used to transmit [periodic, see steps S31 and S32] channel quality indicator CQI feedback information such as the "cqi feedback headers" in Fig. 2, the transmission of such cqi information normally through the cqich as in S31/S32 teaching "said quality notification process", when a "uplink resource allocation" request message is required to be sent by the mobile station, an "indicator flag" is sent on such CQICH/”fast feedback channel” in place of the regular CQI information, the sending of such “indicator flag” teaching “said scheduling request signal transmission”; thus teaching to an ordinary artisan that during the time duration(s) for processing and transmitting such "indicator flag" through the CQICH/”fast feedback channel” [such time duration(s) teaching the recited “time interval during which said mobile terminal transmits said scheduling request signal”], the

CQICH/"fast feedback channel" is not transmitting/feeding-back/processing CQI information, i.e., the "quality notification process" during such time duration(s) is "stop[ped]", thus teaching an embodiment of this limitation pursuant to the broadest reasonable interpretation of the claim terms).

Baker discloses a control process that includes, when said quality notification process coincides with another signal transmission process, stopping said quality notification process during a time interval during which said mobile terminal transmits said another signal (Figs. 2B/D/E/F and paragraph 2, disclosing the mobile station sending to the base station "channel quality information" CQI, i.e., the recited "quality notification process" in particular time intervals; paragraph 61, disclosing for example, "there may be a requirement to interrupt the transmission of CQI reports [by the mobile station] while the mobile station transmits another signal", thus teaching that the transmission of CQI, i.e., "quality notification process", is stopped/suspended "while the mobile station transmits another signal" [teaching "when said quality notification process coincides with another signal transmission process" in reference to claim 2, and "when a transmission of said quality notification signal coincides with that of another signal" in reference to claim 3], teaching this limitation).

At the time of invention, it would have been obvious to a person of ordinary skilled in the art to utilize the teachings disclosed by Baker, in conjunction with the teachings disclosed by Ihm, to teach the limitations recited in this claim. In particular, since Ihm discloses scheduling request signal, wherein such scheduling request signal is not preempted by the quality notification signal, such scheduling request signal in Ihm

may relate to the "another signal" disclosed in Baker that interrupts CQI transmission, so that the teachings of Ihm and Baker discussed above are combinable to teach "a control process that includes, when said quality notification process coincides with said scheduling request signal transmission process, stopping said quality notification process during a time interval during which said mobile terminal transmits said scheduling request signal" recited in claim 2, and "a controller configured to, when a transmission of said quality notification signal coincides with that of said scheduling request signal in said transmitter, stop transmitting said quality notification signal during a time interval during which said transmitter transmits said scheduling request signal" recited in claim 3. The suggestion/motivation would have been to provide an improved method of scheduling controlling signaling in the uplink direction (Baker, paragraphs 1-14 and 61; Ihm, cols. 1-3).

1. **As to claim 3**, please see rejection for claim 2.

2. **As to claim 4**, please see rejection for claim 2.

Conclusion

5. 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 PETER CHENG whose telephone number is (571)272-9021. The examiner can normally be reached on M-Th, 8:00AM - 5:00PM (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Rinehart can be reached on 571-272-3632. 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.

/PETER CHENG/
Primary Examiner, Art Unit 2463

Notice of References Cited	Application/Control No. 14/587,726	Applicant(s)/Patent Under Reexamination MAEDA ET AL.	
	Examiner PETER CHENG	Art Unit 2463	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-2007/0054689 A1	03-2007	Baker; Matthew P.J.	H04L1/0026	455/522
	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	
	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.

CORRECTED

Form PTO 1449 (Modified) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY DOCKET NO. 445600US20CONT	SERIAL NO. 14/587,726
LIST OF REFERENCES CITED BY APPLICANT	APPLICANT Miho MAEDA, et al.	
	FILING DATE December 31, 2014	GROUP 2463

U.S. PATENT DOCUMENTS

EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUB CLASS	FILING DATE IF APPROPRIATE
	AA	2008/0095223	04/2008	Tong et al.			
	AB	2009/0291717	11/2009	Lee et al.			
	AC	6,980,540	12/2005	Larola et al.			
	AD	5,640,395	06/1997	Hamalainen et al.			
	AE	6,807,146	10/2004	McFarland, William			
	AF	2007/0133458	06/2007	Chandra et al.			
	AG	2007/0082620	04/2007	Zhang et al.			
	AH	7,873,023	01/2011	Ihm et al.			
	AI	2009/0196164	08/2009	Vook et al.			
	AJ	2004/0208145	10/2004	Sim et al.			
	AK	2008/0279305	11/2008	Matsumoto et al.			
	AL	2012/0307622	12/2012	Terry et al.			
	AM	2004/0213214	10/2004	Jung et al.			
	AN						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	TRANSLATION YES	TRANSLATION NO
	AO	2006 33778	02/02/2006	Japan (with English Abstract)		X
	AP	2004 274432	09/30/2004	Japan (with English Abstract)		X
	AQ	2004 328498	11/18/2004	Japan (with English Abstract)		X
	AR	CN 1691820A	11/02/2005	People's Republic of China (with English Abstract and machine-generated translation)	X	
	AS					
	AT					
	AU					

OTHER REFERENCES (Including Author, Title, Date, Pertinent Pages, etc.)

	AV	"Data-non-associated L1/L2 Control Channel Structure for E-UTRA", 3GPP TSG RAN WG1 MEETING #46bis, R1 062741, NTT DOCOMO, ERICSSON, MITSUBISHI ELECTRIC, NEC, PANASONIC, SHARP, TOSHIBA CORPORATION, Pages 1-6, (2006)
	AW	"CDM-based Multiplexing Method of Multiplex ACK/NACK and CQI FOR E-UTRA Uplink", 3GPP TSG RAN WG1 MEETING #46bis, R1-062742, NTT DOCOMO, ERICSSON, MITSUBISHI ELECTRIC, NEC, PANASONIC, SHARP, TOSHIBA CORPORATION, Original R1-062742, Pages 1-6, (2006)
	AX	3GPP TR 25,814 V7.0.0, Release 7, Pages 71-74 and 78-84, (2006)
	AY	"Scheduling Request Transmission Method for E-UTRA Uplink", 3GPP TSG RAN WG1 MEETING #46bis, R1-062719, NTT DOCOMO, ERICSSON, MITSUBISHI ELECTRIC, NEC, PANASONIC, SHARP, TOSHIBA CORPORATION, Pages 1-6, (2006)
	AZ	"Uplink resource request for uplink scheduling", 3GPP TSG RAN WG1 #46bis, LG ELECTRONICS, R1-062571, Resubmission of R1-062318, Pages 1-3, (2006)

☐ Additional References sheet(s) attached

Examiner	/Chitang Peter Cheng/	Date considered	03/23/2016

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

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /P.C./

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S318	334	("RTS" or request$3 near3 send$3 or request$3to$3send$3 or (UL or up$1link$3) near7 (schedul$3 or bandwidth or allocat$3 or time$3slot$4) near3 request$3) with (csi or cqi or ack$3 or n$1a$1k$3 or channel$3 near3 qualit$3) with (pre$1empt$3 or collid$3 or collision)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/22 13:48
S319	164	("RTS" or request$3to$3send$3 or (UL or up$1link$3) near3 (schedul$3 or bandwidth or allocat$3 or time$3slot$4) near1 request$3) near11 (csi or cqi or ack$3 or n$1a$1k$3 or channel$3 near3 qualit$3) near9 (pre$1empt$3 or collid$3 or collision)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/22 13:50
S320	295	("RTS" or request$3to$3send$3 or (UL or up$1link$3) near3 (schedul$3 or bandwidth or allocat$3 or time$3slot$4) near1 request$3) with (csi or cqi or ack$3 or n$1a$1k$3 or channel$3 near3 qualit$3) with (pre$1empt$3 or collid$3 or collision or coincid$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/22 14:08
S321	0	("RTS" or request$3to$3send$3 or (UL or up$1link$3) near3 (schedul$3 or bandwidth or allocat$3 or time$3slot$4) near1 request$3) with (csi or cqi or ack$3 or n$1a$1k$3 or channel$3 near3 qualit$3 near1 indicat$3) with pre$1empt$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/22 14:14
S322	81	("RTS" or request$3to$3send$3 or (UL or up$1link$3) near3 (schedul$3 or bandwidth or allocat$3 or time$3slot$4) near1 request$3) with (csi or cqi or ack$3 or n$1a$1k$3 or channel$3 near3 qualit$3 near1 indicat$3) with (priorit$3 or prioritiz$5 or prioritis$5 or precedenc$3 or pre$1empt$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/22 14:15
S323	22	("RTS" or request$3to$3send$3 or (UL or up$1link$3) near3 (schedul$3 or bandwidth or allocat$3 or time$3slot$4) near1 request$3) with (csi or cqi or ack$3 or n$1a$1k$3 or channel$3 near3 qualit$3 near1 indicat$3) with inter$2upt$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/22 14:22
S324	41	("RTS" or request$3to$3send$3 or (UL or up$1link$3) near3 (schedul$3 or bandwidth or allocat$3 or time$3slot$4) near1 request$3 or "sr") with (csi or cqi or ack$3 or n$1a$1k$3 or channel$3 near3 qualit$3 near1 indicat$3) with (pre$1empt$3 or inter$2upt$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/22 14:25

S325	331	("RTS" or request$3to$3send$3 or (UL or up$1link$3) near3 (schedul$3 or bandwidth or allocat$3 or time$3slot$4) near1 request$3 or "sr") near11 (csi or cqi or ack$3 or n$1a$1k$3 or channel$3 near3 qualit$3) near9 (pre$1empt$3 or collid$3 or collision or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/22 14:27
S326	199	("RTS" or request$3to$3send$3 or (UL or up$1link$3) near3 (schedul$3 or bandwidth or allocat$3 or time$3slot$4) near1 request$3 or "sr") near11 (csi or cqi or ack$3 or n$1a$1k$3 or channel$3 near3 qualit$3) near9 drop$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/22 14:29
S327	161	("RTS" or request$3to$3send$3 or (UL or up$1link$3) near3 (schedul$3 or bandwidth or allocat$3 or time$3slot$4) near1 request$3 or "sr") with (csi or cqi or ack$3 or n$1a$1k$3 or channel$3 near3 qualit$3) near5 drop$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/22 14:34
S328	548	("RTS" or request$3to$3send$3 or (UL or up$1link$3) near3 (schedul$3 or bandwidth or allocat$3 or time$3slot$4) near1 request$3 or "sr") same (csi or cqi or ack$3 or n$1a$1k$3 or channel$3 near3 qualit$3 or measur$3 or feedback$3) near5 drop$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/22 14:38
S329	438	("RTS" or request$3to$3send$3 or (UL or up$1link$3) near3 (schedul$3 or bandwidth or allocat$3 or time$3slot$4) near1 request$3 or "sr") same (csi or cqi or ack$3 or n$1a$1k$3 or channel$3 near3 qualit$3 or measur$3 or feedback$3) near3 drop$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/22 14:49
S330	228	("RTS" or request$3to$3send$3 or (UL or up$1link$3) near3 (schedul$3 or bandwidth or allocat$3 or time$3slot$4) near1 request$3 or "sr") same (csi or cqi or ack$3 or n$1a$1k$3 or channel$3 near3 qualit$3 or feedback$3) near3 drop$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/22 14:50
S331	144	"sr" with (csi or cqi or ack$3 or n$1a$1k$3 or channel$3 near3 qualit$3 or feedback$3) near3 drop$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/22 14:56
S332	757	(csi or cqi) near3 drop$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/22 15:36
S333	145	(csi or cqi) near3 drop$4 same "sr"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	ON	2016/03/22 15:36

			DERWENT; IBM_TDB			
S334	1981	(csi or cqi or ack$3 or n$1a$1k$3 or channel$3 near3 qualit$3 near3 (indicat$3 or feedback$3)) near3 drop$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/22 15:48
S335	903	(csi or cqi or channel$3 near3 qualit$3 near3 (indicat$3 or feedback$3)) near5 drop$4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/22 18:47
S336	443	(csi or cqi or channel$3 near3 qualit$3 near3 (indicat$3 or feedback$3)) near5 drop$4 and schedul$3 near5 request$3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/22 18:48
S337	157	(csi or cqi or channel$3 near3 qualit$3 near3 (indicat$3 or feedback$3)) near5 drop$4 same (concurren$3 or coincid$5 or conflict$3 or overlap$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/22 18:54
S338	205	(csi or cqi or channel$3 near1 qualit$3 near1 (indicat$3 or feedback$3)) near5 drop$4 same (concurren$3 or coincid$5 or conflict$3 or overlap$4 or interfer$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/22 18:56
S339	316	(csi or cqi or ack$3 or n$1a$1k$3 or channel$3 near3 qualit$3 near3 (indicat$3 or feedback$3)) near5 drop$4 same (concurren$3 or coincid$5 or conflict$3 or overlap$4 or interfer$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/22 18:59
S340	85	(csi or cqi or ack$3 or n$1a$1k$3 or channel$3 near3 qualit$3 near3 (indicat$3 or feedback$3)) near5 discard$4 same (concurren$3 or coincid$5 or conflict$3 or overlap$4 or interfer$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/22 19:05
S341	1	"14587726"	US-PGPUB	OR	ON	2016/03/23 10:57
S342	3191	(csi or cqi or ack$3 or n$1a$1k$3 or channel$3 near3 qualit$3 near3 (indicat$3 or feedback$3)) near5 (interrupt$3 or suspend$3 or suspension or post$1pon$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/23 10:59

S343	188	(csi or cqi or ack$3 or n$1a$1k$3 or channel$3 near1 qualit$3 near1 (indicat$3 or feedback$3)) near5 (interrupt$3 or suspend$3 or suspension or post$1pon$3) same (concurren$3 or coincid$5 or conflict$3 or overlap$4 or interfer$4 or collid$3 or collision)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/23 11:01
S344	3348	(csi or cqi or ack$3 or n$1a$1k$3 or channel$3 near1 qualit$3 near1 (indicat$3 or feedback$3)) near7 (transmit$4 or transmission) near9 (interrupt$3 or suspend$3 or suspension or post$1pon$3 or stop$3 or terminat$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/23 11:02
S345	1559	(csi or cqi or ack$3 or n$1a$1k$3 or channel$3 near1 qualit$3 near1 (indicat$3 or feedback$3)) near3 (transmit$4 or transmission) near5 (interrupt$3 or suspend$3 or suspension or post$1pon$3 or stop$3 or terminat$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/03/23 11:03

EAST Search History (Interference)

< This search history is empty>

3/ 23/ 2016 11:39:11 AM
C:\ Users\ pcheng\ Documents\ EAST\ Workspaces\ 14587726.wsp

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14587726	MAEDA ET AL.
	Examiner	**Art Unit**
	PETER CHENG	2463

CPC- SEARCHED		
Symbol	**Date**	**Examiner**
h04l47/72,722,724,822,824,827	10/26/15	pc
h04w28/16,18,20,22,24,26	10/26/15	pc
h04w72/0406,0413,042,1278,1284,1289	10/26/15	pc
h04w74/002,004,006,0866,0883,0891	10/26/15	pc
h04w76/021	10/26/15	pc
h04j11/003	10/26/15	pc
h04l1/1671,1854,1858,0026	10/26/15	pc
h04l5/0007,0057	10/26/15	pc

CPC COMBINATION SETS - SEARCHED		
Symbol	**Date**	**Examiner**

US CLASSIFICATION SEARCHED			
Class	**Subclass**	**Date**	**Examiner**
370	436-9, 441-3, 458, 478-480, 498, 509, 522, 524, 527, 529, 537	10/26/15	pc

SEARCH NOTES		
Search Notes	**Date**	**Examiner**
inventors name search in PALM and EAST for double patenting	10/26/15	pc
EAST search	10/26/15, 3/23/16	pc

INTERFERENCE SEARCH			
US Class/ CPC Symbol	**US Subclass / CPC Group**	**Date**	**Examiner**

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14587726	MAEDA ET AL.
	Examiner	**Art Unit**
	PETER CHENG	2463

✓	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	10/27/2015	03/23/2016							
	1	-	-							
	2	✓	✓							
	3	✓	✓							
	4	✓	✓							

Ex. 1002 - TCL Comm Tech Holdings Ltd.
TCL Comm Tech Holdings Ltd. v. Mitsubishi Electric Corp. - IPR2023-00957

DOCKET NO: 445600US20CONT

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF	:
MIHO MAEDA, ET AL.	: EXAMINER: CHENG, CHI TANG P
SERIAL NO: 14/587,726	:
FILED: DECEMBER 31, 2014	: GROUP ART UNIT: 2463
FOR: DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL	:

AMENDMENT UNDER 37 C.F.R. § 1.111

COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313

Commissioner:

In response to the Office Action dated November 4, 2015, please amend the above-identified application as follows:

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Remarks/Arguments begin on page 5 of this paper.

IN THE CLAIMS

Please amend the claims as follows:

Claim 1 (Canceled).

Claim 2 (Currently Amended): A data communication method which is implemented by a communication system, the method comprising:

transmitting data by a base station using an OFDM (Orthogonal Frequency Division Multiplexing) method as a downlink access method;

transmitting, by a mobile terminal, a quality notification signal for notifying downlink communication quality to said base station;

transmitting, by said mobile terminal, a scheduling request signal to said base station requesting allocation of radio resources from said base station before transmitting transmission data to said base station; and

performing, by said mobile terminal:

a quality notification process ~~of~~ that includes transmitting said quality notification signal to said base station;

a scheduling request signal transmission process ~~of~~ that includes transmitting said scheduling request signal to said base station; and

a control process ~~of~~ that includes, when ~~a processing timing of~~ said quality notification process coincides with ~~that of~~ said scheduling request signal transmission process, stopping said quality notification process during a time interval during which said mobile terminal transmits said scheduling request signal.

Claim 3 (Currently Amended): A communications system comprising:

a base station configured to transmit data by using an OFDM (Orthogonal Frequency

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TCL Comm Tech Holdings Ltd. v. Mitsubishi Electric Corp. - IPR2023-00957
Page 115

Division Multiplexing) method as a downlink access method; and

a mobile terminal configured to transmit a quality notification signal for notifying downlink communication quality to said base station, and to transmit a scheduling request signal with which to make a request for allocation of radio resources to said base station before transmitting transmission data to said base station,

wherein said mobile terminal includes:

a ~~transmitting unit~~ transmitter configured to transmit said quality notification signal to said base station, and to transmit said scheduling request signal to said base station; and

a ~~control unit~~ controller configured to, when a transmission ~~timing~~ of said quality notification signal coincides with that of said scheduling request signal in said ~~transmitting unit~~ transmitter, stop ~~the transmission process of~~ transmitting said quality notification signal during a time interval during which said ~~transmitting unit~~ transmitter transmits said scheduling request signal.

Claim 4 (Currently Amended): A mobile terminal configured to:

transmit a quality notification signal for notifying downlink communication quality to a base station, and

transmit a scheduling request signal with which to make a request for allocation of radio resources to said base station before transmitting transmission data to said base station,

wherein said mobile terminal includes:

a ~~transmitting unit~~ transmitter configured to transmit said quality notification signal to said base station, and to transmit said scheduling request signal to said base station; and

a ~~control unit~~ controller configured to, when a transmission ~~timing~~ of said quality notification signal coincides with that of said scheduling request signal in said ~~transmitting unit~~ transmitter, stop ~~the transmission process of~~ transmitting said quality notification signal

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during a time interval during which said ~~transmitting unit~~ transmitter transmits said scheduling request signal.

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REMARKS/ARGUMENTS

Favorable reconsideration of this application, as presently amended and in light of the following discussion, is respectfully requested.

Claims 2-4 are pending in this application. Claims 2-4 are amended by the present response.

Amendments to the claims find support in the application as originally filed. Thus, no new matter is added.

In the outstanding Office Action, an IDS was objected to; Claims 2-4 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite; a claim interpretation under 35 U.S.C. § 112, sixth paragraph, was asserted; Claims 2-4 were rejected on the grounds of nonstatutory double patenting as being unpatentable over Claim 1 of U.S. Patent 9,019,983 to Maeda; Claims 2-4 were rejected under 35 U.S.C. § 102(e) as anticipated by U.S. Patent 7,873,023 to Ihm et al. (hereinafter "Ihm"); Claims 2-4 were rejected under 35 U.S.C. § 103(a) as unpatentable over Ihm in view of "Random Access and UL Scheduling," 3GPP TSG-RAN WG2 LTE#53, R2-061464 to Motorola (hereinafter "R2-061464"); and Claims 2-4 were rejected under 35 U.S.C. § 103(a) as unpatentable over Ihm in view of "Uplink control signaling for E-UTRA," TSG-RAN WG1 LTE Ad Hoc, R1-060111 to Ericsson (hereinafter "R1-060111").

An Information Disclosure Statement (IDS) is filed herewith including the correct identifying information for reference AY from the IDS filed December 31, 2014. Applicant respectfully requests that reference be considered and the consideration be noted, in due course.

Amended Claims 2 and 4 omit the terminology asserted to be unclear or to lack antecedent basis in the Office Action. Therefore, Applicant respectfully requests the rejection of Claims 2-4 under 35 U.S.C. § 112, second paragraph, be withdrawn.

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TCL Comm Tech Holdings Ltd. v. Mitsubishi Electric Corp. - IPR2023-00957
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Amended Claims 3 and 4 omit the terms "transmitting unit" and "control unit" identified in the Office Action. Accordingly, Applicant respectfully submits the corresponding claim elements do not invoke claim interpretations under 35 U.S.C. § 112, sixth paragraph.

Applicant respectfully requests the nonstatutory obviousness-type double patenting rejection be held in abeyance until allowable subject matter in the claims is acknowledged by the Office.

Applicant respectfully traverses the rejection of Claims 2-4 as anticipated by Ihm under 35 U.S.C. § 102(e).

Claim 2 is directed to a data communication method that includes, in part, a control process performed by a mobile terminal. The control process stops a quality notification process, also performed by the mobile terminal, during a time interval during which the mobile terminal transmits a scheduling request signal to a base station.

Applicant respectfully submits that Ihm fails to disclose all the features of any of the independent claims. For example, Applicant respectfully submits that Ihm fails to disclose a control process that stops a quality notification process during a time interval when the mobile terminal transmits a scheduling request signal to a base station.

Ihm indicates that a BS (i.e., base station) may transmit "fast feedback channel location information" to each MS (i.e., mobile station) "via an Uplink Map (UL-MAP)."[1] The BS also notifies the MS of "a transmission period by which the MS has to transmit feedback information."[2] Then, the mobile station uses the fast feedback channel indicated by the fast feedback channel location information to transmit the "feedback information" to the BS within the "transmission period." As shown in Ihm's Fig. 3, the MS periodically sends the feedback information to the BS in steps S31/S32. The MS may also transmit a "request

[1] Ihm at column 4, lines 21-23.
[2] Ihm at column 4, lines 25-28.

message" to the BS, requesting "an uplink resource allocation (an indication flag)" in step S33.[3] According to Ihm, the "indication flag is sent on the fast feedback channel, and … the indication flag is a specific encoding of the payload bits on a fast feedback channel … ."[4] Once the MS receives the required uplink resource allocated by the BS, in step S34, the MS uses the allocated uplink resource to transmit at least one feedback header including the feedback information in step S35.[5]

Thus, Ihm indicates that a mobile station (i.e., MS) may request an uplink resource (i.e., transmit a scheduling request signal), and the mobile station may also send feedback information to the base station (i.e., transmitting a quality notification signal). However, Ihm is silent regarding any control processor or controller that ***stops*** a quality notification process that transmits the quality notification signal when the mobile terminal transmits the scheduling request signal.

Accordingly, Applicant respectfully submits that Ihm fails to disclose "a control process that includes, when said quality notification process coincides with said scheduling request signal transmission process, stopping said quality notification process during a time interval during which said mobile terminal transmits said scheduling request signal," as recited by Claim 2, or as similarly required by Claims 3 and 4.

Therefore, Applicant respectfully requests the rejection of Claims 2-4 as anticipated by Ihm be withdrawn.

In addition, Applicant respectfully traverses the rejection of Claims 2-4 as unpatentable over Ihm in view of R2-061464.

R2-061464 suggests several options for "obtaining uplink resource allocations": (1) piggy-backing of UL scheduling requests with UL-SCH data; (2) signaling over existing UL

[3] Ihm at column 5, lines 22-24.
[4] Ihm at column 5, lines 27-29.
[5] Ihm at column 5, lines 35-39.

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overhead channels; (3) polling; and (4) predetermined assignment of UL resources. According to the second option, the user equipment UE (i.e., mobile device) may use the CQI channel to signal that it has data to send. "The signal can be just one bit indicator, or a special code." Thus, R2-061464, like Ihm, merely suggests that a "bit indicator" may be provided as a signal from the mobile device to the base station device.

However, R2-061464 fails to explicitly disclose, or otherwise suggest, that the transmission of such a "bit indicator" should cause a process that transmits a quality notification signal to be ***stopped***. Furthermore, there is no inherent disclosure, as seems to be suggested by the Office Action, that because the two signals may be sent on the same CQI channel, the "bit indicator" must necessarily cause the process that transmits a quality notification signal to be ***stopped***. For example, the UE scheduling process of R2-061464 may wait for an active quality notification signal to be completed before sending such a "bit indicator," or the "bit indicator" may be encoded as a "special code" and sent with the quality notification signal transmission, as is suggested by R2-061464, and neither of those alternatives requires the process that transmits a quality notification signal to be ***stopped***. Therefore, there is no teaching or suggestion in R2-061464 to ***stop*** a process that transmits a quality notification signal.

Accordingly, Applicant respectfully submits that Ihm in view of R2-061464 also fails to teach or suggest "a control process that includes, when said quality notification process coincides with said scheduling request signal transmission process, stopping said quality notification process during a time interval during which said mobile terminal transmits said scheduling request signal," as recited by Claim 2, or as similarly required by Claims 3 and 4.

Therefore, Applicant respectfully requests the rejection of Claims 2-4 as being unpatentable over Ihm in view of R2-061464 also be withdrawn.

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Furthermore, Applicant respectfully traverses the rejection of Claims 2-4 as being unpatentable over Ihm in view of R1-060111.

R1-060111 indicates "[a]t what time instants a UE is allowed to transmit a scheduling request can be made configurable … by restricting the requests to certain subframes only … [or] scheduling requests may overlap with uplink data transmissions."[6] R1-060111 further indicates "if no concurrent data transmission (or scheduling request) is ongoing, the ACK/NAK and CQI are inserted in the same way."[7] Thus, R1-060111 describes that the ***scheduling request process*** of the mobile station may ***wait*** until a concurrent transmission is completed before sending the scheduling request, or the mobile station may ***overlap*** the transmission of the scheduling request with an uplink data transmission.

However, Applicant respectfully submits that R1-060111 completely fails to teach or suggest to ***stop*** a process that transmits a quality notification signal to a base station.

Accordingly, Applicant respectfully submits that Ihm in view of R1-060111 also fails to teach or suggest "a control process that includes, when said quality notification process coincides with said scheduling request signal transmission process, stopping said quality notification process during a time interval during which said mobile terminal transmits said scheduling request signal," as recited by Claim 2, or as similarly required by Claims 3 and 4.

Therefore, Applicant respectfully requests the rejection of Claims 2-4 as being unpatentable over Ihm in view of R1-060111 also be withdrawn.

Accordingly, Applicant respectfully submits that Claims 2-4 are allowable.

[6] R1-060111 at page 2, second paragraph.
[7] R1-060111 at page 3, first paragraph.

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Consequently, in light of the above discussion and the present amendment, this application is believed to be in condition for allowance, and an early and favorable action to that effect is respectfully requested.

Respectfully Submitted,

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TCL Comm Tech Holdings Ltd. v. Mitsubishi Electric Corp. - IPR2023-00957
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DOCKET NO: 445600US20CONT

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF	:
MIHO MAEDA, ET AL.	: EXAMINER: CHENG, CHI TANG P
SERIAL NO: 14/587,726	:
FILED: DECEMBER 31, 2014	: GROUP ART UNIT: 2463
FOR: DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL	:

LETTER TO U.S.P.T.O.

COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313

Commissioner:

Applicant submits herewith a corrected PTO-1449 form correcting the document number listed under Other References AY from R1-062742 to R1-062719 which was filed in an Information Disclosure Statement on December 31, 2014.

Respectfully Submitted,

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MAIER & NEUSTADT, L.L.P.

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CORRECTED

Form PTO 1449 (Modified) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY DOCKET NO. 445600US20CONT	SERIAL NO. 14/587,726
LIST OF REFERENCES CITED BY APPLICANT	APPLICANT Miho MAEDA, et al.	
	FILING DATE December 31, 2014	GROUP 2463

U.S. PATENT DOCUMENTS

EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUB CLASS	FILING DATE IF APPROPRIATE
	AA	2008/0095223	04/2008	Tong et al.			
	AB	2009/0291717	11/2009	Lee et al.			
	AC	6,980,540	12/2005	Larola et al.			
	AD	5,640,395	06/1997	Hamalainen et al.			
	AE	6,807,146	10/2004	McFarland, William			
	AF	2007/0133458	06/2007	Chandra et al.			
	AG	2007/0082620	04/2007	Zhang et al.			
	AH	7,873,023	01/2011	Ihm et al.			
	AI	2009/0196164	08/2009	Vook et al.			
	AJ	2004/0208145	10/2004	Sim et al.			
	AK	2008/0279305	11/2008	Matsumoto et al.			
	AL	2012/0307622	12/2012	Terry et al.			
	AM	2004/0213214	10/2004	Jung et al.			
	AN						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	TRANSLATION YES	TRANSLATION NO
	AO	2006 33778	02/02/2006	Japan (with English Abstract)		X
	AP	2004 274432	09/30/2004	Japan (with English Abstract)		X
	AQ	2004 328498	11/18/2004	Japan (with English Abstract)		X
	AR	CN 1691820A	11/02/2005	People's Republic of China (with English Abstract and machine-generated translation)	X	
	AS					
	AT					
	AU					

OTHER REFERENCES (Including Author, Title, Date, Pertinent Pages, etc.)

	AV	"Data-non-associated L1/L2 Control Channel Structure for E-UTRA", 3GPP TSG RAN WG1 MEETING #46bis, R1 062741, NTT DOCOMO, ERICSSON, MITSUBISHI ELECTRIC, NEC, PANASONIC, SHARP, TOSHIBA CORPORATION, Pages 1-6, (2006)
	AW	"CDM-based Multiplexing Method of Multiplex ACK/NACK and CQI FOR E-UTRA Uplink", 3GPP TSG RAN WG1 MEETING #46bis, R1-062742, NTT DOCOMO, ERICSSON, MITSUBISHI ELECTRIC, NEC, PANASONIC, SHARP, TOSHIBA CORPORATION, Original R1-062742, Pages 1-6, (2006)
	AX	3GPP TR 25,814 V7.0.0, Release 7, Pages 71-74 and 78-84, (2006)
	AY	"Scheduling Request Transmission Method for E-UTRA Uplink", 3GPP TSG RAN WG1 MEETING #46bis, R1-062719, NTT DOCOMO, ERICSSON, MITSUBISHI ELECTRIC, NEC, PANASONIC, SHARP, TOSHIBA CORPORATION, Pages 1-6, (2006)
	AZ	"Uplink resource request for uplink scheduling", 3GPP TSG RAN WG1 #46bis, LG ELECTRONICS, R1-062571, Resubmission of R1-062318, Pages 1-3, (2006)

☐ Additional References sheet(s) attached

Examiner		Date considered	

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

Electronic Acknowledgement Receipt	
EFS ID:	24803715
Application Number:	14587726
International Application Number:	
Confirmation Number:	6371
Title of Invention:	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL
First Named Inventor/Applicant Name:	Miho Maeda
Customer Number:	22850
Filer:	Bradley Davis Lytle/Nick Hugh
Filer Authorized By:	Bradley Davis Lytle
Attorney Docket Number:	445600US20CONT
Receipt Date:	03-FEB-2016
Filing Date:	31-DEC-2014
Time Stamp:	09:53:18
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		445600USAmn.pdf	436513 93a0122ac486f6101174 1da99d05f8a14ecc5bd2	yes	13

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Miscellaneous Incoming Letter	1	1
	Amendment/Req. Reconsideration-After Non-Final Reject	2	2
	Claims	3	5
	Applicant Arguments/Remarks Made in an Amendment	6	11
	Transmittal Letter	12	12
	Information Disclosure Statement (IDS) Form (SB08)	13	13
Warnings:			
Information:			
	Total Files Size (in bytes):	436513	

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.

Docket No. 445600US20CONT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

INVENTOR(S) Miho MAEDA, et al.

SERIAL NO: 14/587,726 ART UNIT: 2463

FILING DATE: December 31, 2014 EXAMINER: CHENG, CHI TANG P

FOR: DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL

FEE TRANSMITTAL

■ No additional fee is required

☐ Small entity status of this application under 37 C.F.R. §1.9 and §1.27 is claimed.

☐ Track 1 Prioritized Examination

The Fee has been calculated as shown below:

FOR	NUMBER FILED	NUMBER EXTRA	RATE	CALCULATIONS
TOTAL CLAIMS	3 - 20 =	0	x $80 =	$ 0.00
INDEPENDENT CLAIMS	3 - 3 =	0	x $420 =	$ 0.00
☐ MULTIPLE DEPENDENT CLAIMS (If applicable)			+ $780 =	$0.00
☐ LATE FILING OF DECLARATION			+ $140 =	$0.00
☐ NON-ELECTRONIC FILING FEE			+ $400 =	$0.00
			BASIC FEES	$0.00
			TOTAL OF ABOVE CALCULATIONS	$ 0.00
☐ REDUCTION BY 50% FOR FILING BY SMALL ENTITY				$0.00
☐ FILING IN NON-ENGLISH LANGUAGE			+ $140 =	$0.00
			TOTAL	$ 0.00

☐ Please charge Deposit Account No. **15-0030** in the amount of _____

☐ Credit card payment is being made online (if electronically filed), or is attached hereto (if paper filed), in the amount of _____.

■ The Director is hereby authorized to charge any additional fees which may be required for the papers being filed herewith and for which no payment is enclosed herewith, or credit any overpayment to Deposit Account No. **15-0030**, with the **EXCEPTION** of deficiencies in fees for multiple dependent claims in new applications.

■ If these papers are not considered timely filed by the Patent and Trademark Office, then a petition is hereby made under 37 C.F.R. §1.136, and any additional fees required under 37 C.F.R. §1.136 for any necessary extension of time may be charged to Deposit Account No. 15-0030.

Submitted by: /Zachary S. Stern/

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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 14/587,726	Filing Date 12/31/2014	☐ 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

02/03/2016	(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))	* 3	Minus	** 20	= 0	X $80 =	0
Independent (37 CFR 1.16(h))	* 3	Minus	***3	= 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
/CHRISTINE MOLLISH/

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.
14/587,726	12/31/2014	Miho Maeda	445600US20CONT	6371

22850 7590 11/04/2015
OBLON, MCCLELLAND, MAIER & NEUSTADT, L.L.P.
1940 DUKE STREET
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EXAMINER
CHENG, CHI TANG P

ART UNIT	PAPER NUMBER
2463	

NOTIFICATION DATE	DELIVERY MODE
11/04/2015	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):

patentdocket@oblon.com
oblonpat@oblon.com
ahudgens@oblon.com

PTOL-90A (Rev. 04/07)

Office Action Summary	Application No. 14/587,726	Applicant(s) MAEDA ET AL.	
	Examiner PETER CHENG	Art Unit 2463	AIA (First Inventor to File) Status No

-- 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 *3/23/15*.

☐ 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) *2-4* 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) *2-4* 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 *12/31/14* 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: _____.

1. The present application is being examined under the pre-AIA first to invent provisions.

DETAILED ACTION

Information Disclosure Statement

1. The information disclosure statement filed 12/31/14, with respect to the reference identified by AY, “R1-06742”, fails to comply with the provisions of 37 CFR 1.97, 1.98 and MPEP § 609 because this reference appears to be misidentified. Instead of “R1-06742”, the identification should likely be "R1-062719". It has been placed in the application file, but the information referred to therein has not been considered as to the merits. Applicant is advised that the date of any re-submission of any item of information contained in this information disclosure statement or the submission of any missing element(s) will be the date of submission for purposes of determining compliance with the requirements based on the time of filing the statement, including all certification requirements for statements under 37 CFR 1.97(e). See MPEP § 609.05(a).

Claim Rejections - 35 USC § 112

1. The following is a quotation of 35 U.S.C. 112(b):

> (b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. The following claims are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor, or for pre-AIA the applicant regards as the invention.

Claims 2-4:

The recitation “performing ... a ... process of ..." and "process of" are indefinite terms. It is not clear where/when the recited "process" and “performing” begin and end and thus, the scope of each of these terms is unclear.

Claims 3-4:

“the transmission process of” has no claim antecedent basis.

Examiner Remark re Functional Claiming

The following is a quotation of 35 U.S.C. 112(f):

> (f) Element in Claim for a Combination. – An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

The following is a quotation of pre-AIA 35 U.S.C. 112, sixth paragraph:

> An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

Use of the word “means” (or “step for”) in a claim with functional language creates a rebuttable presumption that the claim element is to be treated in accordance with 35 U.S.C. 112(f) (pre-AIA 35 U.S.C. 112, sixth paragraph). The presumption that 35 U.S.C. 112(f) (pre-AIA 35 U.S.C. 112, sixth paragraph) is invoked is rebutted when the function is recited with sufficient structure, material, or acts within the claim itself to entirely perform the recited function.

Absence of the word “means” (or “step for”) in a claim creates a rebuttable presumption that the claim element is not to be treated in accordance with 35 U.S.C. 112(f) (pre-AIA 35 U.S.C. 112, sixth paragraph). The presumption that 35 U.S.C. 112(f) (pre-AIA 35 U.S.C. 112, sixth paragraph) is not invoked is rebutted when the claim element recites function but fails to recite sufficiently definite structure, material or acts to perform that function.

Claim elements in this application that use the word “means” (or “step for”) are presumed to invoke 35 U.S.C. 112(f) except as otherwise indicated in an Office action. Similarly, claim elements that do not use the word “means” (or “step for”) are presumed not to invoke 35 U.S.C. 112(f) except as otherwise indicated in an Office action.

3. Claim limitations “transmitting unit” and “control unit” recited in claims 3 and 4 has/have been interpreted under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, because it uses/they use a generic placeholder “unit” coupled with functional language without reciting sufficient structure to achieve the function. Furthermore, the

generic placeholder is not preceded by a structural modifier. Thus, these limitations invoke 112-6th.

Since the claim limitation(s) invokes 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, claim(s) 3-4 has/have been interpreted to cover the corresponding structure described in the specification that achieves the claimed function, and equivalents thereof.

A review of the specification shows that the following appears to be the corresponding structure described in the specification for the 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph limitation: Figs. 5-8 and their associated paragraphs in the Specification; and paragraphs 131-185 in the PGPub of this application.

If applicant wishes to provide further explanation or dispute the examiner's interpretation of the corresponding structure, applicant must identify the corresponding structure with reference to the specification by page and line number, and to the drawing, if any, by reference characters in response to this Office action.

If applicant does not intend to have the claim limitation(s) treated under 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112 , sixth paragraph, applicant may amend the claim(s) so that it/they will clearly not invoke 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph, or present a sufficient showing that the claim recites/recite sufficient structure, material, or acts for performing the claimed function to preclude application of 35 U.S.C. 112(f) or pre-AIA 35 U.S.C. 112, sixth paragraph.

For more information, see MPEP § 2173 *et seq.* and *Supplementary Examination Guidelines for Determining Compliance With 35 U.S.C. 112 and for Treatment of Related Issues in Patent Applications*, 76 FR 7162, 7167 (Feb. 9, 2011).

Double Patenting

4. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the claims at issue are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); In re Vogel, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the reference application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. See MPEP §

717.02 for applications subject to examination under the first inventor to file provisions of the AIA as explained in MPEP § 2159. See MPEP §§ 706.02(l)(1) - 706.02(l)(3) for applications not subject to examination under the first inventor to file provisions of the AIA. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO Internet website contains terminal disclaimer forms which may be used. Please visit www.uspto.gov/forms/. The filing date of the application in which the form is filed determines what form (e.g., PTO/SB/25, PTO/SB/26, PTO/AIA/25, or PTO/AIA/26) should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to http://www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

5. Claims 2-4 are rejected on the ground of nonstatutory double patenting as being unpatentable over claim 1 of U.S. Patent No. 9019983 to Maeda. Although the claims at issue are not identical, they are not patentably distinct from each other. This is because a straightforward comparison of the limitations recited in claims 2-4 of the present application, on the one hand, and the limitations recited in claim 1 of Maeda, on the other hand, clearly shows that the limitations recited in claims 2-4 of the present application are taught by the respective limitations of claim 1 of Maeda.

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of pre-AIA 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. **Claims 2-4 are** rejected under pre-AIA 35 U.S.C. 102(e) as being anticipated by U.S. Patent No. 7,873,023 B2 to Ihm et al.

1. **As to claim 2**, Ihm discloses a data communication method which is implemented by a communication system, the method comprising:

transmitting data by a base station using an OFDM (Orthogonal Frequency Division Multiplexing) method as a downlink access method (col. 1, lines 20-30, disclosing OFDM system);

transmitting, by a mobile terminal, a quality notification signal for notifying downlink communication quality to said base station (Fig. 3 and cols. 1 and 4, col. 5, lines 11-34, “transmit feedback information S31 and S32");

transmitting, by said mobile terminal, a scheduling request signal to said base station requesting allocation of radio resources from said base station before transmitting transmission data to said base station (Fig. 3 and cols. 1 and 4, col. 5, lines 11-34, “transmit indicator flag S33", wherein such “indicator flag” teaches “scheduling request signal”); and

performing, by said mobile terminal:

a quality notification process of transmitting said quality notification signal to said base station (Fig. 3 and cols. 1 and 4, col. 5, lines 11-34, “transmit feedback information S31 and S32");

a scheduling request signal transmission process of transmitting said scheduling request signal to said base station (Fig. 3 and cols. 1 and 4, col. 5, lines 11-34, “transmit indicator flag S33", wherein such “indicator flag” teaches “scheduling request signal”); and

a control process of, when a processing timing of said quality notification process coincides with that of said scheduling request signal transmission process, stopping said quality notification process during a time interval during which said mobile terminal transmits said scheduling request signal (Fig. 3 and cols. 1 and 4, col. 5, lines 11-34, disclosing that on a "CQICH"/”fast feedback channel” that is normally used to transmit [periodic, see steps S31 and S32] channel quality indicator CQI feedback information such as the "cqi feedback headers" in Fig. 2, the transmission of such cqi information normally through the cqich as in S31/S32 teaching "said quality notification process", when a "uplink resource allocation" request message is required to be sent by the mobile station, an "indicator flag" is sent on such CQICH/”fast feedback channel” in place of the regular CQI information, the sending of such “indicator flag” teaching “said scheduling request signal transmission”; thus teaching to an ordinary artisan that during the time duration(s) for processing and transmitting such "indicator flag" through the CQICH/”fast feedback channel” [such time duration(s) teaching the recited “time interval

during which said mobile terminal transmits said scheduling request signal"], the CQICH/"fast feedback channel" is not transmitting/feeding-back/processing CQI information, i.e., the "quality notification process" during such time duration(s) is "stop[ped]", thus teaching an embodiment of this limitation pursuant to the broadest reasonable interpretation of the claim terms).

1. **As to claim 3**, please see rejection for claim 2.

2. **As to claim 4**, please see rejection for claim 2.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. **Claims 2-4** are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 7,873,023 B2 to Ihm et al., further in view of "Random Access and UL Scheduling", 3GPP TSG-RAN WG2 LTE#53, R2-061464, to Motorola (hereinafter "Motorola").

4. **As to claim 2**, Ihm discloses a data communication method which is implemented by a communication system, the method comprising:

transmitting data by a base station using an OFDM (Orthogonal Frequency Division Multiplexing) method as a downlink access method (col. 1, lines 20-30, disclosing OFDM system);

transmitting, by a mobile terminal, a quality notification signal for notifying downlink communication quality to said base station (Fig. 3 and cols. 1 and 4, col. 5, lines 11-34, “transmit feedback information S31 and S32");

transmitting, by said mobile terminal, a scheduling request signal to said base station requesting allocation of radio resources from said base station before transmitting transmission data to said base station (Fig. 3 and cols. 1 and 4, col. 5, lines 11-34, “transmit indicator flag S33", wherein such “indicator flag” teaches “scheduling request signal”); and

performing, by said mobile terminal:

a quality notification process of transmitting said quality notification signal to said base station (Fig. 3 and cols. 1 and 4, col. 5, lines 11-34, “transmit feedback information S31 and S32");

a scheduling request signal transmission process of transmitting said scheduling request signal to said base station (Fig. 3 and cols. 1 and 4, col. 5, lines 11-34, “transmit indicator flag S33", wherein such “indicator flag” teaches “scheduling request signal”); and

a control process of regulating said scheduling request signal transmission and said quality notification process during a time interval during which said mobile terminal transmits said scheduling request signal (Fig. 3 and cols. 1 and 4, col. 5, lines 11-34, disclosing that on a "CQICH"/”fast feedback channel” that is normally used to transmit [periodic, see steps S31 and S32] channel quality indicator CQI feedback information such as the "cqi feedback headers" in Fig. 2, the transmission of such cqi information

normally through the cqich as in S31/S32 teaching "said quality notification process", when a "uplink resource allocation" request message is required to be sent by the mobile station, an "indicator flag" is sent on such CQICH/"fast feedback channel" in place of the regular CQI information, the sending of such "indicator flag" teaching "said scheduling request signal transmission"; thus teaching to an ordinary artisan that during the time duration(s) for processing and transmitting such "indicator flag" through the CQICH/"fast feedback channel" [such time duration(s) teaching the recited "time interval during which said mobile terminal transmits said scheduling request signal"], the CQICH/"fast feedback channel" is not transmitting/feeding-back/processing CQI information, i.e., the "quality notification process" during such time duration(s) is "stop[ped]", thus teaching an embodiment of this limitation pursuant to the broadest reasonable interpretation of the claim terms).

Motorola discloses a control process of, when a processing timing of said quality notification process coincides with that of said scheduling request signal transmission process, stopping said quality notification process during a time interval during which said mobile terminal transmits said scheduling request signal (page 2, "2. Signaling over existing UL overhead channels", teaching that the UE can "use CQI channel to signal to Node B that is has data to send", where that "signal" can be a "bit indicator" or a "special code", such "signal" thus teaching the recited "scheduling request signal transmission process"; the disclosure of such CQI channel further teaching to one of ordinary skill in the art the recited "quality notification process"; further teaching to an ordinary artisan that during the time duration(s) for processing and transmitting such "bit

indicator"/"special code" through the CQI channel [such time duration(s) teaching the recited “time interval during which said mobile terminal transmits said scheduling request signal”], the CQI channel is not transmitting/feeding-back/processing CQI information, i.e., the “quality notification process” during such time duration(s) is “stop[ped]”, thus teaching an embodiment of this limitation pursuant to the broadest reasonable interpretation of the claim terms).

At the time of invention, it would have been obvious to a person of ordinary skilled in the art to utilize the teachings disclosed by Motorola, in conjunction with the teachings disclosed by Ihm, to teach the limitations recited in this claim. The suggestion/motivation would have been to provide an improved method of scheduling controlling signaling in the uplink direction (Motorola, Introduction; Ihm, cols. 1-3).

3. **As to claim 3**, please see rejection for claim 2.

4. **As to claim 4**, please see rejection for claim 2.

5. **Claims 2-4** are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 7,873,023 B2 to Ihm et al., further in view of “Uplink control signaling for E-UTRA”, TSG-RAN WG1 LTE Ad Hoc, R1-060111, to Ericsson (hereinafter "Ericsson”).

6. **As to claim 2**, Ihm discloses a data communication method which is implemented by a communication system, the method comprising:

transmitting data by a base station using an OFDM (Orthogonal Frequency Division Multiplexing) method as a downlink access method (col. 1, lines 20-30, disclosing OFDM system);

transmitting, by a mobile terminal, a quality notification signal for notifying downlink communication quality to said base station (Fig. 3 and cols. 1 and 4, col. 5, lines 11-34, “transmit feedback information S31 and S32");

transmitting, by said mobile terminal, a scheduling request signal to said base station requesting allocation of radio resources from said base station before transmitting transmission data to said base station (Fig. 3 and cols. 1 and 4, col. 5, lines 11-34, “transmit indicator flag S33", wherein such “indicator flag” teaches “scheduling request signal”); and

performing, by said mobile terminal:

a quality notification process of transmitting said quality notification signal to said base station (Fig. 3 and cols. 1 and 4, col. 5, lines 11-34, “transmit feedback information S31 and S32");

a scheduling request signal transmission process of transmitting said scheduling request signal to said base station (Fig. 3 and cols. 1 and 4, col. 5, lines 11-34, “transmit indicator flag S33", wherein such “indicator flag” teaches “scheduling request signal”); and

a control process of regulating said scheduling request signal transmission and said quality notification process during a time interval during which said mobile terminal transmits said scheduling request signal (Fig. 3 and cols. 1 and 4, col. 5, lines 11-34, disclosing that on a "CQICH"/”fast feedback channel” that is normally used to transmit [periodic, see steps S31 and S32] channel quality indicator CQI feedback information such as the "cqi feedback headers" in Fig. 2, the transmission of such cqi information

normally through the cqich as in S31/S32 teaching "said quality notification process", when a "uplink resource allocation" request message is required to be sent by the mobile station, an "indicator flag" is sent on such CQICH/"fast feedback channel" in place of the regular CQI information, the sending of such "indicator flag" teaching "said scheduling request signal transmission"; thus teaching to an ordinary artisan that during the time duration(s) for processing and transmitting such "indicator flag" through the CQICH/"fast feedback channel" [such time duration(s) teaching the recited "time interval during which said mobile terminal transmits said scheduling request signal"], the CQICH/"fast feedback channel" is not transmitting/feeding-back/processing CQI information, i.e., the "quality notification process" during such time duration(s) is "stop[ped]", thus teaching an embodiment of this limitation pursuant to the broadest reasonable interpretation of the claim terms).

Ericsson discloses a control process of, when a processing timing of said quality notification process coincides with that of said scheduling request signal transmission process, stopping said quality notification process during a time interval during which said mobile terminal transmits said scheduling request signal ("2. Scheduling Request", teaching that the "duration of the scheduling request equals on subframe"; "6. Overall Multiplexing and Multiple Access", and Fig. 1, teaching that "if no concurrent ... scheduling request ... is ongoing", the ACK and CQI are inserted" as in Fig. 1, where ACK and CQI teach "quality notification process" and "scheduling request" teaches "said scheduling request signal transmission process", thus teaching to one of ordinary skill in the art that scheduling requests take precedence over the transmission or

insertion of ACKs/CQIs, as is also clear from Fig. 1, which is a “time-multiplexing" scheme, thus teaching an embodiment of this limitation pursuant to the broadest reasonable interpretation of the claim terms).

At the time of invention, it would have been obvious to a person of ordinary skilled in the art to utilize the teachings disclosed by Ericsson, in conjunction with the teachings disclosed by Ihm, to teach the limitations recited in this claim. The suggestion/motivation would have been to provide an improved method of scheduling controlling signaling in the uplink direction (Motorola, Introduction; Ericsson, Introduction; Ihm, cols. 1-3).

5. **As to claim 3**, please see rejection for claim 2.

6. **As to claim 4**, please see rejection for claim 2.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to PETER CHENG whose telephone number is (571)272-9021. The examiner can normally be reached on M-Th, 8:00AM - 5:00PM (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner’s supervisor, Mark Rinehart can be reached on 571-272-3632. 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.

/PETER CHENG/
Primary Examiner, Art Unit 2463

Notice of References Cited	Application/Control No. 14/587,726	Applicant(s)/Patent Under Reexamination MAEDA ET AL.	
	Examiner PETER CHENG	Art Unit 2463	Page 1 of 1

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*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-7,873,023 B2	01-2011	Ihm; Bin Chul	H04L5/0044	370/329
	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	"Random Access and UL Scheduling", 3GPP TSG-RAN WG2 LTE#53, R2-061464, May 8-12, 2006, Motorola
	V	"Uplink Control Signaling for E-UTRA", TSG-RAN WG1 LTE ADHoc, R1-060111, January 23-25, 2006, Ericsson
	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.

Form PTO 1449 (Modified) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY DOCKET NO. 445600US20CONT	SERIAL NO. New Continuation
LIST OF REFERENCES CITED BY APPLICANT	APPLICANT Miho MAEDA, et al.	
	FILING DATE Herewith	GROUP

U.S. PATENT DOCUMENTS

EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUB CLASS	FILING DATE IF APPROPRIATE
	AA	2008/0095223	04/2008	Tong et al.			
	AB	2009/0291717	11/2009	Lee et al.			
	AC	6,980,540	12/2005	Larola et al.			
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	AN						

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	AO	2006 33778	02/02/2006	Japan (with English Abstract)		X
	AP	2004 274432	09/30/2004	Japan (with English Abstract)		X
	AQ	2004 328498	11/18/2004	Japan (with English Abstract)		X
	AR	CN 1691820A	11/02/2005	People's Republic of China (with English Abstract and machine-generated translation)	X	
	AS					
	AT					
	AU					

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	AV	"Data-non-associated L1/L2 Control Channel Structure for E-UTRA", 3GPP TSG RAN WG1 MEETING #46bis, R1 062741, NTT DOCOMO, ERICSSON, MITSUBISHI ELECTRIC, NEC, PANASONIC, SHARP, TOSHIBA CORPORATION, Pages 1-6, (2006)
	AW	"CDM-based Multiplexing Method of Multiplex ACK/NACK and CQI FOR E-UTRA Uplink", 3GPP TSG RAN WG1 MEETING #46bis, R1-062742, NTT DOCOMO, ERICSSON, MITSUBISHI ELECTRIC, NEC, PANASONIC, SHARP, TOSHIBA CORPORATION, Original R1-062742, Pages 1-6, (2006)
	AX	3GPP TR 25,814 V7.0.0, Release 7, Pages 71-74 and 78-84, (2006)
	~~AY~~	~~"Scheduling Request Transmission Method for E-UTRA Uplink", 3GPP TSG RAN WG1 MEETING #46bis, R1-062742, NTT DOCOMO, ERICSSON, MITSUBISHI ELECTRIC, NEC, PANASONIC, SHARP, TOSHIBA CORPORATION, Pages 1-6, (2006)~~
	AZ	"Uplink resource request for uplink scheduling", 3GPP TSG RAN WG1 #46bis, LG ELECTRONICS, R1-062571, Resubmission of R1-062318, Pages 1-3, (2006)

■ Additional References sheet(s) attached

Examiner	/Chitang Peter Cheng/	Date considered	10/26/2015

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

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /P.C./

Form PTO 1449 (Modified) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY DOCKET NO. 445600US20CONT	SERIAL NO. New Continuation
LIST OF REFERENCES CITED BY APPLICANT	APPLICANT Miho MAEDA, et al.	
	FILING DATE Herewith	GROUP

OTHER REFERENCES (Including Author, Title, Date, Pertinent Pages, etc.)

	AAA	Ericsson, "Uplink Control Signaling for E-UTRA", 3GPP Draft; R1-060111, 3rd Generation Partnership Project (3GPP), Mobile Competence Centre, vol. RAN WG1, January 19, 2006.
	AAB	Motorola, "Synchronized Random Access Channel and Scheduling Request", 3GPP Draft; R1-062664 SYNCHRACH SR, 3rd Generation Partnership Project (3GPP), Mobile Competence Centre, vol. RAN WG1, October 6, 2006.
	AAC	Nortel Networks, "Consideration on UL RACH scheme for LTE", 3GPP Draft; R1-060653 RACH, 3rd Generation Partnership Project (3GPP), Mobile Competence Centre, vol. RAN WG1, February 9, 2006.
	AAD	Lucent Technologies, "Reference signals when no data is transmitted in uplink", 3GPP Draft; R1-061878, 3rd Generation Partnership Project (3GPP), Mobile Competence Centre, vol. RAN WG1, June 20, 2006.
	AAE	Motorola, "Random Access and UL Scheduling", 3GPP Draft; R2-061464_RANDOM_ACCESS_AND_UL_SCHEDULING_V2, 3rd Generation Partnership Project (3GPP), Mobile Competence Centre, vol. RAN WG2, May 4, 2006.
	AAF	Extended European Search Report issued on March 22, 2013 to European Patent Application No. 06843499.2 - 1851.
	AAG	Chinese Office Action issued April 3, 2013 to Chinese Patent Application No. 200680049892.8, with English translation
	AAH	
	AAI	
	AAJ	
	AAK	
	AAL	
	AAM	
	AAN	
	AAO	
	AAP	
	AAQ	

Examiner	/Chitang Peter Cheng/	Date Considered	10/26/2015

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BIB DATA SHEET

CONFIRMATION NO. 6371

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
14/587,726	12/31/2014 RULE	370	2463	445600US20CONT

APPLICANTS
MITSUBISHI ELECTRIC CORPORATION, Chiyoda-ku, JAPAN

INVENTORS
Miho Maeda, Tokyo, JAPAN;
Mitsuru Mochizuki, Tokyo, JAPAN;
Keiko Tada, Tokyo, JAPAN;
Yasushi Iwane, Tokyo, JAPAN;

**** CONTINUING DATA ****************************
This application is a CON of 12/375,574 01/29/2009 PAT 9019983
which is a 371 of PCT/JP2006/326117 12/27/2006

**** FOREIGN APPLICATIONS ***************************
JAPAN 2006-292641 10/27/2006

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ****
01/21/2015

Foreign Priority claimed	☑ Yes ☐ No	☐ Met after Allowance	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
35 USC 119(a-d) conditions met	☑ Yes ☐ No		JAPAN	60	3	3
Verified and Acknowledged	/PETER CHENG/ Examiner's Signature	Initials				

ADDRESS
OBLON, MCCLELLAND, MAIER & NEUSTADT, L.L.P.
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ALEXANDRIA, VA 22314
UNITED STATES

TITLE
DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL

FILING FEE RECEIVED		
2540	FEES: Authority has been given in Paper No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

BIB (Rev. 05/07).

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14587726	MAEDA ET AL.
	Examiner	**Art Unit**
	PETER CHENG	2463

✓	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	10/27/2015								
	1	-								
	2	✓								
	3	✓								
	4	✓								

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S241	126	(up$1link$3 or up$1stream$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near5 request$3 with (ACK or N$1A$1K or cqi or channel$3 near3 qualit$3 or CQI$1ch) with (conflict$3 or coin$2cid$4 or priorit$4 or prioritiz$5 or prioritis$5 or pre$1empt$5 or drop$4 or refrain$4) same (time$2 or tim$3slot$4 or tti or (transmit$4 or transmission) near5 interval$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 13:23
S242	198	(sr or (up$1link$3 or up$1stream$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near5 request$3) with (ACK or N$1A$1K or cqi or channel$3 near3 qualit$3 or CQI$1ch) with (conflict$3 or coin$2cid$4 or priorit$4 or prioritiz$5 or prioritis$5 or pre$1empt$5 or drop$4 or refrain$4) same (time$2 or tim$3slot$4 or tti or (transmit$4 or transmission) near5 interval$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 13:24
S243	127	(sr or (up$1link$3 or up$1stream$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near5 request$3) near9 (ACK or N$1A$1K or cqi or channel$3 near3 qualit$3 or CQI$1ch) near9 (conflict$3 or coin$2cid$4 or priorit$4 or prioritiz$5 or prioritis$5 or pre$1empt$5 or drop$4 or refrain$4) same (time$2 or tim$3slot$4 or tti or (transmit$4 or transmission) near5 interval$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 13:26
S244	274	(sr or schedul$3 near5 request$3) near9 (ACK or N$1A$1K or cqi or channel$3 near3 qualit$3 or CQI$1ch) near9 (conflict$3 or coin$2cid$4 or priorit$4 or prioritiz$5 or prioritis$5 or pre$1empt$5 or drop$4 or refrain$4) and (time$2 or tim$3slot$4 or tti or (transmit$4 or transmission) near5 interval$3 or ofdm$1)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 13:47
S245	169	("sr" or schedul$3 near5 request$3) near9 (ACK or N$1A$1K or cqi or channel$3 near3 qualit$3 or CQI$1ch) near9 (conflict$3 or coin$2cid$4 or pre$1empt$5 or drop$4 or refrain$4) and (time$2 or tim$3slot$4 or tti or (transmit$4 or transmission) near5 interval$3 or ofdm$1)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 13:48
S246	521	("sr" or (up$1link$3 or up$1stream$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near5 request$3) near11 (ACK or N$1A$1K or cqi or (signal$3 or transmission or channel$3) near3 qualit$3 or CQI$1ch)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	ON	2015/10/25 13:52

		near11 (conflict$3 or coin$2cid$4 or preceden$5 or priorit$4 or prioritiz$5 or prioritis$5 or pre$1empt$5 or drop$4 or refrain$4) and (time$2 or tim$3slot$4 or tti or (transmit$4 or transmission) near5 interval$3 or ofdm$1)	IBM_TDB			
S247	465	("sr" or (up$1link$3 or up$1stream$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near5 request$3) near9 (ACK or N$1A$1K or cqi or (signal$3 or transmission or channel$3) near3 qualit$3 or CQI$1ch) near9 (conflict$3 or coin$2cid$4 or preceden$5 or priorit$4 or prioritiz$5 or prioritis$5 or pre$1empt$5 or drop$4 or refrain$4) and (time$2 or tim$3slot$4 or tti or (transmit$4 or transmission) near5 interval$3 or ofdm$1)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 13:53
S248	400	("sr" or (up$1link$3 or up$1stream$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near5 request$3) near7 (ACK or N$1A$1K or cqi or (signal$3 or transmission or channel$3) near3 qualit$3 or CQI$1ch) near7 (conflict$3 or coin$2cid$4 or preceden$5 or priorit$4 or prioritiz$5 or prioritis$5 or pre$1empt$5 or drop$4 or refrain$4) and (time$2 or tim$3slot$4 or tti or (transmit$4 or transmission) near5 interval$3 or ofdm$1)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 13:59
S249	205	("sr" or (up$1link$3 or up$1stream$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near5 request$3) near7 (ACK or N$1A$1K or cqi or (signal$3 or transmission or channel$3) near3 qualit$3 or CQI$1ch) near7 (conflict$3 or coin$2cid$4 or preceden$5 or pre$1empt$5 or drop$4 or refrain$4) and (time$2 or tim$3slot$4 or tti or (transmit$4 or transmission) near5 interval$3 or ofdm$1)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 14:00
S250	316	S246 not S249	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 14:08
S251	78	("SR" or "RTS") near11 (cqi or (signal$3 or transmission or channel$3) near3 qualit$3 or CQI$1ch) near7 (conflict$3 or coin$2cid$4 or preceden$5 or pre$1empt$5 or drop$4 or refrain$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 14:29
S252	182	("SR" or "RTS" or request$3to$3send$3) near11 (cqi or (signal$3 or transmission or channel$3) near3 qualit$3 or CQI$1ch or ACK$3 or N$1ack$3) near7 (conflict$3 or coin$2cid$4 or preceden$5 or pre$1empt$5 or drop$4 or refrain$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 14:32

S253	151	("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near5 request$3) near15 (ACK$3 or N$1A$1K$3 or cqi or (signal$3 or transmission or channel$3) near1 qualit$3 or CQI$1ch) near3 (pre$1empt$5 or drop$4 or refrain$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 14:40
S254	146	("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) near15 (ACK$3 or N$1A$1K$3 or cqi or (signal$3 or transmission or channel$3) near1 qualit$3 or CQI$1ch) near3 (pre$1empt$5 or drop$4 or refrain$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 14:41
S255	413	("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) near15 (ACK$3 or N$1A$1K$3 or cqi or (signal$3 or transmission or channel$3) near1 qualit$3 or CQI$1ch) near3 (pre$1empt$5 or drop$4 or refrain$4 or delay$3 or post$1pon$3 or discard$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 14:42
S256	355	("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) near15 (ACK$3 or N$1A$1K$3 or cqi or (signal$3 or transmission or channel$3) near1 qualit$3 or CQI$1ch) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 14:44
S257	329	("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) near15 (ACK$3 or N$1A$1K$3 or cqi) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 14:45
S258	3	("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) with (coin$1cid$4 or conflict$3) same (ACK$3 or N$1A$1K$3 or cqi or (signal$3 or transmission or channel$3) near1 qualit$3 or CQI$1ch) near3 (pre$1empt$5 or drop$4 or refrain$4 or delay$3 or post$1pon$3 or stop$4 or discard$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 14:46
S259	212	("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) near15 (ACK$3 or N$1A$1K$3 or cqi) near3 (over$1lap$4 or collid$3 or collis$1ion)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 15:16
S260	220	("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) near7 (ACK$3 or	US-PGPUB; USPAT; USOCR; FPRS;	OR	ON	2015/10/25 15:16

		N$1A$1K$3 or cqi or cqi$1ch) near7 (over$1lap$4 or collid$3 or collis$1ion)	EPO; JPO; DERWENT; IBM_TDB			
S261	147	("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) near7 (ACK$3 or N$1A$1K$3 or cqi or cqi$1ch) near7 (over$1lap$4 or collid$3 or collis$1ion) and ofdm$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 15:17
S262	141	"sr" with (ACK$3 or N$1A$1K$3 or cqi or cqi$1ch) near7 (over$1lap$4 or collid$3 or collis$1ion or drop$4) and ofdm$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 15:35
S263	185	("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) with (ACK$3 or N$1A$1K$3 or cqi) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 15:58
S264	584	("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 16:06
S265	1	"12375574"	USPAT	OR	ON	2015/10/25 16:15
S266	6	(up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3 near11 (priorit$4 or prioritiz$5 or prioritis$5 or preceden$5 or overlap$4 or conflict$5) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or terminat$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 16:24
S267	82	(up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3 near11 (priorit$4 or prioritiz$5 or prioritis$5 or preceden$5 or overlap$4 or conflict$5) and (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or terminat$4) and ofdm$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 16:26
S268	48	(up$1link$3 or UL) with (transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 (messag$3 or msg$3 or request$3) with (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or terminat$4 or overlap$4 or conflict$5) and ofdm$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 16:43
S269	58	(up$1link$3 or UL) with (transmit$4 or	US-PGPUB;	OR	ON	2015/10/25

		transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 (messag$3 or msg$3 or request$3) near11 (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi) near11 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or terminat$4 or overlap$4 or conflict$5 or trump$3 or for$1go$3) and ofdm$1	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			16:52
S270	2	(up$1link$3 or UL) with (transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 (messag$3 or msg$3 or request$3) near11 periodic$5 same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi) near11 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or terminat$4 or overlap$4 or conflict$5 or trump$3 or for$1go$3) and ofdm$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 17:03
S271	53	(up$1link$3 or UL) with (transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 (messag$3 or msg$3 or request$3) near11 periodic$5 and (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi) near11 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or terminat$4 or overlap$4 or conflict$5 or trump$3 or for$1go$3 or collid$3 or collision) and ofdm$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 17:04
S272	183	(up$1link$3 or UL) and (transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 (messag$3 or msg$3 or request$3) near11 periodic$5 and (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi) near11 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or terminat$4 or overlap$4 or conflict$5 or trump$3 or for$1go$3 or collid$3 or collision) and ofdm$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 17:12
S273	92	(up$1link$3 or UL) and (schedul$3 or resourc$3 or band$1width or allocat$3) near3 (messag$3 or msg$3 or request$3) near11 periodic$5 and (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi) with (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or terminat$4 or overlap$4 or conflict$5 or trump$3 or for$1go$3 or collid$3 or collision) and ofdm$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 17:19
S274	98	(up$1link$3 or UL) and (schedul$3 or resourc$3 or band$1width or allocat$3) near3 (messag$3 or msg$3 or request$3) near11 periodic$5 and (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or csi) with (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or terminat$4 or overlap$4 or conflict$5 or trump$3 or for$1go$3 or collid$3 or collision) and ofdm$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 17:25
S275	57	("RTS" or request$3 near3 send$3 or request$3to$3send$3) with (ACK$3 or N$1A$1K$3 or cqi or csi) with	US-PGPUB; USPAT; USOCR;	OR	ON	2015/10/25 17:30

		(simultaneous$3 or overlap$4 or conflict$5 or collid$3 or collision) same (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or terminat$4 or trump$3 or for$1go$3) and ofdm$1	FPRS; EPO; JPO; DERWENT; IBM_TDB			
S276	84	("RTS" or request$3 near3 send$3 or request$3to$3send$3) near9 (ACK$3 or N$1A$1K$3 or cqi or csi) near9 (simultaneous$3 or overlap$4 or conflict$5 or collid$3 or collision) and ofdm$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 17:36
S277	0	periodic$5 with ("RTS" or request$3 near3 send$3 or request$3to$3send$3) with (ACK$3 or N$1A$1K$3 or cqi or csi) near9 (simultaneous$3 or overlap$4 or conflict$5 or collid$3 or collision) and ofdm$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 18:11
S278	3	("RTS" or request$3 near3 send$3 or request$3to$3send$3) with (measur$5 near3 report$3) near5 periodic$5 with (simultaneous$3 or overlap$4 or conflict$5 or collid$3 or collision) and ofdm$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 18:14
S279	3	("RTS" or request$3 near3 send$3 or request$3to$3send$3) same (measur$5 near3 report$3) near5 periodic$5 same (simultaneous$3 or overlap$4 or conflict$5 or collid$3 or collision or pre$1empt$4 or drop$4 or discard$4) and ofdm$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 18:15
S280	3	("RTS" or request$3 near3 send$3 or request$3to$3send$3) same (measur$5 near3 (messag$4 or report$3 or indicator or channel$4 or signal$4 or qualit$3 or link$2)) near5 periodic$5 with (simultaneous$3 or overlap$4 or conflict$5 or collid$3 or collision or pre$1empt$4 or drop$4 or discard$4) and ofdm$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 18:17
S281	3	("RTS" or request$3 near3 send$3 or request$3to$3send$3 or (UL or up$1link$3) near7 (schedul$3 or bandwidth or allocat$3 or time$3slot$4) near3 request$3) same (measur$5 near3 (messag$4 or report$3 or indicator or channel$4 or signal$4 or qualit$3 or link$2)) near5 periodic$5 with (simultaneous$3 or overlap$4 or conflict$5 or collid$3 or collision or pre$1empt$4 or drop$4 or discard$4) and ofdm$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 18:19
S282	26	("RTS" or request$3 near3 send$3 or request$3to$3send$3 or (UL or up$1link$3) near7 (schedul$3 or bandwidth or allocat$3 or time$3slot$4) near3 request$3) same (measur$5 or csi or cqi) near5 periodic$5 same (simultaneous$3 or overlap$4 or conflict$5 or collid$3 or collision or pre$1empt$4 or drop$4 or discard$4) and ofdm$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 18:20
S283	198	("RTS" or request$3 near3 send$3 or	US-PGPUB;	OR	ON	2015/10/25

		request$3to$3send$3 or (UL or up$1link$3) near7 (schedul$3 or bandwidth or allocat$3 or time$3slot$4) near3 request$3) and (measur$5 or csi or cqi) near3 periodic$5 same (simultaneous$3 or overlap$4 or conflict$5 or collid$3 or collision or pre$1empt$4 or drop$4 or discard$4 or coincid$3) and ofdm$1	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			18:22
S284	69	("RTS" or request$3 near3 send$3 or request$3to$3send$3 or (UL or up$1link$3) near7 (schedul$3 or bandwidth or allocat$3 or time$3slot$4) near3 request$3) and (measur$5 or csi or cqi) near3 periodic$5 near11 (drop$4 or discard$4) and ofdm$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 18:23
S285	62	(measur$5 or csi or cqi) near3 report$3 near5 periodic$5 near11 (drop$4 or discard$4) and ofdm$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 18:25
S287	2	measur$5 near3 report$3 near11 (drop$4 or discard$4) with periodic$5 and ofdm$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 18:28
S288	0	("RTS" or request$3 near3 send$3 or request$3to$3send$3 or (UL or up$1link$3) near7 (schedul$3 or bandwidth or allocat$3 or time$3slot$4) near3 request$3) and measur$5 near3 periodic$5 with (drop$4 or discard$4) and ofdm$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 18:30
S289	33	("RTS" or request$3 near3 send$3 or request$3to$3send$3 or (UL or up$1link$3) near7 (schedul$3 or bandwidth or allocat$3 or time$3slot$4) near3 request$3) and measur$5 near3 periodic$5 with (drop$4 or discard$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/25 18:31
S290	1	"12375574"	USPAT	OR	ON	2015/10/26 14:35
S291	21	("RTS" or request$3 near3 send$3 or request$3to$3send$3 or (UL or up$1link$3) near7 (schedul$3 or bandwidth or allocat$3 or time$3slot$4) near3 request$3) same (measur$5 or csi or cqi or feed$3back$3) with concurren$5 and ofdm$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/26 17:50
S292	31	("RTS" or request$3 near3 send$3 or request$3to$3send$3 or (UL or up$1link$3) near7 (schedul$3 or bandwidth or allocat$3 or time$3slot$4) near3 request$3) same (measur$5 or csi or cqi or feed$3back$3) same concurren$5 and ofdm$1	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/26 17:50
S293	771	("RTS" or request$3 near3 send$3 or request$3to$3send$3 or (UL or up$1link$3)	US-PGPUB; USPAT;	OR	ON	2015/10/26 17:52

		near7 (schedul$3 or bandwidth or allocat$3 or time$3slot$4) near3 request$3) same (measur$5 or csi or cqi or feed$3back$3 or ack$3 or n$1a$1k$3) same concurren$5	USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			
S294	128	("RTS" or request$3 near3 send$3 or request$3to$3send$3 or (UL or up$1link$3) near7 (schedul$3 or bandwidth or allocat$3 or time$3slot$4) near3 request$3) with (measur$5 or csi or cqi or feed$3back$3 or ack$3 or n$1a$1k$3) with concurren$5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/26 17:53
S295	22577	(370/436-439,441-443,458,478-480,498,509,522,524,527,529,537).CCLS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2015/10/26 18:07
S296	31	S295 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/26 18:07
S297	13744	h04l47/72,722,724,822,824,827.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/26 18:09
S298	14	S297 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/26 18:09
S299	49139	h04w28/16,18,20,22,24,26.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/26 18:09
S300	110	S299 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/26 18:09
S301	57386	h04w72/0406,0413,042,1278,1284,1289.cpc.	US-PGPUB;	OR	ON	2015/10/26

			USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			18:09
S302	341	S301 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/26 18:09
S303	13332	h04w74/002,004,006,0866,0883,0891.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/26 18:09
S304	53	S303 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/26 18:09
S305	5836	h04w76/021.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/26 18:09
S306	11	S305 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/26 18:09
S307	906	h04j11/003.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/26 18:10
S308	34623	h04l1/1671,1854,1858,0026.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/26 18:10

S309	37183	h04l5/0007,0057.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/26 18:11
S310	21	S307 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/26 18:11
S311	282	S308 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/26 18:11
S312	171	S309 and ("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3) near3 (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3 or simultane$6 or concurren$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/26 18:11
S313	1005753	(mitsubishi).as. or (miho with maeda or mitsuru with mochizuki or keiko with tada or yasushi with iwane).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/26 18:12
S314	1	S313 and (("sr" or "RTS" or (up$1link$3 or UL or transmit$4 or transmission or schedul$3 or resourc$3 or band$1width or allocat$3) near3 request$3) same (acknowledg$5 or ACK$3 or N$1A$1K$3 or cqi or feed$3back$3 or qualit$3 near3 (notification or notif$4)) same (pre$1empt$5 or drop$4 or refrain$4 or stop$4 or post$1pon$3 or discard$3) with (simultane$6 or concurren$4 or coin$1cid$4 or overlap$4)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2015/10/26 18:15

EAST Search History (Interference)

< This search history is empty>

10/26/2015 6:17:29 PM
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Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14587726	MAEDA ET AL.
	Examiner	**Art Unit**
	PETER CHENG	2463

CPC- SEARCHED		
Symbol	**Date**	**Examiner**
h04l47/72,722,724,822,824,827	10/26/15	pc
h04w28/16,18,20,22,24,26	10/26/15	pc
h04w72/0406,0413,042,1278,1284,1289	10/26/15	pc
h04w74/002,004,006,0866,0883,0891	10/26/15	pc
h04w76/021	10/26/15	pc
h04j11/003	10/26/15	pc
h04l1/1671,1854,1858,0026	10/26/15	pc
h04l5/0007,0057	10/26/15	pc

CPC COMBINATION SETS - SEARCHED		
Symbol	**Date**	**Examiner**

US CLASSIFICATION SEARCHED			
Class	**Subclass**	**Date**	**Examiner**
370	436-9, 441-3, 458, 478-480, 498, 509, 522, 524, 527, 529, 537	10/26/15	pc

SEARCH NOTES		
Search Notes	**Date**	**Examiner**
inventors name search in PALM and EAST for double patenting	10/26/15	pc
EAST search	10/26/15	pc

INTERFERENCE SEARCH			
US Class/ CPC Symbol	**US Subclass / CPC Group**	**Date**	**Examiner**

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22850
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ALEXANDRIA, VA 22314

PUBLICATION NOTICE

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Title:DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL

Publication No.US-2015-0189645-A1
Publication Date:07/02/2015

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【書類名】特許請求の範囲
【請求項１】
下りアクセス方式としてOFDM（Orthogonal Frequency Division Multiplexing）方式を用いてデータの送信を行う基地局と、この基地局から送信されたデータの受信結果に応じた応答信号を含む制御信号を前記基地局に送信するとともに、送信信号を送信する前に、前記基地局に対して無線リソースの割り当てを要求するスケジューリング要求信号を送信する移動端末とを含む通信システムで実行されるデータ通信方法において、
　前記移動端末から前記基地局への上り方向に設けられた、前記応答信号を送信するための上り制御チャネルを用いて、前記応答信号を送信する応答信号送信処理と、
　前記基地局に対して送信するデータが発生したときに、前記上り制御チャネルとは異なる物理チャネルを介して、適時前記スケジューリング要求信号を送信するスケジューリング要求信号送信処理と、
　前記応答信号送信処理と前記スケジューリング要求信号送信処理のタイミングが重なった場合に、前記スケジューリング要求信号を送信している期間、前記応答信号送信処理を停止させる制御処理とを含むことを特徴とするデータ通信方法。
【請求項２】
スケジューリング要求信号は、送信元の移動端末を識別するための識別信号を含むプレアンブルと、前記移動端末が送信する送信データ量、前記送信データのQoS（Quality Of Service）、前記移動端末の送信電力余裕の少なくともいずれかを含むメッセージより構成されていることを特徴とする請求項１に記載のデータ通信方法。
【請求項３】
スケジューリング要求信号送信処理は、スケジューリング要求信号のプレアンブルとメッセージを分けて送信する分割送信処理と、前記プレアンブルと前記メッセージを一括送信する一括送信処理とを選択的に行うことを特徴とする請求項２に記載のデータ通信方法。
【請求項４】
応答信号送信処理は、それぞれデータシンボルが割り当てられる複数のデータブロックより成るサブフレームを複数含み、１送信時間区間あたり第一のサブフレームと第二のサブフレームを送信するものであって、前記第一のサブフレーム及び前記第二のサブフレームそれぞれのデータブロックには同じ配列でシンボルが割り当てられていることを特徴とする請求項１に記載のデータ通信方法。
【請求項５】
応答信号送信処理は、サブフレームの先頭のデータブロックに優先度の低いシンボルを割り当てることを特徴とする請求項４に記載のデータ通信方法。
【請求項６】
下りアクセス方式としてOFDM（Orthogonal Frequency Division Multiplexing）方式を用いてデータの送信を行う基地局と、この基地局から送信されたデータの受信結果に応じた応答信号を含む制御信号を前記基地局に送信するとともに、送信信号を送信する前に、前記基地局に対して無線リソースの割り当てを要求するスケジューリング要求信号を送信する移動端末とを含む通信システムにおいて、
　前記移動端末は、前記基地局への上り方向に設けられた前記応答信号を送信するための上り制御チャネルを用いて、前記応答信号を送信するとともに、前記基地局に対して送信するデータが発生したときに、前記上り制御チャネルとは異なる物理チャネルを介して、適時前記スケジューリング要求信号を送信する送信部と、
　前記応答信号送信処理と前記スケジューリング要求信号送信処理のタイミングが重なった場合に、前記スケジューリング要求信号を送信している期間、前記応答信号送信処理を停止させる制御部とを設けたことを特徴とする通信システム。
【請求項７】
下りアクセス方式としてOFDM（Orthogonal Frequency Division Multiplexing）方式を用いてデータの送信を行う基地局と、この基地局から送信されたデータの受信結果に応じた応答信号を含む制御信号を前記基地局に送信するとともに、送信信号を送信する前に、前

記基地局に対して無線リソースの割り当てを要求するスケジューリング要求信号を送信する移動端末とを含む通信システムで実行されるデータ通信方法において、
　前記移動端末から前記基地局への上り方向に設けられた、前記応答信号を送信するための上り制御チャネルを用いて、少なくとも前記応答信号を含む上り制御信号を作成するとともに、前記基地局に対して送信するデータが発生したときには、前記スケジューリング要求信号と前記応答信号を時分割多重して前記上り制御信号を作成する制御信号作成処理と、
　この制御信号作成処理により作成された前記上り制御信号を含む制御信号を送信する制御信号送信処理とを含むことを特徴とするデータ通信方法。
【請求項８】
制御信号作成処理により作成された制御信号がスケジューリング要求信号を含んでいない場合に第一のコードを用いて前記制御信号に対して符号化処理を行い、前記制御信号が前記スケジューリング要求信号を含む場合に第二のコードを用いて前記制御信号に符号化処理を行う符号化処理をさらに含むことを特徴とする請求項７に記載のデータ通信方法。
【請求項９】
下りアクセス方式としてOFDM（Orthogonal Frequency Division Multiplexing）方式を用いてデータの送信を行う基地局と、この基地局から送信されたデータの受信結果に応じた応答信号を含む制御信号を前記基地局に送信するとともに、前記基地局に対して送信したスケジューリング要求信号に応じて前記基地局より無線リソースが割り当てられると、上り共通チャネルを用いて個別データを送信する移動端末を含む通信システムで実行されるデータ通信方法において、
　前記個別データに第一のコードを用いて符号化する処理と、前記基地局に対して送信するデータが発生したときには、前記スケジューリング要求信号を含む前記個別データに第二のコードを用いて符号化する処理を選択的に行うとともに、符号化された前記個別データを前記上り共通チャネルを用いて送信する処理とを行うことを特徴とするデータ通信方法。
【請求項１０】
下りアクセス方式としてOFDM（Orthogonal Frequency Division Multiplexing）方式を用いてデータの送信を行う基地局と、この基地局から送信されたデータの受信結果に応じた応答信号を含む制御信号を前記基地局に送信するとともに、送信信号を送信する前に、前記基地局に対して無線リソースの割り当てを要求するスケジューリング要求信号を送信する移動端末を含む通信システムで実行されるデータ通信方法において、
　前記基地局に対して送信するデータが発生したときに前記基地局に対して適時信号を送信するための物理チャネルであるランダムアクセスチャネルに、少なくとも前記スケジューリング要求信号と前記応答信号を時分割多重して上り制御信号を作成する制御信号作成処理と、
　この制御信号作成処理により作成された前記上り制御信号を含む制御信号を送信する制御信号送信処理とを含むことを特徴とするデータ通信方法。

【書類名】明細書
【発明の名称】データ通信方法、通信システム
【技術分野】
【０００１】
本発明は、”Ｌｏｎｇ　Ｔｅｒｍ　Ｅｖｏｌｕｔｉｏｎ”（LTE）と呼ばれる通信システムにおいて実施される、移動端末が基地局に対して送信する上り制御信号の通信方法に関する。
【背景技術】
【０００２】
第３世代と呼ばれる通信方式のうち、Ｗ－ＣＤＭＡ（Wideband Code division Multiple Access）方式が２００１年から日本で商用サービスが開始されている。また、下りリンク（個別データチャネル、個別制御チャネル）にパケット伝送用のチャネル（HS-DSCH: High Speed-Downlink Shared Channel）を追加することにより、下りリンクを用いたデータ送信の更なる高速化を実現するＨＳＤＰＡ（High Speed Down Link Packet Access）のサービス開始が予定されている。さらに、上り方向のデータ送信を高速化するためＨＳＵＰＡ（High Speed Up Link Packet Access）方式についても提案、検討されている。Ｗ－ＣＤＭＡは、移動体通信システムの規格化団体である３ＧＰＰ（3rd Generation Partnership Project）により定められた通信方式であり、現在リリース６版の規格書がとりまとめられている。
【０００３】
また、３ＧＰＰにおいて、Ｗ－ＣＤＭＡとは別の通信方式として、無線区間については”Ｌｏｎｇ　Ｔｅｒｍ　Ｅｖｏｌｕｔｉｏｎ”（LTE）、コアネットワークを含めたシステム全体構成については”Ｓｙｓｔｅｍ　Ａｒｃｈｉｔｅｃｔｕｒｅ　Ｅｖｏｌｕｔｉｏｎ”（SAE）と称される新たな通信方式が検討されている。ＬＴＥでは、アクセス方式、無線のチャネル構成やプロトコルが、現在のＷ－ＣＤＭＡ（HSDPA/HSUPA）とは異なるものになる。たとえば、アクセス方式は、Ｗ－ＣＤＭＡが符号分割多元接続（Code Division Multiple Access）を用いているのに対して、ＬＴＥは下り方向はＯＦＤＭ（Orthogonal Frequency Division Multiplexing）、上り方向はＳＣ－ＦＤＭＡ（Single Career Frequency Division Multiple Access）を用いる。また、帯域幅は、Ｗ－ＣＤＭＡが５ＭＨｚであるのに対し、ＬＴＥでは１．２５／２．５／５／１０／１５／２０ＭＨｚを適用し得る。また、ＬＴＥでは、Ｗ－ＣＤＭＡのような回線交換ではなく、パケット通信方式のみになる。
【０００４】
ＬＴＥはＷ－ＣＤＭＡのコアネットワーク(General Packet Radio System GPRS)とは異なる新たなコアネットワークを用いて通信システムが構成されるため、Ｗ－ＣＤＭＡ網とは別の独立した無線アクセス網として定義される。したがって、Ｗ－ＣＤＭＡの通信システムと区別するため、ＬＴＥの通信システムでは、移動端末ＵＥ（User Equipment）と通信を行う基地局（Base station）はｅＮＢ（E-UTRAN NodeB）、複数の基地局と制御データやユーザデータのやり取りを行う基地局制御装置(Radio Network Controller)はａＧＷ(Access Gateway)と称される。このＬＴＥの通信システムでは、Ｅ-ＭＢＭＳ（Evolved Multimedia Broadcast Multicast Service）と称されるマルチキャスト・放送型マルチメディアサービスのような１対多（Point to Multipoint）通信を実施するほか、複数の移動端末のうち個別の移動端末に対するユニキャスト（Unicast）サービスのような通信サービスも提供する。ＬＴＥではＷ－ＣＤＭＡと異なり、トランスポートチャネル、物理チャネルでは個別の移動端末に向けた個別のチャネル（Dedicated Channel、 Dedicated Physical Channel）は存在しないので、個別の移動端末へのデータ送信は共通チャネル（Shared channel）で実施される。
【０００５】
移動端末は、基地局より下りリンクを介してデータを受信すると、問題なくデータを受信できたかを示す信号や、受信データの品質を示す信号を上りリンクを介して基地局に伝

達する。基地局から送信されたデータを受信できたかを示す応答信号をＡｃｋ／Ｎａｃｋ、受信データの品質を示す品質情報をＣＱＩ（Channel Quality Indicator）という。Ａｃｋ／Ｎａｃｋは、移動端末が下りデータを受信している場合に、そのデータを受信できたか否かを基地局へ送信するための信号であり、再送制御に用いられる。ＣＱＩは、移動端末で測定した下りチャネル状態を基地局へ送信するための信号であり、基地局での下りスケジューリングに用いられる。また、移動端末が基地局に対して送信するデータが発生したときには、移動端末は基地局に対して、上りリンクの無線リソースを割り当てるように要求する信号を送信する。このような要求信号をスケジューリングリクエスト、または上りスケジューリング要求信号（SR: Scheduling Request）という。上記のようなＡｃｋ／Ｎａｃｋ、ＣＱＩ、ＳＲを「上りＬ１／Ｌ２制御信号」（L1/L2 control signaling）と称する。

【０００６】

図２２は上りＬ１／Ｌ２制御信号を説明する説明図である。図２２に示すように、上りＬ１／Ｌ２制御信号には大きく分けて２種類ある。上りデータ付随Ｌ１／Ｌ２制御信号(data-associated L1/L2 control signaling)と、上りデータ非付随Ｌ１／Ｌ２制御信号(data-non-associated L1/L2 control signaling)である。上りデータ付随Ｌ１／Ｌ２制御信号は、トランスポートフォーマット等の上りデータ送信に必要な情報で、上りデータと一緒に送信される。上りデータ非付随Ｌ１／Ｌ２制御信号には、下りリンクに関連したＡｃｋ／Ｎａｃｋ、ＣＱＩ、そして上りデータ送信を始める前に送るスケジューリングリクエスト(SR、UL SR)等のランダムアクセス(Random Access)信号がある。Ａｃｋ／Ｎａｃｋ、ＣＱＩは下りリンクに関連した信号なので上りデータ送信とは関係なく送信されるが、上りデータと同時に送信される場合がある。一方、ランダムアクセス信号には、同期ランダムアクセス（Synchronous Random Access　以下SRA）と非同期ランダムアクセス（Non-Synchronous Random Access　以下NSRA）がある。ＳＲＡは上りリンクの時間同期が取れている状態の場合に送信され、ＮＳＲＡは上りリンクの時間同期が取れていない状態の場合に送信される。なお、上りデータ付随Ｌ１／Ｌ２制御信号もＡｃｋ／Ｎａｃｋ、ＣＱＩも、上りリンクの時間同期が取れている状態で送信される信号である。ここでは、上りデータ送信が行われていない場合のＡｃｋ／Ｎａｃｋ、ＣＱＩとＳＲＡが同時に送信される状態があることを述べ、その課題と解決方法について述べる。

【０００７】

上りのＡｃｋ／Ｎａｃｋ、ＣＱＩは下りリンクに関連した信号である。上りデータ送信が行われていない場合のＡｃｋ／Ｎａｃｋ、ＣＱＩの物理的なリソース割り当てについては、ある一つの時間-周波数領域を独占的に割り当てる方法、分離した狭帯域の複数の時間-周波数領域を独占的に割り当てる方法がある(非特許文献1)。以下、これらの領域のことを、Ａｃｋ／Ｎａｃｋ専用チャネルと称する。図２３は上りデータ送信を行っているとき、あるいは行っていないときにＡｃｋ／Ｎａｃｋ、ＣＱＩを割り当てた無線リソースを示す説明図である。図２３は、ある一つの時間-周波数領域を独占的に割り当てる方法を示す。上りデータ送信が行われていない場合のＡｃｋ／Ｎａｃｋ、ＣＱＩを、時間的にはサブフレーム単位、周波数的には１リソースユニット単位もしくはそれ以上の領域に割り当てる。一方、上りデータと、上りデータ付随Ｌ１／Ｌ２制御信号もしくは上りデータ送信が行われている場合のＡｃｋ／Ｎａｃｋ、ＣＱＩはそれ以外の領域に割り当てられる。

【０００８】

上りデータ送信が行われていない場合のＡｃｋ／Ｎａｃｋ、ＣＱＩ、つまりＡｃｋ／Ｎａｃｋ、ＣＱＩのみの信号をその信号専用として独占的な領域に割り当てる事によって、Ａｃｋ／Ｎａｃｋ、ＣＱＩ信号を送信する期間を大きくでき、従って広いカバレッジを得る事ができる。図２４はＡｃｋ／Ｎａｃｋ専用チャネルにＡｃｋ／Ｎａｃｋ、ＣＱＩを割り当てた無線リソースを示す説明図である。図２４に、分離した狭帯域の複数の時間-周波数領域（図24 A,B）をＡｃｋ／Ｎａｃｋ、ＣＱＩ用に独占的に割り当てる方法を示す。上りデータ送信が行われていない場合のＡｃｋ／Ｎａｃｋ、ＣＱＩを、時間的にはサブフレーム単位、周波数的にはサブキャリア単位でいくつかの分離した領域に割り当てる。周

波数領域をいくつかに分離（例えば、図24A,B）する事によって、周波数ダイバーシチゲインを得る事ができる。どちらの方法においても、ひとつの領域には、ひとつまたは複数の移動端末のＡｃｋ／Ｎａｃｋ、ＣＱＩを割り当てる事ができる。ひとつの領域に、ひとつまたは複数の移動端末のＡｃｋ／Ｎａｃｋ、ＣＱＩを多重する方法として、ＦＤＭ（Frequency Division Multiplex）／ＴＤＭ(Time Division Multiplex)／ＣＤＭ(Code Division Multiplex)を用いて各移動端末毎の直交性を確保することが検討されている。また、基地局でのＡｃｋ／Ｎａｃｋ、ＣＱＩの受信品質を確保するために、Ａｃｋ／Ｎａｃｋ、ＣＱＩを繰り返し(repetition)送信して電力を増加させることが検討されている。具体的には、１送信時間区間(Transmission Time Interval　TTI)内で同じサブフレームを２回繰り返したり、サブフレーム内のＬＢ(Long Block)にＡｃｋ／Ｎａｃｋ、ＣＱＩのビットを繰り返し埋め込んで送信する方法等がある。

【０００９】

同期ランダムアクセス（Synchronous Random Access　SRA）は上りリンクの時間同期が取れている状態の場合に送信される、上りデータ送信を始める前に送るスケジューリングリクエスト（SR）のための信号である。ＳＲＡの物理的なリソース割り当てについては、ある一つの時間ー周波数領域を独占的に割り当てる方法がある(非特許文献３：TR25.814V7.0.0)。図２５は、Ｓ－ＲＡＣＨに上りスケジューリング要求信号を割り当てた無線リソースを示す説明図である。図２５に、ある一つの時間ー周波数領域を独占的に割り当てる方法を示す。時間的にはサブフレーム単位、周波数的には１リソースユニット単位もしくはそれ以上の領域に割り当てる。以下、これらの領域のことをＳ－ＲＡＣＨ(Synchronous Random Access CHannel)と称する。一方、上りデータはそれ以外の領域に割り当てられる。したがって、ＳＲＡとデータは時間と周波数のいずれか、あるいは両方で多重される。移動端末がどの領域でＳＲＡを送信するかは、あらかじめ決められているか、もしくは前もって基地局より通知される。一つの領域にはひとつまたは複数の移動端末のＳＲＡが割り当てられる。複数の移動端末のＳＲＡの送信が同じ領域で発生した場合、各移動端末からの信号が衝突してしまう。各移動端末からのＳＲＡが衝突して基地局で受信できなかった場合、通常は、それぞれの移動端末が異なる時間間隔と異なる領域のいずれか、あるいは両方で再度送信を繰り返す。また、衝突しても基地局で受信できるようにするため、ＦＤＭ／ＴＤＭ／ＣＤＭを用いて各移動端末の直交性を確保する方法が検討されている。

【００１０】

同期ランダムアクセスＳＲＡの物理的なリソース割当てとして、スケジュールドチャネルを用いる事も検討されている（非特許文献４）。スケジュールドチャネルとは、Ｓ－ＲＡＣＨのように複数の移動端末からの信号の衝突（または競合という）を許すチャネルとは異なり、対象となるひとつひとつの移動端末への割当てがスケジュールドされたチャネルである。この場合、あらかじめ移動端末毎に割当てられた領域が決まっているため、複数の移動端末からの信号の競合が無いため、移動端末が送信したＳＲ信号としてセル内での移動端末のＩＤ番号（ＵＥ－ＩＤ）を送る必要がない。それゆえ、上りＳＲＡをスケジュールドチャネルで送った場合は、上りＳＲ信号の情報量を少なくできる。

【００１１】

上りデータ送信が行われていない場合のＡｃｋ／Ｎａｃｋ、ＣＱＩと同期ランダムアクセス（ＳＲなどの）の同時送信をする場合の処理について説明する。上りＡｃｋ／Ｎａｃｋ、ＣＱＩは、移動端末が下りデータを受信している場合に、その受信状況に応じて基地局へ送信する信号である。一方ＳＲＡは、上りデータ送信を始める前に基地局へ送るＳＲ等のための信号である。これらの信号の内容は独立であるため、同時に送信される場合が生じる。図２６に、上りデータ送信が行われていない場合のＡｃｋ／ＮａｃｋとＳＲＡが同時に送信される場合の一例を示す。移動端末が下りデータを連続受信している時に、上りデータ送信が発生する場合である。移動端末は下りデータを連続で受信している。データはTTI単位毎に復調、デコードされる。移動端末は受信した下りデータの受信状況に応じて、受信判定結果の結果情報（Ack/Nack）を基地局に伝達する。移動端末は基地局からの送信データを正常に受信すると、基地局に対してＡｃｋ信号を送信する。Ａｃｋを受信

した基地局は、次に新しいデータを送信する。逆に、基地局から送信された送信データが正常に受信できなかったとき、基地局に対してＮａｃｋ信号を送信する。Ｎａｃｋを受信した基地局は移動端末にて正常に受信出来なかったデータを再送する。

【００１２】

上りＡｃｋ／Ｎａｃｋの物理的リソースへの割り当ては上記説明のように、分離した狭帯域の複数の時間－周波数領域を独占的に割り当てる。このため、上りＡｃｋ／Ｎａｃｋも連続して送信される事になる。一方、移動端末に上りデータが発生した場合、その上りデータを送信する前に、基地局へスケジューリングリクエストＳＲを送信する。ＳＲの物理的リソースの割り当ては上記説明のように、ある一つの時間－周波数領域を独占的に割り当てる。したがって、図に示すように、ある時間に上りデータが発生した場合、短い遅延時間の後にＳＲが発生する。移動端末が送信したＳＲ信号を基地局が受信できなかった場合、移動端末は再度ＳＲ信号を送信する。以上からわかるように、例えば移動端末が下りデータを連続受信している時に、上りデータ送信が発生した場合、上りＡｃｋ／Ｎａｃｋと上りＳＲＡを同時に送信しなければならない状況が生じる。また、たとえ、移動端末が下りデータを連続受信ではなく不連続に受信している場合でも、その受信データに対する上りＡｃｋ／Ｎａｃｋを送信している場合は、上りＳＲ信号の送信が同時に行われてしまう場合が生じることがわかる。

【００１３】

同様に、基地局へ送信するスケジューリングリクエストＳＲの物理的なリソース割当てとして、スケジュールドチャネルを割当てた場合も、上りＡｃｋ／Ｎａｃｋと上りＳＲＡを同時に送信しなければならない状況が生じることが考えられる。非特許文献４ではスケジュールドチャネルとしてどのようなチャネルを用いるか、また、物理的リソースとして時間－周波数領域をどのように割当てるかについて、何も記載されていないため、例えば、スケジューリングリクエストＳＲ専用の１bitの物理リソースを割当てたチャネルを考えたとしても、移動端末が下りデータを連続受信している時は上りＡｃｋ／Ｎａｃｋを連続して送信せねばならず、この時に上りデータ送信が発生した場合、上りＡｃｋ／Ｎａｃｋと上りＳＲＡを同時に送信しなければならない状況が生じてしまうことがわかる。

【００１４】

【非特許文献１】３ＧＰＰ寄書Ｒ１－０６２７４１

【００１５】

【非特許文献２】３ＧＰＰ寄書Ｒ１－０６２７４２

【００１６】

【非特許文献３】３ＧＰＰ　ＴＲ２５．８１４Ｖ７．０．０

【００１７】

【非特許文献４】３ＧＰＰ寄書Ｒ１－０６２７１９

【発明の開示】

【発明が解決しようとする課題】

【００１８】

ところで、ＬＴＥの通信システムでは、上りのアクセス方式にＳＣ－ＦＤＭＡ(Single Career Frequency Division Multiple Access　DFT-spread OFDMとも称される)が用いられる。ＳＣ－ＦＤＭＡはシングルキャリア伝送であるため、ＯＦＤＭのように各サブキャリア上にシンボルデータをのせて送信するマルチキャリア伝送に比べて、ＰＡＰＲ(Peak to Average Power Ratio　ピーク対平均電力比)を低く抑えることができるという特長を有している。したがって、移動端末の送信時の消費電力を低くでき、また、規定された隣接チャネル漏洩電力を満たす送信電力を増大することができるため、セルカバレッジが広がるという利点を有する。しかし、移動端末は、状況によっては、Ａｃｋ／Ｎａｃｋ専用チャネルを用いて上りＡｃｋ／ＮａｃｋやＣＱＩを送信する処理と、Ｓ－ＲＡＣＨもしくはスケジュールドチャネルを用いてＳＲＡを送信する処理とを同時に実行しなければならない場合が生じる。この場合、それぞれの信号は無相関であるため、時間的に同時に送信されるとシングルキャリア伝送とはならずマルチキャリア伝送となってしまう。無相関の

信号が時間的に同時に送信される場合、送信信号の時間波形のピークが高くなるため、ＰＡＰＲが高くなってしまう。ＰＡＰＲが高くなると、移動端末の消費電力が増大し、さらにはセルカバレッジが狭くなってしまうという問題が生じる。さらには、ＰＡＰＲが高くなることにより、ほかの移動端末やシステムへの妨害波となってしまうという問題も生じる。

【課題を解決するための手段】

【００１９】

本発明に係るデータ通信方法は、上記のような課題を解決するために提案されたものであり、下りアクセス方式としてOFDM（Orthogonal Frequency Division Multiplexing）方式を用いてデータの送信を行う基地局と、この基地局から送信されたデータの受信結果に応じた応答信号を含む制御信号を前記基地局に送信するとともに、送信信号を送信する前に、基地局に対して無線リソースの割り当てを要求するスケジューリング要求信号を送信する移動端末とを含む通信システムで実行されるデータ通信方法において、移動端末から基地局への上り方向に設けられた、応答信号を送信するための上り制御チャネルを用いて、応答信号を送信する応答信号送信処理と、基地局に対して送信するデータが発生したときに、上り制御チャネルとは異なる物理チャネルを介して、適時前記スケジューリング要求信号を送信するスケジューリング要求信号送信処理と、応答信号送信処理とスケジューリング要求信号送信処理のタイミングが重なった場合に、スケジューリング要求信号を送信している期間、応答信号送信処理を停止させる制御処理とを含むものである。

【００２０】

本発明に係るデータ通信システムは、下りアクセス方式としてOFDM（Orthogonal Frequency Division Multiplexing）方式を用いてデータの送信を行う基地局と、この基地局から送信されたデータの受信結果に応じた応答信号を含む制御信号を前記基地局に送信するとともに、送信信号を送信する前に、基地局に対して無線リソースの割り当てを要求するスケジューリング要求信号を送信する移動端末とを含む通信システムにおいて、移動端末は、基地局への上り方向に設けられた応答信号を送信するための上り制御チャネルを用いて、応答信号を送信するとともに、基地局に対して送信するデータが発生したときに、上り制御チャネルとは異なる物理チャネルを介して、適時前記スケジューリング要求信号を送信する送信部と、応答信号送信処理と前記スケジューリング要求信号送信処理のタイミングが重なった場合に、スケジューリング要求信号を送信している期間、応答信号送信処理を停止させる制御部とを備えたものである。

【００２１】

本発明に係るデータ通信方法は、下りアクセス方式としてOFDM（Orthogonal Frequency Division Multiplexing）方式を用いてデータの送信を行う基地局と、この基地局から送信されたデータの受信結果に応じた応答信号を含む制御信号を基地局に送信するとともに、送信信号を送信する前に、基地局に対して無線リソースの割り当てを要求するスケジューリング要求信号を送信する移動端末とを含む通信システムで実行されるデータ通信方法において、移動端末から基地局への上り方向に設けられた、応答信号を送信するための上り制御チャネルを用いて、少なくとも応答信号を含む上り制御信号を作成するとともに、基地局に対して送信するデータが発生したときには、スケジューリング要求信号と応答信号を時分割多重して上り制御信号を作成する制御信号作成処理と、制御信号作成処理により作成された上り制御信号を含む制御信号を送信する制御信号送信処理とを含むものである。

【００２２】

本発明に係るデータ通信方法は、下りアクセス方式としてOFDM（Orthogonal Frequency Division Multiplexing）方式を用いてデータの送信を行う基地局と、この基地局から送信されたデータの受信結果に応じた応答信号を含む制御信号を基地局に送信するとともに、基地局に対して送信したスケジューリング要求信号に応じて基地局より無線リソースが割り当てられると、上り共通チャネルを用いて個別データを送信する移動端末を含む通信システムで実行されるデータ通信方法において、個別データに第一のコードを用いて符号

化する処理と、基地局に対して送信するデータが発生したときには、スケジューリング要求信号を含む個別データに第二のコードを用いて符号化する処理を選択的に行うとともに、符号化された個別データを上り共通チャネルを用いて送信する処理とを行うものである。

【００２３】

本発明に係るデータ通信方法は、下りアクセス方式としてOFDM（Orthogonal Frequency Division Multiplexing）方式を用いてデータの送信を行う基地局と、この基地局から送信されたデータの受信結果に応じた応答信号を含む制御信号を基地局に送信するとともに、送信信号を送信する前に、基地局に対して無線リソースの割り当てを要求するスケジューリング要求信号を送信する移動端末を含む通信システムで実行されるデータ通信方法において、基地局に対して送信するデータが発生したときに基地局に対して適時信号を送信するための物理チャネルであるランダムアクセスチャネルに、少なくともスケジューリング要求信号と応答信号を時分割多重して上り制御信号を作成する制御信号作成処理と、この制御信号作成処理により作成された上り制御信号を含む制御信号を送信する制御信号送信処理とを含むものである。

【発明の効果】

【００２４】

本発明は、下りアクセス方式としてOFDM（Orthogonal Frequency Division Multiplexing）方式を用いてデータの送信を行う基地局と、この基地局から送信されたデータの受信結果に応じた応答信号を含む制御信号を前記基地局に送信するとともに、送信信号を送信する前に、基地局に対して無線リソースの割り当てを要求するスケジューリング要求信号を送信する移動端末とを含む通信システムで実行されるデータ通信方法において、移動端末から基地局への上り方向に設けられた、応答信号を送信するための上り制御チャネルを用いて、応答信号を送信する応答信号送信処理と、基地局に対して送信するデータが発生したときに、上り制御チャネルとは異なる物理チャネルを介して、適時前記スケジューリング要求信号を送信するスケジューリング要求信号送信処理と、応答信号送信処理とスケジューリング要求信号送信処理のタイミングが重なった場合に、スケジューリング要求信号を送信している期間、応答信号送信処理を停止させる制御処理とを含むので、２種類の帯域に割り当てた２つの物理チャネル（Ack/Nack専用チャネルとS-RACH）のデータを同時に送信するマルチキャリア方式を使用せずに済み、一時的な物理チャネルの増加による通信システムの無線リソース負荷の増加を防ぐとともに、ＰＡＰＲ（ピーク対平均電力比）を低減できる。

【００２５】

本発明に係るデータ通信システムは、下りアクセス方式としてOFDM（Orthogonal Frequency Division Multiplexing）方式を用いてデータの送信を行う基地局と、この基地局から送信されたデータの受信結果に応じた応答信号を含む制御信号を前記基地局に送信するとともに、送信信号を送信する前に、基地局に対して無線リソースの割り当てを要求するスケジューリング要求信号を送信する移動端末とを含む通信システムにおいて、移動端末は、基地局への上り方向に設けられた応答信号を送信するための上り制御チャネルを用いて、応答信号を送信するとともに、基地局に対して送信するデータが発生したときに、上り制御チャネルとは異なる物理チャネルを介して、適時前記スケジューリング要求信号を送信する送信部と、応答信号送信処理と前記スケジューリング要求信号送信処理のタイミングが重なった場合に、スケジューリング要求信号を送信している期間、応答信号送信処理を停止させる制御部とを備えたので、２種類の帯域に割り当てた２つの物理チャネル（Ack/Nack専用チャネルとS-RACH）のデータを同時に送信するマルチキャリア方式を使用せずに済み、一時的な物理チャネルの増加による通信システムの無線リソース負荷の増加を防ぐとともに、ＰＡＰＲ（ピーク対平均電力比）を低減できる。

【００２６】

本発明に係るデータ通信方法は、本発明に係るデータ通信方法は、下りアクセス方式としてOFDM（Orthogonal Frequency Division Multiplexing）方式を用いてデータの送信を

行う基地局と、この基地局から送信されたデータの受信結果に応じた応答信号を含む制御信号を基地局に送信するとともに、送信信号を送信する前に、基地局に対して無線リソースの割り当てを要求するスケジューリング要求信号を送信する移動端末とを含む通信システムで実行されるデータ通信方法において、移動端末から基地局への上り方向に設けられた、応答信号を送信するための上り制御チャネルを用いて、少なくとも応答信号を含む上り制御信号を作成するとともに、基地局に対して送信するデータが発生したときには、スケジューリング要求信号と応答信号を時分割多重して上り制御信号を作成する制御信号作成処理と、制御信号作成処理により作成された上り制御信号を含む制御信号を送信する制御信号送信処理とを含むので、２種類の帯域に割り当てた２つの物理チャネル（Ack/Nack専用チャネルとS-RACH）のデータを同時に送信するマルチキャリア方式を使用せずに済み、一時的な物理チャネルの増加による通信システムの無線リソース負荷の増加を防ぐとともに、ＰＡＰＲ（ピーク対平均電力比）を低減できる。

【００２７】

本発明に係るデータ通信方法は、下りアクセス方式としてOFDM（Orthogonal Frequency Division Multiplexing）方式を用いてデータの送信を行う基地局と、この基地局から送信されたデータの受信結果に応じた応答信号を含む制御信号を基地局に送信するとともに、基地局に対して送信したスケジューリング要求信号に応じて基地局より無線リソースが割り当てられると、上り共通チャネルを用いて個別データを送信する移動端末を含む通信システムで実行されるデータ通信方法において、個別データに第一のコードを用いて符号化する処理と、基地局に対して送信するデータが発生したときには、スケジューリング要求信号を含む個別データに第二のコードを用いて符号化する処理を選択的に行うとともに、符号化された個別データを上り共通チャネルを用いて送信する処理とを行うので、２種類の帯域に割り当てた２つの物理チャネル（Ack/Nack専用チャネルとS-RACH）のデータを同時に送信するマルチキャリア方式を使用せずに済み、一時的な物理チャネルの増加による通信システムの無線リソース負荷の増加を防ぐとともに、ＰＡＰＲ（ピーク対平均電力比）を低減できる。

【００２８】

本発明に係るデータ通信方法は、下りアクセス方式としてOFDM（Orthogonal Frequency Division Multiplexing）方式を用いてデータの送信を行う基地局と、この基地局から送信されたデータの受信結果に応じた応答信号を含む制御信号を基地局に送信するとともに、送信信号を送信する前に、基地局に対して無線リソースの割り当てを要求するスケジューリング要求信号を送信する移動端末を含む通信システムで実行されるデータ通信方法において、基地局に対して送信するデータが発生したときに基地局に対して適時信号を送信するための物理チャネルであるランダムアクセスチャネルに、少なくともスケジューリング要求信号と応答信号を時分割多重して上り制御信号を作成する制御信号作成処理と、この制御信号作成処理により作成された上り制御信号を含む制御信号を送信する制御信号送信処理とを含むので、２種類の帯域に割り当てた２つの物理チャネル（Ack/Nack専用チャネルとS-RACH）のデータを同時に送信するマルチキャリア方式を使用せずに済み、一時的な物理チャネルの増加による通信システムの無線リソース負荷の増加を防ぐとともに、ＰＡＰＲ（ピーク対平均電力比）を低減できる。

【発明を実施するための最良の形態】

【００２９】

実施の形態１．

図１はＬＴＥにおける移動通信システムの構成を示す説明図である。図１において、ａＧＷ１は複数の基地局（eNodeB）２と制御データやユーザデータの送受信を行い、基地局２は複数の移動端末３に対してデータの送受信を行う。基地局２と移動端末３間においては、報知情報、着呼処理に用いられる情報、個別制御データ、個別ユーザデータ、Ｅ－ＭＢＭＳ用の制御データやユーザデータ等が送信される。また、基地局２同士がお互いに通信することも検討されている。基地局２は上り及び下りのスケジューラを有する。スケジューラは、基地局２と各移動端末３のデータの送受信を可能にし、個々の移動端末３及び

移動通信システム全体のスループット向上のためにスケジューリングを行う。

【００３０】

Ｅ－ＭＢＭＳはある基地局から複数の移動端末に向けてデータを一斉に送信する放送型の一対多（Point to Multipoint　PtoM）型の通信サービスを提供するものである。具体的には、ニュースや天気予報等の情報サービスや、モバイルＴＶなどの大容量の放送サービスが検討されている。ａＧＷ１はＰＤＮ４(Packet Data Network)を介してサービスセンタ５と通信を行う。サービスセンタ５はユーザにサービスを提供するためのコンテンツを保管、配信するための装置である。コンテンツプロバイダは、サービスセンタ５に対してモバイルＴＶ放送データ等のＥ－ＭＢＭＳデータを送信する。サービスセンタ５ではＥ－ＭＢＭＳデータを記憶するとともに、ＰＤＮ４、ａＧＷ１を介して基地局２へＥ－ＭＢＭＳデータを送信する。

【００３１】

図２は、チャネルの構成を示す説明図である。図２には、論理チャネル（Logical channel）とトランスポートチャネル(Transport channel)のマッピングが示されている。論理チャネルは伝送信号の機能や論理的な特性によって分類される。トランスポートチャネルは伝送形態によって分類される。報知情報はＢＣＣＨ(Broadcast Control Channel)上にのせられる。ＢＣＣＨはＢＣＨ(Broadcast Channel)にマッピングされ基地局から移動端末へ送信される。着呼処理に用いられる情報はＰＣＣＨ(Paging Control Channel)上にのせられる。ＰＣＣＨはＰＣＨ(Paging Channel)にマッピングされ基地局からセル内の移動端末へ送信される。個別の移動端末あての個別制御データはＤＣＣＨ(Dedicated Control Channel)上にのせられる。

【００３２】

また、個別の移動端末あての個別ユーザデータはＤＴＣＨ(Dedicated Traffic Channel)上にのせられる。ＤＣＣＨとＤＴＣＨはＤＬ－ＳＣＨ(Downlink Shared Channel)にマッピングされて、基地局から個々の移動端末にあてて個別に送信される。逆に、ＵＬ－ＳＣＨ(Uplink Shared Channel)を用いて個々の移動端末から基地局へ個別に送信される。ＤＬ－ＳＣＨは共有チャネル(Shared Channel)である。Ｅ－ＭＢＭＳ用の制御データ及びユーザデータはそれぞれＭＣＣＨ(Multicast Control Channel)とＭＴＣＨ(Multicast Traffic Channel)上にのせられ、ＤＬ－ＳＣＨもしくはＭＣＨ(Multicast Channel)にマッピングされて基地局から移動端末へ送信される。移動端末からの接続要求信号、例えばスケジューリング要求信号ＳＲはランダムアクセスチャネル（Random Access Channel　RACH）により個々の移動端末から基地局へ送信される。Ｓ－ＲＡＣＨはＲＡＣＨのひとつである。

【００３３】

図３は、移動端末の構成を示すブロック図である。移動端末３の送信処理は以下のとおり実行される。まず、プロトコル処理部６からの制御データ、アプリケーション部７からのユーザデータが送信データバッファ部８へ保存される。送信データバッファ部８に保存されたデータはエンコーダ部９へ渡され、誤り訂正などのエンコード処理が施される。エンコード処理を施さずに送信データバッファ部８から変調部１０へ直接出力されるデータが存在しても良い。エンコーダ部９でエンコード処理されたデータは変調部１０にて変調処理が行われる。変調されたデータはベースバンド信号に変換された後、周波数変換部１１へ出力され、無線送信周波数に変換される。その後、アンテナ１２から基地局２に送信信号が送信される。また、移動端末３の受信処理は以下のとおり実行される。基地局２からの無線信号がアンテナ１２により受信される。受信信号は、周波数変換部１１にて無線受信周波数からベースバンド信号に変換され、復調部１３において復調処理が行われる。復調後のデータはデコーダ部１４へ渡され、誤り訂正などのデコード処理が行われる。デコードされたデータのうち、制御データはプロトコル処理部６へ渡され、ユーザデータはアプリケーション部７へ渡される。移動端末の一連の送受信処理は制御部１５によって制御される。

【００３４】

図４は、基地局の構成を示すブロック図である。基地局２の送信処理は以下のとおり実行される。ａＧＷ通信部１６は、基地局２とａＧＷ１間のデータの送受信を行う。他基地局通信部１７は、他の基地局との間のデータの送受信を行う。ａＧＷ通信部１６、他基地局通信部１７はそれぞれプロトコル処理部１８と情報の受け渡しを行う。プロトコル処理部１８からの制御データ、またａＧＷ通信部１６と他基地局通信部１７からのユーザデータが送信データバッファ部１９へ保存される。送信データバッファ部１９に保存されたデータはエンコーダ部２０へ渡され、誤り訂正などのエンコード処理が施される。エンコード処理を施さずに送信データバッファ部１９から変調部２１へ直接出力されるデータが存在しても良い。エンコードされたデータは変調部２１にて変調処理が行われる。

【００３５】

変調されたデータはベースバンド信号に変換された後、周波数変換部２２へ出力され、無線送信周波数に変換される。その後、アンテナ２３より一つもしくは複数の移動端末１に対して送信信号が送信される。また、基地局２の受信処理は以下のとおり実行される。ひとつもしくは複数の移動端末３からの無線信号がアンテナ２３により受信される。受信信号は周波数変換部２２にて無線受信周波数からベースバンド信号に変換され、復調部２４で復調処理が行われる。復調されたデータはデコーダ部２５へ渡され、誤り訂正などのデコード処理が行われる。デコードされたデータのうち、制御データはプロトコル処理部１８へ渡され、ユーザデータはａＧＷ通信部１６、他基地局通信部１７へ渡される。基地局２の一連の送受信処理は制御部２６によって制御される。

【００３６】

以下、本発明にかかる移動端末の動作について説明する。移動端末が、上りデータ送信を行なっておらず、かつ、下りデータを連続して受信している場合、移動端末は下りデータの受信結果（正常に受信した／していない）を示すＡｃｋ／Ｎａｃｋ信号をＡｃｋ／Ｎａｃｋ専用チャネルを用いて基地局へ送信する。上記のような、Ａｃｋ／Ｎａｃｋ信号を送信している状態において、上りデータの送信を開始する場合、移動端末は基地局に向けて、上記Ａｃｋ／Ｎａｃｋとは別に上りスケジューリング要求信号ＳＲを送信する必要がある。本実施の形態では、Ａｃｋ／Ｎａｃｋ専用チャネルと異なる物理チャネル（Ｓ－ＲＡＣＨ）を用いて、上りスケジューリング要求信号ＳＲを基地局に送信する場合に、より広いカバレッジと低いＰＡＰＲを実現するＳＣ－ＦＤＭＡ方式で送信を行う方法について説明する。

【００３７】

実施の形態１では、移動端末が、上りデータ送信を行わずに、下りデータを連続して受信しながら、Ａｃｋ／Ｎａｃｋ信号を上りのＡｃｋ／Ｎａｃｋ専用チャネルにて送信している状態において、上りデータの送信を開始したい場合、上りデータ送信用チャネルを設定するための上りスケジューリング要求信号ＳＲを、Ａｃｋ／Ｎａｃｋ専用チャネルと別の周波数帯域を割り当てた物理チャネル（本実施の形態１ではＳ－ＲＡＣＨを利用）にて送信する。この時、二種類の帯域に割り当てた二つの物理チャネルのデータを同時に送信するマルチキャリア方式を使わず、移動端末が上りデータ送信を開始した時に一時的に基地局とやりとりされるＳＲ(preamble/message)を送信している間は、Ａｃｋ／Ｎａｃｋ専用チャネルでのＡｃｋ／Ｎａｃｋ信号を送信しない（ＤＴＸ Discontinuous Transmission）ようにする。これにより、一つの移動端末の一時的な物理チャネル増によるシステムの無線リソース負荷の増加を防ぐと共に、低いＰＡＰＲを保証するシングルキャリア方式での送信を実現できる。

【００３８】

図５は、Ａｃｋ／Ｎａｃｋ専用チャネルと上りスケジューリング要求信号ＳＲ送信用のＳ－ＲＡＣＨに割り当てる無線リソースを説明する説明図である。図６は、上りスケジューリング要求信号を送信するまでの移動端末における処理を説明するフローチャートである。図７、図８は上りスケジューリング要求信号送信から上りデータ送信開始までの一連の処理を説明するフローチャートである。図５において、移動端末ＵＥ１は、ユーザデータなどの上りデータ送信を行わず、下りデータのみを連続して受信すると同時に、この受

信データに対するＡｃｋ／ＮａｃｋをＡｃｋ／Ｎａｃｋ専用チャネルを用いて送信しているものとする。図３に示す移動端末の変調部１０はＡｃｋ／Ｎａｃｋ信号に対して移動端末毎のＣＤＭ多重処理を行い、Ａｃｋ／Ｎａｃｋ専用チャネルを用いて送信している。このため、移動端末ＵＥ１は時間的に連続してＡｃｋ／Ｎａｃｋ専用チャネルでＡｃｋ／Ｎａｃｋ信号を送信することもできる。

【００３９】

ここで、図６のＳＴ６０１における上りデータ送信要求が発生すると（ST601でYes）、ＳＴ６０２において、下りデータ（ＤＬデータ）の受信状況を確認する。本実施の形態１では、下りデータを受信しているため、ＳＴ６０４へ進み、Ｓ－ＲＡＣＨにて上りスケジューリング要求信号ＳＲ(preamble or/and message)を送信するタイミングを決定する。仮に、下りデータを受信しておらず、基地局と同期が取れてない場合は（ST602でNo）、ＳＴ６０３において、Ｎｏｎ－Ｓ－ＲＡＣＨと呼ばれる物理チャネルを用いて、上りスケジューリング要求信号ＳＲを送信するアルゴリズムを実行する。ＳＴ６０４で上りスケジューリング要求信号ＳＲの送信タイミングを決定すると、ＳＴ６０５において、移動端末ＵＥ１は、Ｓ－ＲＡＣＨを用いて上りスケジューリング要求信号ＳＲを送信すると同時に、同じタイミングで送信する予定だった、上りＡｃｋ／Ｎａｃｋ専用チャネルの所定のＡｃｋ／Ｎａｃｋシンボル(あるいはＬＢ)の送信を、上りスケジューリング要求信号ＳＲを送信している間、停止する（シンボルDTX、あるいはLBのDTX）。このＡｃｋ／Ｎａｃｋシンボルの送信停止（ＤＴＸ）は、制御部１５による制御のもと変調部１０で行なわれる。

【００４０】

図５は上りスケジューリング要求信号ＳＲを送信する物理チャネルであるＳ－ＲＡＣＨと、Ａｃｋ／Ｎａｃｋ専用チャネルの無線リソースの割り当て例を示す。図５において、無線リソースは、複数の時間－周波数領域に分割される。時間－周波数領域において、時間軸はサブフレーム(=0.5ms)単位で区切られ、周波数軸は、物理チャネルの送信データ量に応じて異なる帯域で区切られる。本実施例での無線リソース割り当てでは、Ｓ－ＲＡＣＨと上りデータ送信用チャネルで同じ大きさの時間－周波数の単位領域を用い、Ａｃｋ／Ｎａｃｋ専用チャネルは、それよりも狭い周波数帯域（時間区分は同じ）の単位領域を用いている。Ａｃｋ／Ｎａｃｋ専用チャネルにおける１サブキャリアの、サブフレーム１は、６つのロングブロック(Long Block、 LB1-LB6)と２つのショートブロック（Short Block、 SB）とから構成される。ショートブロックＳＢには物理チャネル同期用シンボルが含められる。移動端末ＵＥ１は、図５のように割り当てられたＳ－ＲＡＣＨの時間-周波数領域を用いて、上りスケジューリング要求信号ＳＲを１サブフレームの長さで送信している間、Ａｃｋ／Ｎａｃｋ専用チャネルに割り当てられていたロングブロックＬＢ１～ＬＢ６と２つのショートブロックＳＢのシンボルデータの変調及び送信を停止する（ＤＴＸする）。

【００４１】

しかし、次のサブフレーム２においては、Ｓ－ＲＡＣＨによる上りスケジューリング要求信号ＳＲの送信はなく、ユーザデータなどの上りデータの送信もないため、Ａｃｋ／Ｎａｃｋ専用チャネルにより、サブフレーム２用のシンボルデータ（LB2-1～LB2-6）が送信される。さらに、その次のサブフレーム（TTI No.2のサブフレーム1）では、別の移動端末ＵＥの上りスケジューリング要求信号ＳＲが発生し、移動端末ＵＥ１とは別の周波数帯域に存在する時間-周波数領域に、このＳＲ用のＳ－ＲＡＣＨが割り当てられる。この場合、他の移動端末ＵＥのＳ－ＲＡＣＨが送信され、このサブフレーム期間中の、Ａｃｋ／Ｎａｃｋ専用チャネルの移動端末ＵＥ１からのＡｃｋ／Ｎａｃｋシンボルデータは送信される。Ｓ－ＲＡＣＨを用いた上りスケジューリング要求信号ＳＲの送信から上りデータ送信までのシーケンスを示したものが、図７、図８である。

【００４２】

図７では、上りスケジューリング要求信号ＳＲ(preamble or/and message)を１回で送信する（ST701）場合のフローチャートを示す。図８では、上りスケジューリング要求信号ＳＲをプレアンブル（preamble）とメッセージ（message）を時系列に２回に分けて送

信する（ST801、803）場合のフローチャートを示す。どちらにしても、移動端末は、プレアンブルとメッセージで上りスケジューリング要求を基地局に通知した後、基地局から、下りＬ１/Ｌ２制御信号による、上りデータ送信用の無線リソース割り当てやタイミングに関する情報（Uplink Data Resource Allocation）を受信する。そして、移動端末は、ＵＬ－ＳＣＨ（Uplink Shared channel）を用いて上りデータ送信を開始する。本実施の形態では、上りスケジューリング要求信号ＳＲの送信に１サブフレーム期間を割り当てる例を説明した。しかし、図７、図８のように、長い送信期間でプレアンブルとメッセージを１度で送る場合と、短い送信期間で、２度に分けて送る場合があるため、上りスケジューリング要求信号ＳＲの送信区間の長さや頻度により、Ａｃｋ／Ｎａｃｋを送信できない区間の長さや、発生頻度が変わることはあり得る。また、図５に示したサブフレーム内のロングブロックとショートブロックの構成は、あくまで１つの例であり、サブフレームの構成が変わっても、この発明の考え方を適用できる。

【００４３】

ここで、上りスケジューリング要求信号ＳＲのプレアンブルとメッセージについて説明する。プレアンブルとは、例えば、端末を識別するための固有の識別情報である「ランダムＩＤ(random ID(UE ID))」が割り当てられると考えられる。また、メッセージとは、先の「ＵＥ　ＩＤ」のほか、上り送信データ量(UE内のバッファ状態)や上り送信データのQoS、端末の送信パワーマージンも考えられる。

【００４４】

従来の通信方式（ＦＤＭＡ、ＴＤＭＡ、ＣＤＭＡ）においては、上りにおけるシンボルの送信停止（ＤＴＸ）は、移動端末の消費電力の低減や、移動端末の最高送信電力を基地局から指定された電力範囲内に抑え、システム全体の送信電力を一定内に抑える効果があったのに対し、本発明におけるシンボル送信停止（ＤＴＸ）方法を利用すれば、従来の通信方式でのＤＴＸとは異なり、上りにおいて、移動端末内のＰＡＰＲを低く抑えることができるのみならず、シングルキャリア伝送が可能であるため、マルチキャリア伝送方式に比べ、移動端末、基地局双方において、変復調処理の実装規模を小さく出来、システム全体の処理負荷を低減できるという効果を有している。

【００４５】

以上のように、実施の形態１を用いることにより、上りデータ送信を行っていない場合であって、下りデータを受信している場合に、Ａｃｋ／Ｎａｃｋとともに上りスケジューリング要求信号ＳＲを送信する必要が生じた移動端末が移動端末内のＰＡＰＲを増加させることなく、同時にそれらの送信を行うことが出来るという効果を得ることが出来る。

【００４６】

実施の形態２．

上記説明の実施の形態１では、Ａｃｋ／Ｎａｃｋ専用チャネルを用いてＡｃｋ／Ｎａｃｋ信号を送信しているときに、Ｓ－ＲＡＣＨを用いて上りスケジューリング要求信号ＳＲを送信する場合、移動端末は、上りスケジューリング要求信号ＳＲを送信している間、Ａｃｋ／Ｎａｃｋ信号の送信を停止していた。上りスケジューリング要求信号を送信している間、Ａｃｋ／Ｎａｃｋ信号の送信を停止することにより、２種類の帯域に割り当てた２つの物理チャネル（Ack/Nack専用チャネルとS-RACH）のデータを同時に送信するマルチキャリア方式を使用せずに済むので、一時的な物理チャネルの増加による通信システムの無線リソース負荷の増加を防ぐとともに、低いＰＡＰＲを保証するシングルキャリア方式での送信を実現していた。以下説明する実施の形態２では、Ａｃｋ／Ｎａｃｋシンボル送信停止（DTX）を行った場合に、Ａｃｋ／Ｎａｃｋ専用チャネル上のシンボルの通信性能に悪影響を出にくくするための、Ａｃｋ／Ｎａｃｋ専用チャネルでのマッピング方法について説明する。

【００４７】

実施の形態１において、図７、８を用いて、S-RACHを用いた上りスケジューリング要求信号ＳＲの送信から上りデータ送信までの処理を説明した。つまり、上りスケジューリング要求信号ＳＲ(preamble or/and message)の送信には、図７のようにプレアンブルと

メッセージをまとめて１度に送るため、長い送信期間が必要となるものと、図８のように、プレアンブルとメッセージをそれぞれ分けて送るため、それぞれの送信期間が短くなるものがある。上りスケジューリング要求信号ＳＲの送信期間が長くなる場合は、Ａｃｋ／Ｎａｃｋを送信できない（ACK/NACKシンボルDTX）期間が長くなり、上りスケジューリング要求信号ＳＲの送信期間が短くなる場合は、Ａｃｋ／Ｎａｃｋを送信できない期間は短くなる。それぞれの場合において、上りスケジューリング要求信号ＳＲを送信している期間のＡｃｋ／Ｎａｃｋシンボル情報の送信誤りによる通信品質の低下を防ぐための方法について、以下に説明する。

【００４８】

まず、図７の処理の場合について説明する。図７に示す上りスケジューリング要求信号ＳＲの送信は、プレアンブルとメッセージをまとめて一度に送信するので、Ａｃｋ／Ｎａｃｋを送信できない期間が長くなり、図５のように、１サブフレーム程度の期間になるとする。この期間中に発生し得る、Ａｃｋ／Ｎａｃｋシンボル情報の送信誤りによる通信品質の低下を防ぐため、本実施の形態では、Ａｃｋ／Ｎａｃｋ専用チャネルで送るシンボルのパターンを、１サブフレーム長のパターンを２回繰り返し、１送信時間区間（TTI）単位で更新されるようにマッピングすることとした。また、通信品質を確保するため、１サブフレーム長のシンボルパターンでは、重要な情報（上位ビット）を優先して繰り返し数を多くするようなシンボルの組み合わせにする。Ａｃｋ／Ｎａｃｋ専用チャネルで送信するシンボル情報の具体的なマッピング例を説明したものが、図９と図１０である。

【００４９】

図９は、Ａｃｋ／Ｎａｃｋ専用チャネルで送信するＡｃｋ／Ｎａｃｋシンボルのマッピング例を説明した説明図である。図９はこれまでに、３ＧＰＰ（3rd Generation Partnership Project）で提案されてきたＡｃｋ／Ｎａｃｋ専用チャネルへのシンボルマッピング例を示したものである（非特許文献２）。Ａｃｋ／Ｎａｃｋシンボルのみの場合（図9(a)）、ＣＱＩシンボルのみの場合（図9(b)）、ＣＱＩシンボルとＡｃｋ／Ｎａｃｋシンボルをそれぞれ多重してロングブロックＬＢにマッピングした場合（図9(c)）について、それぞれ、送信時間区間長（TTI）でシンボルマッピング構成が示されている。本実施の形態で提案するシンボルパターンは、Ａｃｋ／Ｎａｃｋが長期間（＝1サブフレーム）送信できない場合においても、１ＴＴＩ内で、１サブフレーム長のシンボルパターンを２回繰り返すことにより、Ａｃｋ／Ｎａｃｋの送信誤りを防ぎ、通信品質を向上させることを目的としている。図９に記載のシンボルパターンは、ＣＱＩシンボルの場合、１サブフレームＡがＣＱＩ１、ＣＱＩ２、ＣＱＩ３、ＣＱＩ４、ＣＱＩ５、ＣＱＩ１とマッピングされているのに対し、１サブフレームＢでは、ＣＱＩ２、ＣＱＩ３、ＣＱＩ４、ＣＱＩ１、ＣＱＩ２、ＣＱＩ１とマッピングされており、同一のシンボルパターンで配列されていない。ＣＱＩとＡｃｋ／Ｎａｃｋが時系列に多重されるシンボルパターンもまた、１サブフレームＡと１サブフレームＢで同一のシンボルパターンで配列されていない。

【００５０】

本発明で提案するＣＱＩシンボルのマッピング案とＣＱＩとＡｃｋ／Ｎａｃｋの多重マッピング案をしめしたものが、図１０である。まず、図１０（ａ）のＣＱＩシンボルマッピング例では、１ＴＴＩ内の１サブフレーム目（1 sub-frame A）と２サブフレーム目(1 sub-frame B)で同じシンボルマッピングパターンを繰り返す構成になっている。また、サブフレーム長のシンボルマッピングは、優先順位の高いシンボル（CQIの上位の桁を示すシンボル：本例ではCQI1）を数多く繰り返すようにしている。さらに、図１０（ｂ）のＣＱＩとＡｃｋ／Ｎａｃｋの多重マッピング例でも、１ＴＴＩ内の１サブフレーム目（1 sub-frame A）と２サブフレーム目(1 sub-frame B)で同じシンボルマッピングパターンを繰り返し、サブフレーム長のシンボルマッピングは、優先順位の高いシンボル（Ack/Nackなど）を、スモールブロックＳＢの周辺に配置するようにしている。本発明の実施の形態２においては、優先順位の高いシンボルとして、Ack/NackとCQIの上位ビット（CQI1が最上位ビット）を考えている。Ack/Nackは下りデータの受信結果であり、このビットが基地局側でうまく受信できないと、該当するパケットデータの再送が発生してしまう、という問

題が起こるため、シンボル配置において優先順位を高くする必要がある。下りデータの受信状態を示すCQIビットも、上位のビットは、送信誤り等に対応できるよう、優先的に配置する必要がある。

【００５１】

このように、上りスケジューリング要求信号ＳＲを送信している間、Ａｃｋ／Ｎａｃｋ情報が送信されないリスクや、シンボルの重要度を考慮したシンボルマッピング方法でのマッピングパターンは、本実施の形態に説明したパターンに限る必要はない。また、Ａｃｋ/Ｎａｃｋ情報（Ack/Nack、CQI）のシンボルマッピングは、あらかじめ決められたいくつかのパターンが存在し、その中から移動局が選択してもよいし、基地局からパターンを指定されてもよいし、また、動的に割り当てられてもよい。上記説明のように、Ｓ－ＲＡＣＨを用いた上りスケジューリング要求信号ＳＲの送信により、一時的にＡｃｋ／Ｎａｃｋ専用チャネルによるＡｃｋ／Ｎａｃｋシンボルを長期間（=1サブフレーム）送信できない場合に、Ａｃｋ／Ｎａｃｋ専用チャネルの情報シンボルの送信誤りを防ぎ、高い通信品質を維持することができる。

【００５２】

次に、図８のシーケンスのように、１回の上りスケジューリング要求信号ＳＲの送信期間が十分短い場合について、説明する。図６のＳＴ６０５において、図８で示すフローチャートのように、上りスケジューリング要求信号ＳＲを送信する際に、プレアンブルとメッセージを分けて送信したり、プレアンブルと小サイズのメッセージを一緒に送信する場合、上りスケジューリング要求信号ＳＲの送信に要する期間は短くなる。したがって、上りスケジューリング要求信号ＳＲの送信中に送信が停止されるＡｃｋ／Ｎａｃｋ専用チャネルにおけるＡｃｋ／Ｎａｃｋシンボルの送信停止期間も短くなる。このような場合において、上りスケジューリング要求信号ＳＲの送信に用いるＳ－ＲＡＣＨと、Ａｃｋ／Ｎａｃｋ専用チャネルが、時間－周波数でどのように割り当てられているかの１例を示したものが、図１１である。

【００５３】

図８のフローチャートにおける上りスケジューリング要求信号ＳＲの情報量は十分に短いため、図１１において、移動端末ＵＥ１のＳ－ＲＡＣＨが時間－周波数に割り当てられる領域は、１つの時間－周波数単位領域の中の、先頭のデータシンボルブロック分だけとなっている。これと同タイミングで送信されるＡｃｋ／Ｎａｃｋシンボルは、Ａｃｋ／Ｎａｃｋ専用チャネルのロングブロックＬＢ１のシンボルである。移動端末ＵＥ１のＳ－ＲＡＣＨによる上りスケジューリング要求信号ＳＲが送信されている間、ロングブロックＬＢ１のブロックのＡｃｋ／Ｎａｃｋ情報シンボルは送信されない。

【００５４】

図１２は、Ａｃｋ／Ｎａｃｋ専用チャネルで送信するＡｃｋ／Ｎａｃｋシンボルのマッピング例を説明した説明図である。図１０と異なり、図１２では、１ＴＴＩ内の１サブフレーム目（1 sub-frame A）と２サブフレーム目(1 sub-frame B)で異なるシンボルをマッピングし、ＴＴＩ内で、優先順位の高いＡｃｋ／Ｎａｃｋまたは上位のＣＱＩビットを数多く配置するようにしている。図１２(ａ)に示すように、ＣＱＩシンボルのみの場合、１つの時間－周波数単位領域に配置された６つのデータシンボルブロック（LB1～LB6）に、ＣＱＩ１～ＣＱＩ５をマッピングする必要がある。図１２では、上りスケジューリング要求信号ＳＲの送信が発生した場合、送信されなくなる可能性のあるロングブロックＬＢの位置に（例えばLB1）、優先度の高いシンボルＣＱＩ１を割り当てるとともに、次のロングブロックＬＢ２にも同じＣＱＩ１を割当てている。これにより、上りスケジューリング要求信号ＳＲの送信が発生した場合であっても、最も重要なシンボルＣＱＩ１を２つめのロングブロックＬＢ２で送信することができ、かつ、上りスケジューリング要求信号ＳＲの送信が発生しない場合でも、最も重要なシンボルＣＱＩ１を４回送信することにより、通信誤り時の品質劣化を防ぐことができる。

【００５５】

また、図１２(ｂ)に示すように、ＣＱＩシンボルとＡｃｋ／Ｎａｃｋシンボルの多重し

てマッピングする場合、１つの時間ー周波数単位領域に存在するデータシンボルブロック（＝LB）数以上の数のシンボルを送信しなければならない場合においては、上りスケジューリング要求信号ＳＲの送信が発生した場合、送信されなくなる可能性のあるＬＢの位置に（LB1）、優先順位の低いシンボルＣＱＩ５を割り当てることにより、上りスケジューリング要求信号ＳＲの送信が発生して、ＣＱＩ５シンボルが送信できなかった場合でも、他の優先順位の高いシンボルは送ることが可能であるので、通信品質を維持することができる。

【００５６】

なお、シンボルの重要度に応じたシンボルマッピング方法でのマッピングパターンは、本実施の形態に説明したパターンに限る必要はない。また、Ａｃｋ／Ｎａｃｋ情報（Ack/Nack、 CQI）のシンボルマッピングは、あらかじめ決められたいくつかのパターンから移動端末ないし基地局が選択してもよいし、動的に割り当てられてもよい。また、図１１にあるように、移動端末ＵＥ１のＳ−ＲＡＣＨが時間−周波数に割り当てられる領域が、一部の時間のデータシンボルブロック分だけとなっている場合として、図８のフローチャートのようにＳ−ＲＡＣＨで送信する情報が十分小さい場合のみならず、図７のフローチャートのように、上りスケジューリング要求信号ＳＲの情報量が多い場合も考えられる。この場合は、Ｓ−ＲＡＣＨを周波数方向に帯域を広げた時間ー周波数領域に割り当てて送信することにより、少ない時間で送ることができる。具体的には、図１１の割り当て時に比べ、上りスケジューリング要求信号ＳＲの送信に、周波数方向に広い時間ー周波数領域を割り当てる、もしくは、周波数方向に連続した、複数の時間−周波数単位領域を割り当てることになる。

【００５７】

実施の形態１及び実施の形態２では、Ａｃｋ/Ｎａｃｋ専用チャネルにおいて移動端末毎にＡｃｋ/Ｎａｃｋ情報がＣＤＭ多重されていることを前提としたが、複数の移動端末のＡｃｋ/Ｎａｃｋ情報をＴＤＭ多重やＦＤＭ多重する方法もあり、そのような場合においても、実施の形態１で説明した発明を適用することは可能である。以上のようにすれば、Ｓ−ＲＡＣＨにて上り送信要求信号ＳＲのシンボルを割り当てた時間ー周波数領域と同じタイミングに割り当てた上りＡｃｋ/Ｎａｃｋシンボルが、上りスケジューリング要求信号ＳＲ送信期間中、変調・送信できない場合においても、無線リソースを効果的に利用し、かつ上りの通信品質を維持出来るという効果を得ることができる。

【００５８】

実施の形態３．

上記説明の実施の形態１では、Ｓ－ＲＡＣＨを用いて上りスケジューリング要求信号を送信している間、Ａｃｋ／Ｎａｃｋ専用チャネルを用いたＡｃｋ／Ｎａｃｋ信号の送信を停止することにより、２種類の帯域に割り当てた２つの物理チャネル（Ack/Nack専用チャネルとS-RACH）のデータを同時に送信するマルチキャリア方式を使用しないことにより、一時的な物理チャネルの増加による通信システムの無線リソース負荷の増加を防ぐとともに、低いＰＡＰＲを保証するシングルキャリア方式での送信を実現していた。以下、説明する実施の形態３では、Ａｃｋ／Ｎａｃｋと上りスケジューリング要求信号ＳＲを同じ物理チャネルを用いて送信することにより、より広いカバレッジと低いＰＡＰＲ（ピーク対平均電力比）を実現するＳＣ－ＦＤＭＡ方式で送信を実現する方法について説明する。

【００５９】

実施の形態３では、移動端末が、上りスケジューリング要求信号ＳＲをＳ－ＲＡＣＨではなく、Ａｃｋ／Ｎａｃｋ専用チャネルにマッピングして、送信を行うものである。上りスケジューリング要求信号ＳＲをＡｃｋ／Ｎａｃｋ専用チャネルで送信することにより、一時的な物理チャネルの増加による通信システムの無線リソース負荷の増加を防ぐとともに、低いＰＡＰＲを保証するシングルキャリア方式での送信を実現できる。これにより、ある移動端末で一時的に送信すべき制御信号（L1/L2 control signaling）が増えた場合にも、システムの無線リソース負荷の増加を防ぐとともに、低いＰＡＰＲと、高い通信品質を保証するシングルキャリア方式での送信を実現できる。

【００６０】
ここで、Ack/NacK専用チャネルはあらかじめ無線リソースがスケジュールされたスケジュールドチャネルである。前述したように、非特許文献４において同期ランダムアクセスＳＲＡをスケジュールドチャネルに割当てることが検討されていることは述べた。しかし、非特許文献４ではスケジュールドチャネルとしてどのようなチャネルを用いるか、また、物理的リソースとして時間ー周波数領域をどのように割当てるかについて、何も記載されていないため、通常のように、ＳＲＡにスケジューリングリクエストＳＲ専用の１bitの物理リソースを割当てたチャネルを設けた場合は、上りＡｃｋ／Ｎａｃｋと上りＳＲＡを同時に送信しなければならない状況が生じてしまい、それぞれの信号が時間的に同時に送信されてしまう。この場合、シングルキャリア伝送とはならずマルチキャリア伝送となってしまうためＰＡＰＲが高くなってしまう、という問題が生じる。
【００６１】
このような問題を解決するため、実施の形態３では、移動端末が、上りスケジューリング要求信号ＳＲを、Ack/Nack，CQIとともに、Ａｃｋ／Ｎａｃｋ専用チャネルにマッピングして、送信を行うものである。上りスケジューリング要求信号ＳＲをAck/Nack，CQIとともに、Ａｃｋ／Ｎａｃｋ専用チャネルで送信することにより、一時的な物理チャネルの増加による通信システムの無線リソース負荷の増加を防ぐとともに、低いＰＡＰＲを保証するシングルキャリア方式での送信を実現できる。これにより、ある移動端末で一時的に送信すべき制御信号（L1/L2 control signaling）が増えた場合にも、システムの無線リソース負荷の増加を防ぐとともに、低いＰＡＰＲと、高い通信品質を保証するシングルキャリア方式での送信を実現できる。
【００６２】
図１３は、上りスケジューリング要求信号を送信するまでの移動端末における処理を説明するフローチャートである。図１４は、Ａｃｋ／Ｎａｃｋ専用チャネルで送信する上りスケジューリング要求信号のマッピング例を説明した説明図である。以下、図１３を用いて、本発明の実施の形態３に係る移動端末の動作を説明する。なお、図１３において、図６と同一の符号は同一または相当部分を示すので説明は省略する。移動端末は、送信を行わず、下りデータのみを連続して受信すると同時に、上りにて、受信データに対するＡｃｋ／Ｎａｃｋを専用物理チャネルで送信している。Ａｃｋ／Ｎａｃｋ専用チャネルでは移動端末毎のＡｃｋ／Ｎａｃｋ情報がＣＤＭ、ＦＤＭ、ＴＤＭのいずれかの方法で多重されている。移動端末において、上りデータ送信要求が発生する（ST601）と、ST602において、下りデータの受信状況が確認される。本実施の形態では、下りデータを受信しているため、ＳＴ１３０１へ進み、Ａｃｋ／Ｎａｃｋ専用チャネルを用いて、Ａｃｋ／Ｎａｃｋ情報とともに、上りスケジューリング要求信号ＳＲ(preamble/message)を送信する。
【００６３】
ＳＴ１３０１における、上りスケジューリング要求信号ＳＲの送信から上りデータ送信までのシーケンスを示したものが、図８である。１回の上りスケジューリング要求信号ＳＲの情報サイズが小さく、送信期間が短い場合、上りスケジューリング要求信号ＳＲをＡｃｋ／Ｎａｃｋ専用チャネルで送信することは、無線リソース利用の効率化、及びＡｃｋ／Ｎａｃｋや上りスケジューリング要求信号ＳＲのようなサイズの小さいＬ１／Ｌ２制御信号送信（L1/L2 control signaling）の通信品質を確保するという２つの側面において非常に有効である。
【００６４】
図１１は、Ａｃｋ／Ｎａｃｋ専用チャネルと上りスケジューリング要求信号ＳＲ送信用のＳ－ＲＡＣＨに割り当てる無線リソースを説明する説明図である。図１４は、Ａｃｋ／Ｎａｃｋ専用チャネルで送信する上りスケジューリング要求信号のマッピング例を説明した説明図である。図１１のように、無線リソースは、複数の時間ー周波数領域に分割される。時間ー周波数領域において、時間軸は、サブフレーム(=0.5ms)単位で区切られ、周波数軸は、物理チャネルでの送信データ量に応じて異なる帯域で区切られる。本実施例での無線リソース割り当てでは、Ａｃｋ／Ｎａｃｋ専用チャネルは情報量が少ないため、通常

のデータ用物理チャネルよりも小さな周波数帯域（時間区分は同じ）の単位領域を用いている。

【００６５】

Ａｃｋ／Ｎａｃｋ専用チャネルにおける１サブフレーム長の時間ー周波数領域は、６つのロングブロックＬＢと言われるデータシンボルブロックと、ショートブロックＳＢといわれる物理チャネル同期用シンボルブロックから構成される。本実施の形態においては、上りスケジューリング要求信号ＳＲとＡｃｋ／Ｎａｃｋ情報とを１ＴＴＩ(=2サブフレーム)分の時間ー周波数領域内で、あらかじめ決めた位置関係で多重した際のシンボルマッピングの一例を示す。

【００６６】

図１４は、ＣＱＩとＡｃｋ／Ｎａｃｋ情報が多重されている場合において、これに上りスケジューリング要求信号ＳＲを更に割り当てる時のシンボルマッピング例である。ここでは、Ａｃｋ／Ｎａｃｋ、ＣＱＩ、上りスケジューリング要求信号ＳＲを多重するＡｃｋ／Ｎａｃｋ情報を１ＴＴＩ単位でマッピング、更新するものとする。まず、上りスケジューリング要求（UL scheduling request）は送信時間区間（TTI）長（=2サブフレーム長）の時間ー周波数領域で、先頭のシンボルブロック（LB1）にマッピングされる。上りスケジューリング要求信号ＳＲがマッピングされて送信されるのは、最速で１回/２サブフレームである。ＳＲシンボルの内容は１ビット長でリクエスト有／リクエスト無の情報となる。このビットの値設定については、次のような２つの設定例が考えられる。

【００６７】

第一の設定例は、上りスケジューリング要求信号ＳＲがない場合は、常に０を送信する。一方、図８のフローチャートにおいて移動端末が上りスケジューリング要求信号ＳＲを送信する場合は、「リクエスト有り(=’1’)」を送信し、次の送信時間区間（TTI）で０を送信するものである。受信エラーがなければ基地局から移動局に送信しているはずの“Uplink Data Resource Allocation”が届かない場合、移動端末は基地局側で受信エラーが発生したと判断し、再度上りスケジューリング要求信号ＳＲ「リクエスト有り＝(‘1)」を送信する。また、第二の設定例は、上りスケジューリング要求信号ＳＲがない場合は、第一の設定例と同様、常に０を送信する。一方、図８のフローチャートにおいて移動端末が上りスケジューリング要求信号ＳＲを送信する場合は、“Uplink Data Resource Allocation”が基地局から送信されるまで、「リクエスト有り(=’1’)」の送信を続け、“Uplink Data Resource Allocation”受信後、「リクエストなし(=’０’)を送信するものである。

【００６８】

上りスケジューリング要求信号ＳＲがマッピングされる送信時間区間（TTI）の先頭ＬＢ（LB1）以外のロングブロック（LB2～LB6）には、Ａｃｋ／ＮａｃｋシンボルとＣＱＩシンボルがマッピングされる。このマッピングでは、Ａｃｋ／Ｎａｃｋシンボルと、ＣＱＩシンボルの中でも優先順位の高い上位の桁のＣＱＩが優先して繰り返しマッピングされる。図１４では、１ＴＴＩ(=2サブフレーム)の中で、Ａｃｋ／Ｎａｃｋシンボルが３回、優先順位の高いＣＱＩ１とＣＱＩ２が２回、繰り返しマッピングされている。

【００６９】

上記説明のとおり、上りスケジューリング要求信号ＳＲの送信期間が、図８のシーケンスにあるように十分短い場合には、Ａｃｋ／Ｎａｃｋ専用チャネルに、上りスケジューリング要求信号ＳＲをＡｃｋ／Ｎａｃｋ情報シンボルとともにマッピングすることにより、一つの移動端末で同時に複数の送信すべき「データ付随なしのＬ１／Ｌ２制御信号」が発生した場合にも、これらの重要な制御信号の通信品質を確保しつつ、システムの無線リソース負荷の増加を防ぐことができ、低いＰＡＰＲと、高い通信品質を保証するシングルキャリア方式での送信を実現できる。

【００７０】

さらに、Ａｃｋ／Ｎａｃｋ専用チャネルは、Ｓ－ＲＡＣＨのような複数の移動端末による通信競合を許すチャネル（contention based channel）ではないので、この方法であれ

ば、Ｓ－ＲＡＣＨを用いる場合に比べ、上りスケジューリング要求信号ＳＲ送信で移動端末の識別番号（UE-ID）を送信する必要がないというメリットも得ることができる。

【００７１】

Ａｃｋ／Ｎａｃｋ専用チャネルは、移動端末が、上りデータ送信を行なっておらず、かつ、下りデータを連続して受信している状態において、既に使用しているチャネルである。従って、上りスケジューリング要求信号ＳＲを、Ack/Nack，CQIとともに、Ａｃｋ／Ｎａｃｋ専用チャネルにマッピングすることで、低いＰＡＰＲと、高い通信品質を保証するシングルキャリア方式での送信を実現できる効果に加えて、利用中の無線リソースを有効に利用できる、という利点がある。また、前述したように、Ａｃｋ／Ｎａｃｋ専用チャネルのようなスケジュールドチャネルでは、上りスケジューリング要求信号ＳＲ送信で移動端末の識別番号（UE-ID）を送信する必要がないというメリットも得ることができるため、基地局側での受信において、処理負荷を低減することができる。加えて、Ａｃｋ／Ｎａｃｋ専用チャネルは通常より狭い周波数帯域を割当てて使用するため、単位時間で処理が必要な情報量が少ない。従って、送受信双方での処理時間も短くなるため、上りスケジューリング要求信号ＳＲの送信から送信開始までのシーケンス（図7のST701～ST703、図８のST801～ST804）の処理遅延（Latency）が短くなり、通信システム全体の処理の効率化・高速化に貢献することができる。

【００７２】

実施の形態４．

移動端末がユーザデータ等の上りデータ(Uplink data、UL data)送信を行っていない場合であって、基地局から送信された下りデータ(Downlink data、DL data)を受信している場合、下りデータの受信結果であるＡｃｋ／Ｎａｃｋ信号を基地局に送信する必要がある。また、移動端末に上りデータ送信の必要が生じた場合には、上りスケジューリング要求信号ＳＲを基地局に送信する必要がある。以下、Ａｃｋ／Ｎａｃｋと上りスケジューリング要求信号ＳＲを同時に送信する必要が生じた移動端末が、ＰＡＰＲを増加させることなく、同時にそれらの送信を行う方法を説明する。実施の形態３ではスケジューリング要求信号ＳＲ、Ａｃｋ／ＮａｃｋをともにＡｃｋ／Ｎａｃｋ専用チャネルを用いて送信することで、低いＰＡＲＲと、高い通信品質を保証するシングルキャリア方式での送信を実現していたが、図１４に示すようにＡｃｋ／Ｎａｃｋ専用チャネル上にスケジューリング要求信号ＳＲの有無を示すシンボルをマッピングする必要があった。そのため、実施の形態３を用いて、Ack/Nack専用チャネルにＡｃｋ／Ｎａｃｋと上りスケジューリング要求信号ＳＲ（ＳＲ）をＴＤＭにて多重した場合以下２つの課題が新たに発生する。

【００７３】

第１の課題について説明する。ＳＲを送信する必要がない場合においても、ＳＲがマッピングするためのＬＢをあらかじめ割り当てなければならない。そのため、送信する必要がない情報に対して常に無線リソースを割り当てなければならない。よって無線リソースを有効に活用しているとは言えないという課題が発生する。第２の課題について説明する。Ａｃｋ／Ｎａｃｋ専用チャネルにＳＲをＴＤＭにて多重しない場合と比較して、Ａｃｋ／ＮａｃｋあるいはＣＱＩの繰り返し回数が減少するというデメリットが発生する。Ａｃｋ／ＮａｃｋおよびＣＱＩは、データのように誤り訂正能力の高いエンコードが施されない場合がほとんどである。よって基地局での受信エラーを防ぐために、同じ情報を繰り返して基地局での受信電力を稼ぐことは受信品質を高めるために重要である(repetition)。その繰り返しに用いることができるＬＢの数が減ることは基地局の受信品質を保つという意味において可能な限り避けるべきである課題が発生する。

【００７４】

上記新たな第１の課題及び第２の課題について解決する方法について以下説明する。図１５は、上りスケジューリング要求信号を送信する移動端末の処理と、受信した基地局の処理とを説明するフローチャートである。図１５は、移動端末が上りデータ送信を行っていない場合であって、下りデータを受信している場合の処理を示す。ＳＴ１５００において移動端末は、上りデータ送信の要求が発生したか否かを判断する。要求が発生していな

い場合は（ST1500でNo）、ＳＴ１５０１へ進む。ＳＴ１５０１において移動端末は、Ａｃｋ／Ｎａｃｋ専用チャネルにＡｃｋ／Ｎａｃｋ、ＣＱＩのいずれか一方または両方をマッピングする。マッピングの一例としては図９を用いることができる。ＳＴ１５０３において移動端末は、Ａｃｋ／Ｎａｃｋ専用チャネルにＡｃｋ／Ｎａｃｋ、ＣＱＩのいずれか一方または両方がマッピングされていることを示すコード(コードa)を乗算する。

【００７５】

このコード乗算は、変調部１０あるいはエンコーダ部９により実施される。コード乗算後、ＳＴ１５０５の処理が実行される。一方、ＳＴ１５００において要求が発生している場合は、ＳＴ１５０２の処理が実行される。ＳＴ１５０２では、移動端末は、Ａｃｋ／Ｎａｃｋ専用チャネルにＡｃｋ／Ｎａｃｋ、ＣＱＩのいずれか一方または両方がマッピングされているほか、上りスケジューリング要求信号ＳＲをマッピングする。マッピングの一例としては図１４を用いることができる。ＳＴ１５０４において移動端末は、Ａｃｋ／Ｎａｃｋ専用チャネルにＡｃｋ／Ｎａｃｋ、ＣＱＩのいずれか一方または両方と、上りスケジューリング要求信号ＳＲがマッピングされていることを示すコードａとは異なるコード(コードb)を乗算する。このコード乗算は、変調部１０あるいはエンコーダ部９により実施される。コード乗算後、ＳＴ１５０５の処理が実行される。コードａとコードｂは、基地局での判断の誤りを少なくするため、互いに直交したコードを用いた方が良い。

【００７６】

移動体通信システムにおいて、Ａｃｋ／Ｎａｃｋ専用チャネル内の複数の移動端末の多重にコード多重を用いていた場合、ＳＴ１５０５において、移動端末を識別するためのコード(コードA)を乗算する。このコード乗算は、変調部１０により実施される。コード乗算後ＳＴ１５０６が実施される。ＳＴ１５０５において移動端末を識別するためのコード(コードA)が乗算されることから、ＳＴ１５０３、ＳＴ１５０４で乗算されるコード(コードa、コードb)は、Ａｃｋ／Ｎａｃｋ専用チャネル内に多重される移動端末が共通して用いることが可能である。コードａとコードＡ、またコードｂとコードＡを乗算する順序は逆でも良い。ＳＴ１５０６において移動端末は基地局に対してＡｃｋ／Ｎａｃｋ専用チャネルを送信する。

【００７７】

ＳＴ１５０７において、基地局は、Ａｃｋ／Ｎａｃｋ専用チャネルにより送信された信号を受信する。そして、基地局は、Ａｃｋ／Ｎａｃｋ専用チャネルにより伝達された信号に含まれる、複数の移動端末からの信号の分離を行うとともに、Ａｃｋ／Ｎａｃｋ専用チャネル内の移動端末多重用に用いたコードを乗算する処理を行う。ＳＴ１５０８において、移動端末を示すコード(コードA)を用いて相関演算を行う。その結果が規定された閾値以上である場合は（ST1508でYes）、当該移動端末からのＡｃｋ／Ｎａｃｋ専用チャネルの受信とし、ＳＴ１５０９の処理を実行する。ＳＴ１５０８において行った相関演算の結果が規定された閾値未満である場合は（ST1508でNo）、当該移動端末からのACK/NACK専用チャネルの受信はないとして終了する。コードＡを用いた相関演算は、復調部２４により実施される。ＳＴ１５０９において、基地局は、当該移動端末からのＡｃｋ／Ｎａｃｋ専用チャネルにＡｃｋ／Ｎａｃｋ、ＣＱＩのみがマッピングされているか否かを判断するため、コードａを用いて相関演算を行う。その結果が規定された閾値以上である場合は（ST1509でYes）、当該移動端末からのACK/NACK専用チャネルにＡｃｋ／Ｎａｃｋ、ＣＱＩのみがマッピングされていると判断し（スケジューリング要求信号ＳＲはマッピングされていないと判断し）、ＳＴ１５１０の処理が実行される。コードaを用いた相関演算は、復調部２４あるいはデコーダ部２５により実施される。ＳＴ１５１０において基地局は、受信した当該移動端末からのＡｃｋ／Ｎａｃｋ専用チャネルにはＡｃｋ／Ｎａｃｋ、ＣＱＩのみがマッピングされているとして処理を行う。

【００７８】

一方、ＳＴ１５０９においてコードａを用いて相関演算を行った結果が規定された閾値未満である場合（ST1509でNo）、ST1511が実行される。ＳＴ１５１１において基地局は、当該移動端末からのＡｃｋ／Ｎａｃｋ専用チャネルにＡｃｋ／Ｎａｃｋ、ＣＱＩのほか、

スケジューリング要求信号ＳＲがマッピングされているか否かを判断するためにコードｂを用いて相関演算を行う。その結果が規定された閾値以上である場合（ST1511でYes）、当該移動端末からのＡｃｋ／Ｎａｃｋ専用チャネルにＡｃｋ／Ｎａｃｋ、ＣＱＩのほか、スケジューリング要求信号ＳＲがマッピングされていると判断し、ＳＴ１５１２の処理が実行される。コードｂを用いた相関演算は、復調部２４あるいはデコーダ部２５により実施される。ＳＴ１５１２において基地局は、受信した当該移動端末からのＡｃｋ／Ｎａｃｋ専用チャネルにはＡｃｋ／Ｎａｃｋ、ＣＱＩのほか、スケジューリング要求信号ＳＲがマッピングされているとして処理を行う。一方、ＳＴ１５１１においてコードｂを用いて相関演算を行った結果が規定された閾値未満である場合（ST1511でNo）、なんらかの受信エラーが発生したとして終了する。

【００７９】

上記説明のとおり、移動端末は、Ａｃｋ／Ｎａｃｋ専用チャネルにＡｃｋ／Ｎａｃｋ、ＣＱＩのほか、スケジューリング要求信号ＳＲがマッピングされている場合とされていない場合で異なるコードを乗算することにより、Ａｃｋ／Ｎａｃｋ専用チャネル内にてスケジューリング要求信号ＳＲ用のシンボルをリザーブする必要がなくなる。例えば、スケジューリング要求信号ＳＲは、図１４に示す一番最初のロングブロックＬＢ１にマッピングされるが、スケジューリング要求信号ＳＲが送信されていない場合には、ＬＢ１にＡｃｋ／Ｎａｃｋ、ＣＱＩ等をマッピングすることが可能である。また、乗算されているコードによって、基地局は、所定の移動端末からの信号がスケジューリング要求信号ＳＲを含んでいるか容易に識別できるので、スケジューリング要求信号ＳＲがマッピングされている場合とされていない場合で、適切な処理を行うことが可能である。

【００８０】

従来技術であるＷ－ＣＤＭＡにおいては移動端末から同時に送信される複数のチャネルを分離するためにチャネル毎に異なるコード（チャネライゼーションコード）が乗算され、移動端末から基地局に対して複数のチャネルが同時に送信される。一方実施の形態４においてはコードにより送信する情報（「Ａｃｋ／Ｎａｃｋ，ＣＱＩ」あるいは「Ａｃｋ／Ｎａｃｋ，ＣＱＩ，ＳＲ」）の種類を分離するためにコードを用いる。本実施の形態４においては移動端末から基地局に対して「Ａｃｋ／Ｎａｃｋ，ＣＱＩ」あるいは「Ａｃｋ／Ｎａｃｋ，ＣＱＩ，ＳＲ」のどちらかが送信され、コードにより分離された「Ａｃｋ／Ｎａｃｋ，ＣＱＩ」「Ａｃｋ／Ｎａｃｋ，ＣＱＩ，ＳＲ」が同時に送信されることはない。上記点において、同時に送信される複数のチャネルを分離するためにコードを用いる従来技術（Ｗ－ＣＤＭＡ）と実施の形態４は異なる。

【００８１】

実施の形態４を用いることにより、実施の形態３を用いる場合と同様に以下の効果を得ることが出来る。上りデータ送信を行っていない場合であって、下りデータを受信している場合に、Ａｃｋ／Ｎａｃｋとともに上りスケジューリング要求信号ＳＲを送信する必要が生じた移動端末が移動端末内のＰＡＰＲを増加させることなく、同時にそれらの送信を行うことが出来るという効果を得ることが出来る。また、Ａｃｋ／Ｎａｃｋ専用チャネルによりスケジューリング要求信号ＳＲを送信することにより、ＳＲにＵＥ－ＩＤを付加する必要がないという効果を得ることが出来る。よってＳＲの送信頻度が高い場合は、ＳＲを送信するための必要ビット数が小さいために有効な手段であるといえる。更に、Ａｃｋ／Ｎａｃｋ専用チャネルは図２４に示すように分離した狭帯域の複数の時間-周波数領域（図２４　Ａ，Ｂ）が割り当てられる。これによりＡｃｋ／Ｎａｃｋ専用チャネルにてスケジューリング要求信号ＳＲを送信することにＳＲは周波数選択性フェージングに強くなる。言い換えれば、ＳＲは周波数ダイバーシチゲインを得ることが可能となる。

【００８２】

実施の形態４を用いることにより、実施の形態３を用いる場合の効果に加えて、以下の効果を得ることが出来る。移動端末内にてＳＲが発生していない場合において、Ａｃｋ／Ｎａｃｋ専用チャネル内のＳＲを送信するためのあらかじめ割り当てられたＬＢが不要となり、無線リソースを有効に活用することが可能となる。更に、ＳＲをマッピングするた

めの割り当てが不要になるために、移動端末内にてＳＲが発生していない場合は、従来のＡｃｋ／Ｎａｃｋ専用チャネル内のＡｃｋ／Ｎａｃｋ あるいはＣＱＩの繰り返し回数を減らす必要がなくなり、Ａｃｋ／Ｎａｃｋ あるいはＣＱＩの基地局での受信品質向上という効果を得ることが可能となる。更に、上りデータ送信を行なっておらず、かつ、下りデータを受信している場合のＳＲはＳ－ＲＡＣＨではなくＡｃｋ／Ｎａｃｋ専用チャネルを用いて移動端末から基地局に対して送信するとした場合、Ｓ－ＲＡＣＨのためにあらかじめ割り当てられていた無線リソース(周波数-時間領域)をＵＬ－ＳＣＨなどに開放することが可能となり、無線リソースの有効活用という意味においても効果的である。

【００８３】

以下、変形例を説明する。第１の変形例としては、Ａｃｋ／Ｎａｃｋ専用チャネルにＡｃｋ／Ｎａｃｋ、ＣＱＩのみがマッピングされているか否かを判断するためにコードａあるいは、上りスケジューリング要求信号ＳＲがさらにマッピングされていることを示すコードｂのいずれか一方のみを利用することが考えられる。具体例としては、移動端末において、Ａｃｋ／Ｎａｃｋ専用チャネルにＡｃｋ／Ｎａｃｋ、ＣＱＩのみがマッピングされる場合はコードａを乗算し、Ａｃｋ／Ｎａｃｋ、ＣＱＩのほか、上りスケジューリング要求信号ＳＲがマッピングされている場合には、コードｂを乗算せずに(ST1504を省略する)、ＳＴ１５０５の処理を実行する。基地局は、ＳＴ１５０９においてコードaを用いて相関演算を行う。その結果が規定された閾値以上である場合は、Ａｃｋ／Ｎａｃｋ、ＣＱＩのみがマッピングされていると判断しＳＴ１５１０へ進む。一方、ＳＴ１５０９の相関演算を行った結果が規定された閾値未満である場合、Ａｃｋ／Ｎａｃｋ、ＣＱＩのほか、上りスケジューリング要求信号ＳＲがマッピングされていると判断し、ＳＴ１５１２が実行される。この第1の変形例を用いるとコード数を削減することができ、移動端末内のコードを乗算する処理、基地局内のコードを用いて相関演算を行う処理を削減することが可能となる。

【００８４】

また、第２の変形例としては、Ａｃｋ／Ｎａｃｋ専用チャネルに多重される移動端末ごとにＡｃｋ／Ｎａｃｋ専用チャネルにＡｃｋ／Ｎａｃｋ、ＣＱＩのみ、あるいは、Ａｃｋ／Ｎａｃｋ、ＣＱＩのほか上りスケジューリング要求信号ＳＲがマッピングされていることを示す二つのコード(コードA、コードB)を割り当てることが考えられる。具体例としては、移動端末において、Ａｃｋ／Ｎａｃｋ専用チャネルにＡｃｋ／ＮａｃｋとＣＱＩのみがマッピングされる場合はコードＡを乗算し(ST1503)、Ａｃｋ／Ｎａｃｋ、ＣＱＩのほか上りスケジューリング要求信号ＳＲがマッピングされる場合にはコードＢを乗算し(ST1504)、ＳＴ１５０６へ進む。つまり移動端末ごとに割り当てられたコードを用いるために、ＳＴ１５０５において移動端末を示すコードを更に乗算する必要はなくなる。基地局は、ＳＴ１５０８において、当該移動端末を示すコード(コードA)を用いて相関演算を行う。その結果が規定された閾値以上である場合は、当該移動端末からＡｃｋ／Ｎａｃｋ、ＣＱＩのみがマッピングされていると判断し、ＳＴ１５１０へ進む。更にＳＴ１５０８において当該移動端末を示すコード(コードB)を用いて相関演算を行う。その結果が規定された閾値以上である場合は、Ａｃｋ／Ｎａｃｋ、ＣＱＩのほか上りスケジューリング要求信号ＳＲがマッピングされていると判断し、ＳＴ１５１２へ進む。つまり、図１５のステップのうち、ＳＴ１５０９とＳＴ１５１１を省略することが可能となる。

【００８５】

また、実施の形態４では、Ａｃｋ／Ｎａｃｋ専用チャネルに、Ａｃｋ／Ｎａｃｋ、ＣＱＩのみがマッピングされていることを示すコードａか、Ａｃｋ／Ｎａｃｋ、ＣＱＩのほか、上りスケジューリング要求信号ＳＲがマッピングされていることを示すコードｂのどちらかがＡｃｋ／Ｎａｃｋ専用チャネル全体に乗算されている。第３の変形例では、Ａｃｋ／Ｎａｃｋ専用チャネル上のＡｃｋ／ＮａｃｋとＣＱＩがマッピングされているロングブロックにはそれを示すコードaを乗算し、Ａｃｋ／Ｎａｃｋ専用チャネル上の上りスケジューリング要求信号ＳＲがマッピングされているロングブロックにはそれを示すコードｂを乗算する。具体的には、図１５のステップのうち、ＳＴ１５０２を省略し、その代わり

に、Ａｃｋ／Ｎａｃｋ専用チャネル上のＡｃｋ／ＮａｃｋとＣＱＩがマッピングされているロングブロックにはそれを示すコードaを乗算し、Ａｃｋ／Ｎａｃｋ専用チャネル上の上りスケジューリング要求信号ＳＲがマッピングされているロングブロックにはそれを示すコードｂを乗算するステップを追加する。また、基地局により実行されるステップのうち、ＳＴ１５０９、ＳＴ１５１０、ＳＴ１５１１、ＳＴ１５１２を省略し、その代わりに、Ａｃｋ／ＮａｃｋとＣＱＩがマッピングされているロングブロックであるか否かを判断するためにコードａを用いて相関演算を行う処理を追加する。相関演算の結果が規定された閾値以上である場合は、基地局は、Ａｃｋ／ＮａｃｋとＣＱＩがマッピングされたロングブロックであると判断し、その後の処理を行う。相関演算の結果が閾値未満である場合は、上りスケジューリング要求信号ＳＲがマッピングされているロングブロックであるかを判断するため、コードｂを用いて相関演算を行う。相関結果が閾値以上である場合は、上りスケジューリング要求信号ＳＲがマッピングされたロングブロックであると判断し、その後の処理を行う。この場合、実施の形態４による効果に加えて、Ａｃｋ／Ｎａｃｋ専用チャネル上に上りスケジューリング要求信号ＳＲをマッピングするロングブロックの場所が自由に選べるという効果を得ることが出来る。

【００８６】

また、第４の変形例を以下に説明する。Ack/Nack専用チャネルのマッピングはSRを含むか否かに関わらず1種類とする。そのマッピングは例えば図9を用いることが出来る。よってST1501，ST1502においてAck/Nack専用チャネルに実際にマッピングされるのはAck/Nack or/and CQIのみとなる。以降の移動端末内の処理は図15と同様であるために説明を省略する。Ack/Nack専用チャネルを受信した基地局においては、ST1510において当該移動端末からのSRは無しとして、Ack/Nack専用チャネルの処理はAck/Nack or/and CQIのみがマッピングされているとして処理を行う。また、ST1512において当該移動端末からのSRは有りとして、Ack/Nack専用チャネルの処理はAck/Nack or/and CQIのみがマッピングされているとして処理を行う。図２７は、実施の形態４の第４の変形例のＡｃｋ／Ｎａｃｋ専用チャネルのマッピング例を説明した説明図である。この実施の形態４の第４の変形例にてAck/Nack専用チャネル内のSRをマッピングする必要がなくなり、更なる無線リソースの有効活用が可能となる。また移動端末から上りスケジューリング要求信号ＳＲを送信する場合であってもAck/Nack or/and CQIの繰り返し回数を維持することが出来るために、ＳＲ有りを送信する場合であっても基地局でのAck/Nack or/and CQIの受信品質をＳＲ無しの場合と同様の品質に維持することが出来るという効果を得ることが可能となる。なお、上記説明は、Ａｃｋ／Ｎａｃｋ専用チャネル内の複数の移動端末の多重方法がＣＤＭで行われた場合について説明したが、多重方法にＦＤＭ、ＴＤＭが用いられた場合にも適応可能である。本実施の形態４及びその変形例については、図２４に示すような分離した狭帯域の複数の時間-周波数領域を独占的に割り当てられたＡｃｋ／Ｎａｃｋ専用チャネルについて説明した。しかし本実施の形態４及びその変形例については、図２３に示すような狭帯域ではないＡｃｋ／Ｎａｃｋ専用チャネルにおいても適応することが可能である。

【００８７】

実施の形態５．

図１６は、上りスケジューリング要求信号を送信する移動端末の処理と、受信した基地局の処理とを説明するフローチャートである。ＳＴ１６０１において移動端末は、上りデータ送信中あるいは上りデータ送信開始であるか否かを判断する。上りデータ送信中である場合、ＳＴ１６０２へ進む。上りデータ送信中、つまり基地局より上りリソースをスケジューリングされている移動端末においては、上りスケジューリング要求信号ＳＲを送信する必要はないため、ＳＴ１６０１にて上りデータ送信中である場合には、ＳＴ１６０４の判断を経由せずにＳＴ１６０２へ進むという処理が可能である。言い換えれば、１つの移動端末においては、ＵＬ－ＳＣＨにて上りデータと上りスケジューリング要求信号ＳＲが並存することはなく、ＳＣ－ＦＤＭＡの関係を満たし移動端末内のＰＡＰＲの増加をもたらすことはないと考えられる。

【００８８】

ＳＴ１６０２において、移動端末は、ＵＬ－ＳＣＨへマッピングされているシンボルが上りデータであることを示すコード(コードc)を乗算する。このコード乗算は、変調部１０あるいはエンコーダ部９により実施される。コードｃ乗算後ＳＴ１６０３へ進む。ＳＴ１６０３において、上りデータを基地局よりスケジューリングされたＵＬ－ＳＣＨ中のリソースに対してマッピングし、ＳＴ１６０７へ進む。一方、ＳＴ１６０１において上りデータ送信中でない場合、ＳＴ１６０４へ進む。ＳＴ１６０４において上りデータ送信の要求が発生したか否かを判断する。要求が発生していない場合は、ＳＴ１６０１へ戻る。要求が発生している場合は、ＳＴ１６０５へ進む。ＳＴ１６０５においてＵＬ－ＳＣＨにマッピングされているシンボルが上りスケジューリング要求信号ＳＲであることを示すコード(コードd)を乗算する。このコード乗算は、変調部１０あるいはエンコーダ部９により実現される。コードｄ乗算後ＳＴ１６０６へ進む。ＳＴ１６０６において、上りスケジューリング要求信号ＳＲ(resource request、preamble、messageなど)をＵＬ－ＳＣＨ中のリソースに対してマッピングし、ＳＴ１６０７へ進む。コードｃとコードｄは、基地局での判断の誤りを少なくするために、直交したコードを用いた方が良い。

【００８９】

ＳＴ１６０７において移動端末は基地局に対してＵＬ－ＳＣＨの送信を行う。ＳＴ１６０８において、基地局は移動端末から送信されたＵＬ－ＳＣＨの受信を行う。ＳＴ１６０９において基地局は、ＵＬ－ＳＣＨに上りデータがマッピングされているか否かを判断するためにコードcを用いて相関演算を行う。その結果が規定された閾値以上である場合は、ＵＬ－ＳＣＨに上りデータがマッピングされていると判断しＳＴ１６１０へ進む。コードcを用いた相関演算は、復調部あるいはデコーダ部により実現される。ＳＴ１６１０において基地局は、ＵＬ－ＳＣＨに上りデータがマッピングされているとして処理を行う。一方ＳＴ１６０９において、コードcを用いて相関演算を行った結果が規定された閾値未満である場合は、ＳＴ１６１１へ進む。ＳＴ１６１１において基地局は、ＵＬ－ＳＣＨに上りスケジューリング要求信号ＳＲがマッピングされているか否かを判断するため、コードｄを用いて相関演算を行う。その結果が規定された閾値以上である場合は、ＵＬ－ＳＣＨに上りスケジューリング要求信号ＳＲがマッピングされていると判断しＳＴ１６１２へ進む。コードｄを用いた相関演算は、復調部２４あるいはデコーダ部２５により実現される。ＳＴ１６１２において基地局は、ＵＬ－ＳＣＨに上りスケジューリング要求信号ＳＲがマッピングされているとして処理を行う。

【００９０】

上記説明のとおり、ＲＡＣＨ(Non-S-RACH、S-RACH)送信用に無線リソースをリザーブしておく必要がなくなるという効果を奏する（図１７）。よって上り無線リソースを効率的に使用できるという効果を得る。また、移動端末が上りスケジューリング要求信号ＳＲの送信要求が発生した場合、従来の方法ではＲＡＣＨ(Non-S-RACH、S-RACH)用にリザーブされていた上りリソースタイミングまで基地局に対してSRを送信することが出来なかったが、いつでも移動端末から基地局に対して上りスケジューリング要求信号ＳＲを送信することが可能となる。よって移動体通信システムとしての制御遅延を削減できるという効果を得る。

【００９１】

また、上記説明の実施の形態５は、移動端末が、上りデータ送信を行っていない場合であって、下りデータを受信している場合、上りにて下りデータ用のＡｃｋ／Ｎａｃｋ送信と上りデータ(UL-SCH)の多重方法にも適応可能である。移動体通信システムとしての動作は、図１６のフローチャートで示す処理と同様であるために省略する。実施の形態５と同様、１つの移動端末においては、ＵＬ－ＳＣＨ内にて上りデータと上りデータ送信を行っていない場合であって、下りデータを受信している場合のACK/NACK送信が並存することはなく、ＳＣ－ＦＤＭＡの関係を満たし移動端末内のＰＡＰＲの増加をもたらすことはないと考えられる。効果としては、上りデータ送信を行っていない場合であって、下りデータを受信している場合、上りにて下りデータ用のＡｃｋ／Ｎａｃｋ送信用にＡｃｋ／Ｎａｃｋ専用チャネル（図２３、図２４）を設ける必要がなくなることである。さらに、Ａｃｋ

／Ｎａｃｋ専用チャネルのために割り当てられていた無線リソースをＵＬ－ＳＣＨなどに開放することが可能となる。よって上り無線リソースを効率的に使用できるという効果を得る。

【００９２】

実施の形態６．

移動端末がユーザデータ等の上りデータ(Uplink data、UL data)送信を行っていない場合であって、基地局から送信された下りデータ(Downlink data、DL data)を受信している場合、下りデータの受信結果であるＡｃｋ／Ｎａｃｋ信号を基地局に送信する必要がある。また、移動端末に上りデータ送信の必要が生じた場合には、上りスケジューリング要求信号ＳＲを基地局に送信する必要がある。Ａｃｋ／Ｎａｃｋと上りＳＲを同時に送信する必要が生じた移動端末が移動端末内のＰＡＰＲを増加させることなく、同時にそれらの送信を行う方法を説明する。

【００９３】

非特許文献１にて上りデータ送信を行なっておらず、かつ、下りデータを受信している場合のAck/Nack or/and CQIは図23に示すような広帯域のAck/Nack専用チャネルで送信されることが開示されている。非特許文献４にて上りデータ送信を行なっておらず、かつ、下りデータを受信している場合のSRをS-RACHにて送信することが開示されている。しかし上記2つの非特許文献２及び非特許文献４には、本発明の課題についての示唆はない。本発明の課題について繰り返しになるが以下に説明する。Ａｃｋ／Ｎａｃｋ専用チャネルを用いて上りＡｃｋ／ＮａｃｋやＣＱＩを送信する処理と、Ｓ－ＲＡＣＨを用いてＳＲＡを送信する処理とを同時に実行しなければならない場合が生じる。この場合、それぞれの信号は無相関であるため、時間的に同時に送信されるとシングルキャリア伝送とはならずマルチキャリア伝送となってしまう。無相関の信号が時間的に同時に送信される場合、送信信号の時間波形のピークが高くなるため、ＰＡＰＲが高くなってしまう。ＰＡＰＲが高くなると、移動端末の消費電力が増大し、さらにはセルカバレッジが狭くなってしまうという問題が生じる。さらには、ＰＡＰＲが高くなることにより、ほかの移動端末やシステムへの妨害波となってしまうという問題も生じる。

【００９４】

上りAck/Nack，CQIとSRAを同時に送信しなければならない場合、移動端末内のPAPRの増加を抑えるためにSC-FDMAはシングルキャリア伝送にすべきである。

従来技術に開示されている広帯域のAck/Nack専用チャネルにて送信されるAck/Nack or/and CQIとS-RACHにて送信されるSRをそのまま用いた場合は、移動端末がそれぞれの情報を同時に送信する必要が発生する場合が考えられる。

そのため、本実施の形態4ではAck/Nack or/and CQIとSRを、ある一つの時間－周波数領域が独占的に割り当てられたＡｃｋ／Ｎａｃｋ専用チャネル、もしくはＳ－ＲＡＣＨのどちらか一つのチャネルで多重することを提示する。

【００９５】

その多重方法について以下に説明する。上りスケジューリング要求信号ＳＲ、Ａｃｋ／Ｎａｃｋをともに、図２３に示すようなある一つの時間－周波数領域が独占的に割り当てられたＡｃｋ／Ｎａｃｋ専用チャネル、もしくは図２５に示すようなＳ－ＲＡＣＨのどちらか一方で送信する方法を説明する。Ａｃｋ／Ｎａｃｋ専用チャネルとＳ－ＲＡＣＨはどちらも、時間的にはサブフレーム単位、周波数的には１リソースユニット単位もしくはそれ以上の領域が割り当てられているため、どちらのチャネルでも本発明が適用可能となるのである。本実施の形態では、Ａｃｋ／Ｎａｃｋと上りスケジューリング要求信号ＳＲを同時に送信する必要が生じた場合、Ａｃｋ／Ｎａｃｋと上りスケジューリング要求信号ＳＲをともにＳ－ＲＡＣＨで送信する場合について示す。言い換えれば、下りデータを受信しＡｃｋ／Ｎａｃｋを送信する必要がある移動端末であっても、上りスケジューリング要求信号ＳＲ送信を行っている期間は、Ａｃｋ／Ｎａｃｋ専用チャネルを用いないことを意味する。さらに、上りスケジューリング要求信号ＳＲの送信を行っている期間は、ＣＱＩの送信、あるいはＡｃｋ／Ｎａｃｋ送信及びＣＱＩをＳ－ＲＡＣＨを用いて送信し、Ａｃ

ｋ／Ｎａｃｋ専用チャネルを用いないようにしても良い。

【００９６】

図１８は、上りスケジューリング要求信号を送信するまでの移動端末における処理を説明するフローチャートである。以下、図１８を用いて移動端末の動作を説明する。なお、図１８において、図６と同一のステップは同一または相当のステップを示すので説明は省略する。ＳＴ６０１からＳＴ６０３は図６と同様のステップである。ＳＴ６０２において下りデータ受信中であった場合、ＳＴ１８０１が実行される。ＳＴ１８０１において、移動端末は上りスケジューリング要求信号ＳＲとＡｃｋ／ＮａｃｋをＳ－ＲＡＣＨ上にマッピングして基地局に対して送信する。移動体通信システムとしての処理は、図７、８と同様であるため、説明を省略する。

【００９７】

次にＳ－ＲＡＣＨ上のマッピング方法について以下に説明する。第一のマッピング方法としては、Ｓ－ＲＡＣＨ上にプレアンブルとメッセージ、Ａｃｋ／Ｎａｃｋ、ＣＱＩをマッピングする。図１９は、Ｓ－ＲＡＣＨ上にプレアンブルとメッセージ、Ａｃｋ／Ｎａｃｋ、ＣＱＩをマッピングした無線リソースを示す説明図である。第二のマッピング方法としては、Ｓ－ＲＡＣＨ上にプレアンブル、Ａｃｋ／Ｎａｃｋ、ＣＱＩをマッピングする。上りスケジューリング要求信号ＳＲに必要なメッセージ情報は、次のＳ－ＲＡＣＨ送信タイミングにて送信するか、あるいは、基地局により割り当てられた上りリソースにより送信する。図２０は、Ｓ－ＲＡＣＨ上にプレアンブルとメッセージ、Ａｃｋ／Ｎａｃｋ、ＣＱＩをマッピングした無線リソースを示す説明図である。第三のマッピング方法としては、従来通りＳ－ＲＡＣＨ上にプレアンブル、メッセージをマッピングするものである。上りリンクの時間同期が取れている状態で送信されるＳ－ＲＡＣＨ上のメッセージ内にＡｃｋ／Ｎａｃｋ、ＣＱＩを新たに追加する。図２１は、Ｓ－ＲＡＣＨ上にプレアンブルとメッセージ、Ａｃｋ／Ｎａｃｋ、ＣＱＩをマッピングした無線リソースを示す説明図である。

【００９８】

上記説明のとおり、Ａｃｋ／Ｎａｃｋ専用チャネルではなくＳ－ＲＡＣＨに上りスケジューリング要求信号ＳＲをＡｃｋ／Ｎａｃｋ情報シンボルを時間的に分離してマッピングすることにより、時間的に分離して送信するために同時に送信することにはならない。よって一つの移動端末で同時に複数の送信すべき「データ付随なしのＬ１／Ｌ２制御信号」が発生した場合にも、これらの重要な制御信号の通信品質を確保しつつ、システムの無線リソース負荷の増加を防ぐことができ、低いＰＡＲＲと、高い通信品質を保証するシングルキャリア方式での送信を実現できる。

【００９９】

更に分離した狭帯域の複数の時間-周波数領域にてＡｃｋ／Ｎａｃｋ，ＣＱＩを送信する場合と比較して、図２３に示すようなある一つの時間－周波数領域が独占的に割り当てられたＡｃｋ／Ｎａｃｋ専用チャネル、もしくは図２５に示すようなＳ－ＲＡＣＨのどちらか一方でＡｃｋ／Ｎａｃｋ，ＣＱＩを送信する本実施の形態の方法の場合、帯域幅が大きくなる。よって独占的に割り当てた無線リソースにより送信可能な情報量が増えることになる。よって通信路の環境に応じて、Ａｃｋ／Ｎａｃｋ，ＣＱＩの繰り返しパターン（回数など）を変更できるという効果を得ることが出来る。繰り返しパターンを通信路の環境に応じて基地局からの指示により変更することで、Ａｃｋ／Ｎａｃｋ，ＣＱＩの受信品質を通信路の環境によらず一定に保つことが可能となる。

【図面の簡単な説明】

【０１００】

【図１】ＬＴＥにおける移動通信システムの構成を示す説明図である。

【図２】ＬＴＥの通信システムで使用されるチャネルの構成を示す説明図である。

【図３】移動端末の構成を示すブロック図である。

【図４】基地局の構成を示すブロック図である。

【図５】Ａｃｋ／Ｎａｃｋ専用チャネルと上りスケジューリング要求信号ＳＲ送信用

のＳ－ＲＡＣＨに割り当てる無線リソースを説明する説明図である。
【図６】上りスケジューリング要求信号を送信するまでの移動端末における処理を説明するフローチャートである。
【図７】上りスケジューリング要求信号送信から上りデータ送信開始までの一連の処理を説明するフローチャートである。
【図８】上りスケジューリング要求信号送信から上りデータ送信開始までの一連の処理を説明するフローチャートである。
【図９】Ａｃｋ／Ｎａｃｋ専用チャネルで送信するＡｃｋ／Ｎａｃｋシンボルのマッピング例を説明した説明図である。
【図１０】Ａｃｋ／Ｎａｃｋ専用チャネルで送信するＡｃｋ／Ｎａｃｋシンボルのマッピング例を説明した説明図である。
【図１１】Ａｃｋ／Ｎａｃｋ専用チャネルと上りスケジューリング要求信号ＳＲ送信用のＳ－ＲＡＣＨに割り当てる無線リソースを説明する説明図である。
【図１２】Ａｃｋ／Ｎａｃｋ専用チャネルで送信するＡｃｋ／Ｎａｃｋシンボルのマッピング例を説明した説明図である。
【図１３】上りスケジューリング要求信号を送信するまでの移動端末における処理を説明するフローチャートである。
【図１４】Ａｃｋ／Ｎａｃｋ専用チャネルで送信する上りスケジューリング要求信号のマッピング例を説明した説明図である。
【図１５】上りスケジューリング要求信号を送信する移動端末の処理と、受信した基地局の処理とを説明するフローチャートである。
【図１６】上りスケジューリング要求信号を送信する移動端末の処理と、受信した基地局の処理とを説明するフローチャートである。
【図１７】ＵＬ－ＳＣＨとＲＡＣＨの無線リソース割り当てを示す説明図である。
【図１８】上りスケジューリング要求信号を送信するまでの移動端末における処理を説明するフローチャートである。
【図１９】Ｓ－ＲＡＣＨ上にプレアンブルとメッセージ、Ａｃｋ／Ｎａｃｋ、ＣＱＩ、ＳＲをマッピングした無線リソースを示す説明図である。
【図２０】Ｓ－ＲＡＣＨ上にプレアンブルとメッセージ、Ａｃｋ／Ｎａｃｋ、ＣＱＩ、ＳＲをマッピングした無線リソースを示す説明図である。
【図２１】Ｓ－ＲＡＣＨ上にプレアンブルとメッセージ、Ａｃｋ／Ｎａｃｋ、ＣＱＩ、ＳＲをマッピングした無線リソースを示す説明図である。
【図２２】上りＬ１／Ｌ２制御信号を説明する説明図である。
【図２３】上りデータ送信を行っているとき、あるいは行っていないときにＡｃｋ／Ｎａｃｋ、ＣＱＩを割り当てた無線リソースを示す説明図である。
【図２４】Ａｃｋ／Ｎａｃｋ専用チャネルにＡｃｋ／Ｎａｃｋ、ＣＱＩを割り当てた無線リソースを示す説明図である。
【図２５】Ｓ－ＲＡＣＨに上りスケジューリング要求信号を割り当てた無線リソースを示す説明図である。
【図２６】上りデータ送信が行われていない場合のＡｃｋ／ＮａｃｋとＳＲＡが同時に送信される場合の一例を示す説明図である。
【図２７】Ａｃｋ／Ｎａｃｋ専用チャネルで送信する上りスケジューリング要求信号のマッピング例を説明した説明図である。

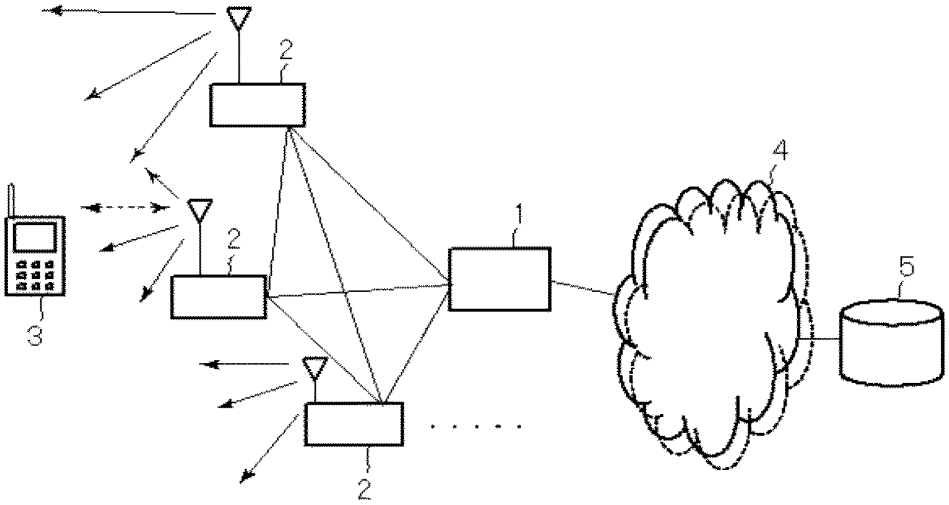
【符号の説明】

【０１０１】

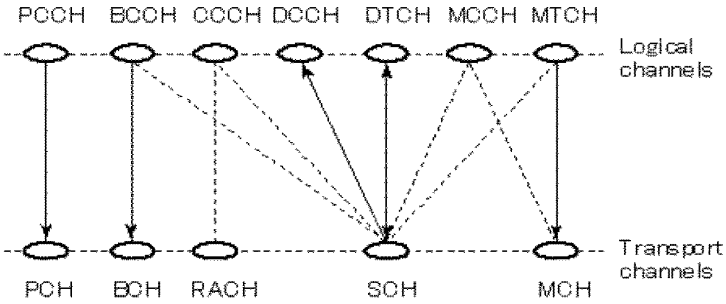
１　ａＧＷ、２　基地局、３　移動局、４　パケットデータネットワーク、
５　サービスセンタ、６　プロトコル処理部、７　アプリケーション部、
８　送信データバッファ部、９　エンコーダ部、１０　変調部、１１　周波数変換部、１２　アンテナ、１３　復調部、１４　デコード部、１５　制御部、
１６　ａＧＷ通信部、１７　他基地局通信部、１８　プロトコル処理部、

１９　送信データバッファ部、２０　エンコーダ部、２１　変調部、
２２　周波数変換部、２３　アンテナ、２４　復調部、２５　デコーダ部、
２６　制御部

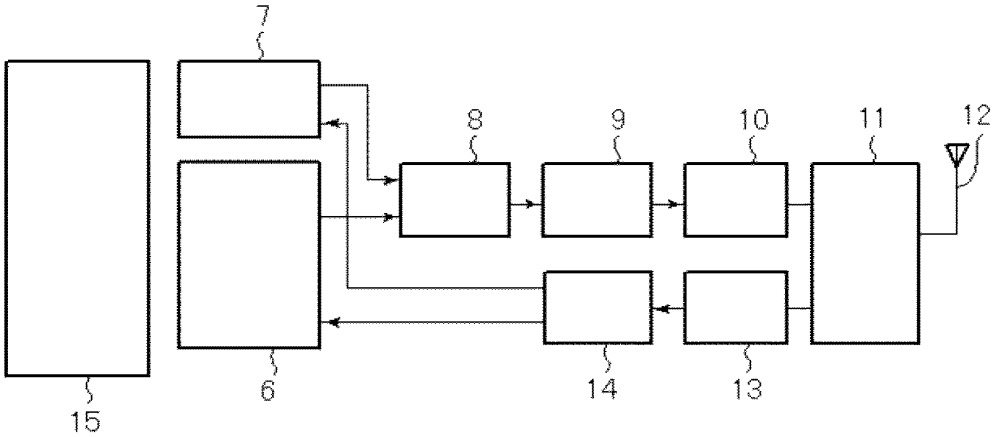
【書類名】図面
【図１】


2
2
2
1
3
4
5

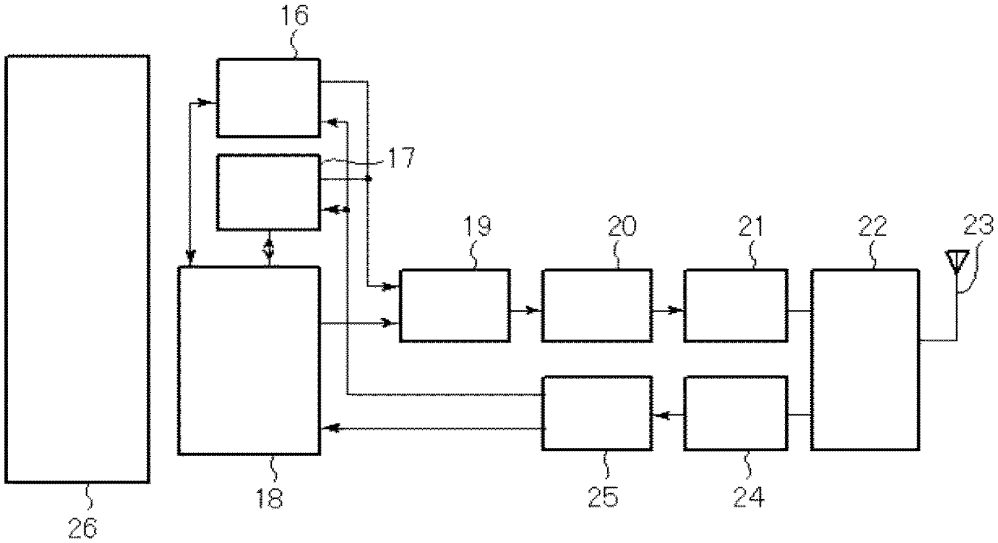
【図２】


PCCH
BCCH
CCCH
DCCH
DTCH
MCCH
MTCH
Logical channels
Transport channels
PCH
BCH
RACH
SCH
MCH

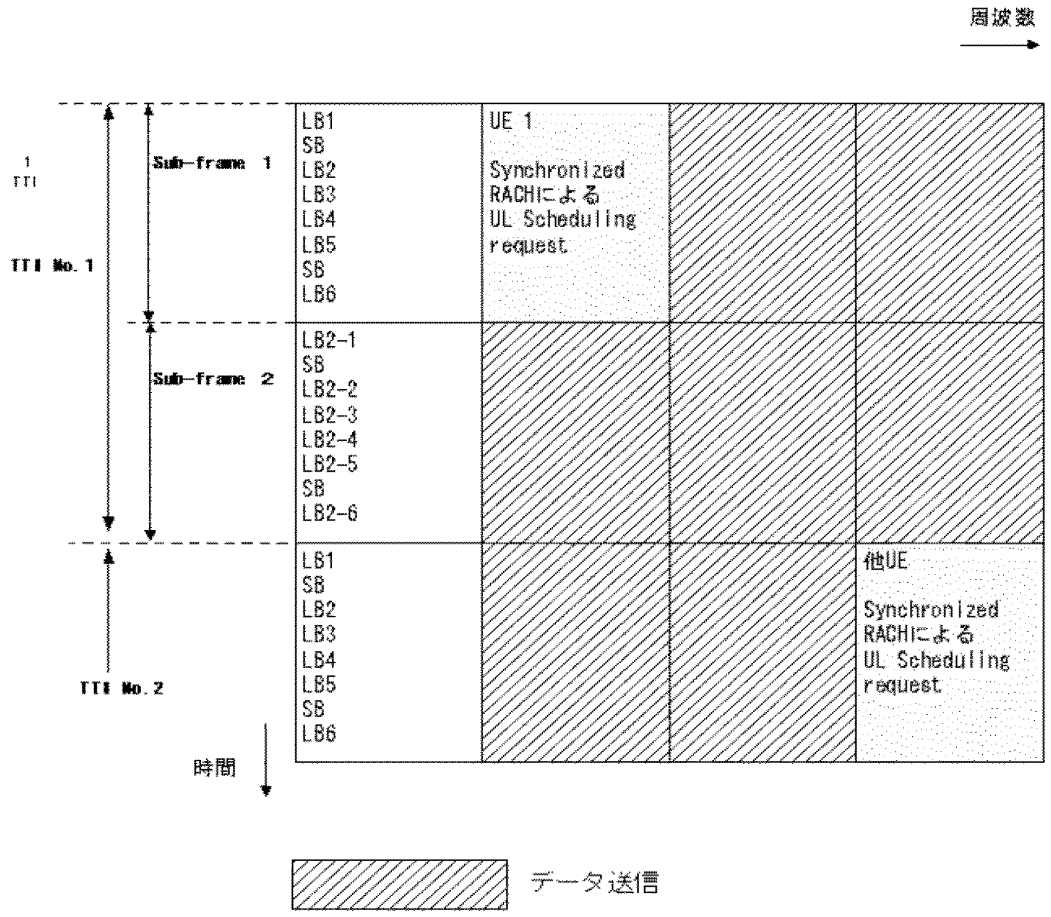
【図３】



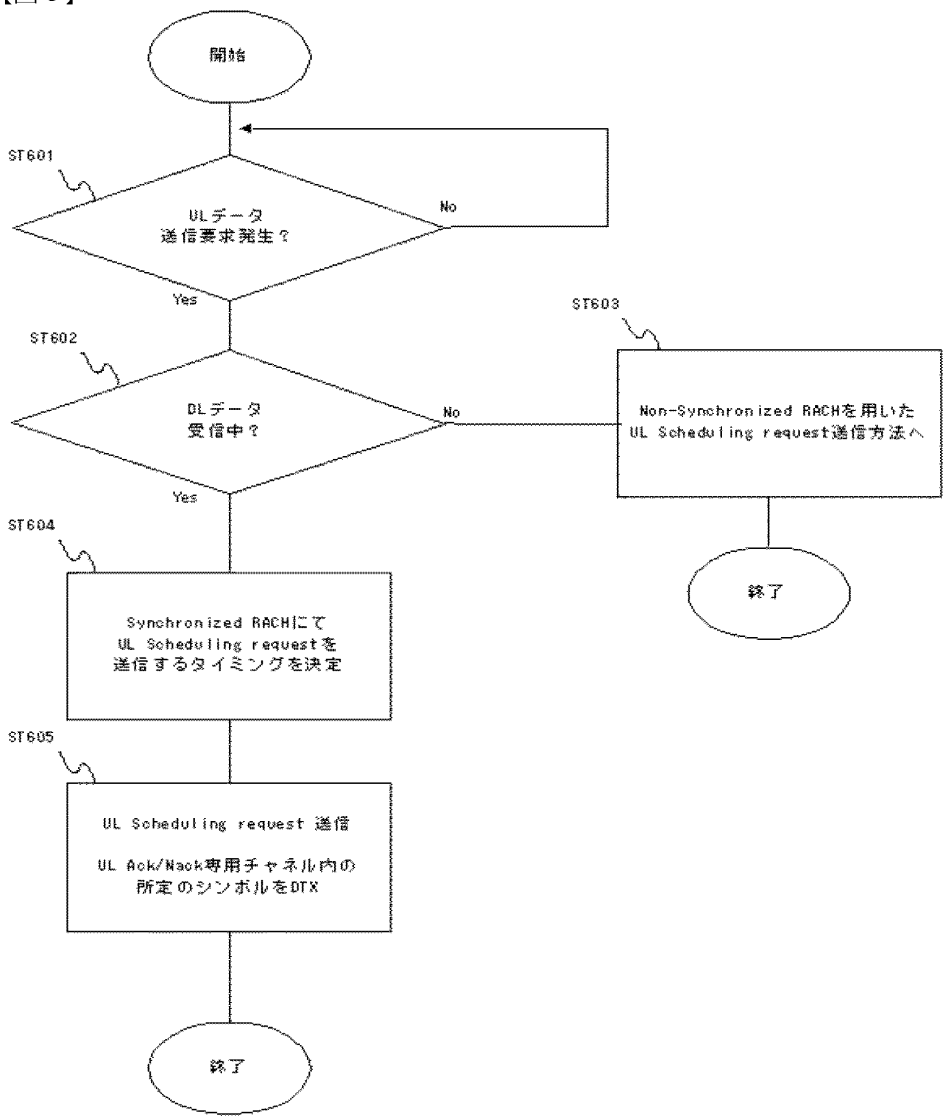
【図４】



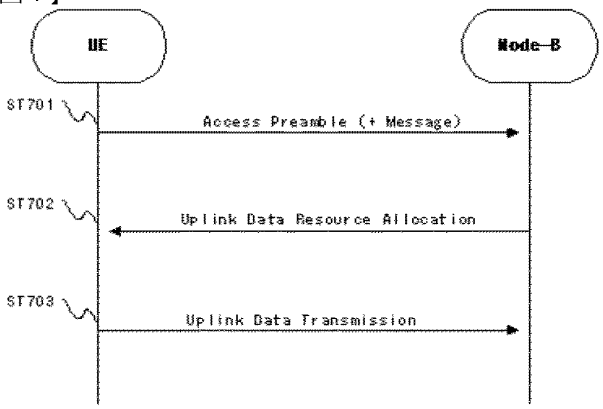
【図５】


周波数
1
TTI
TTI No. 1
Sub-frame 1
Sub-frame 2
TTI No. 2
LB1
SB
LB2
LB3
LB4
LB5
SB
LB6
UE 1
Synchronized
RACHによる
UL Scheduling
request
LB2-1
SB
LB2-2
LB2-3
LB2-4
LB2-5
SB
LB2-6
LB1
SB
LB2
LB3
LB4
LB5
SB
LB6
他UE
Synchronized
RACHによる
UL Scheduling
request
時間
データ送信

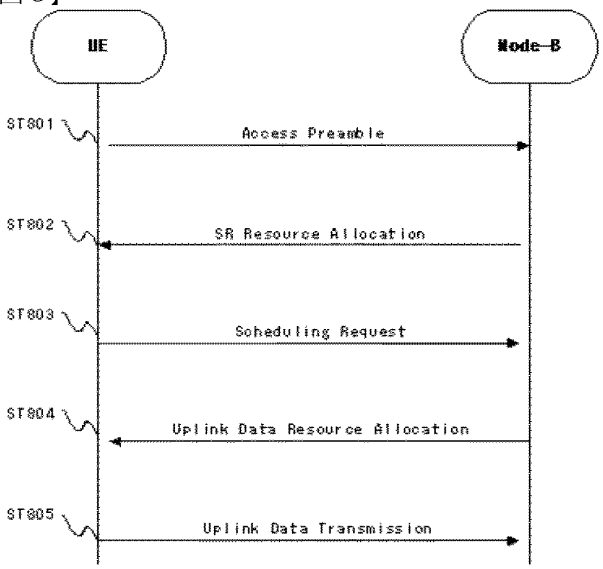
【図６】


開始
ST601
ULデータ
送信要求発生？
No
Yes
ST602
DLデータ
受信中？
No
Yes
ST603
Non-Synchronized RACHを用いた
UL Scheduling request送信方法へ
終了
ST604
Synchronized RACHにて
UL Scheduling requestを
送信するタイミングを決定
ST605
UL Scheduling request 送信
UL Ack/Nack専用チャネル内の
所定のシンボルをDTX
終了

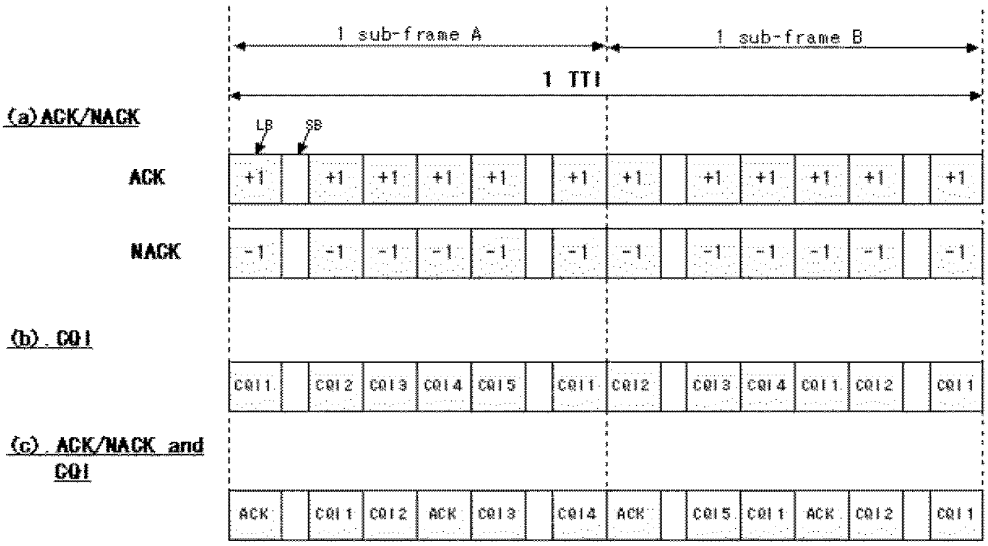
【図７】


UE
Node-B
ST701
Access Preamble (+ Message)
ST702
Uplink Data Resource Allocation
ST703
Uplink Data Transmission

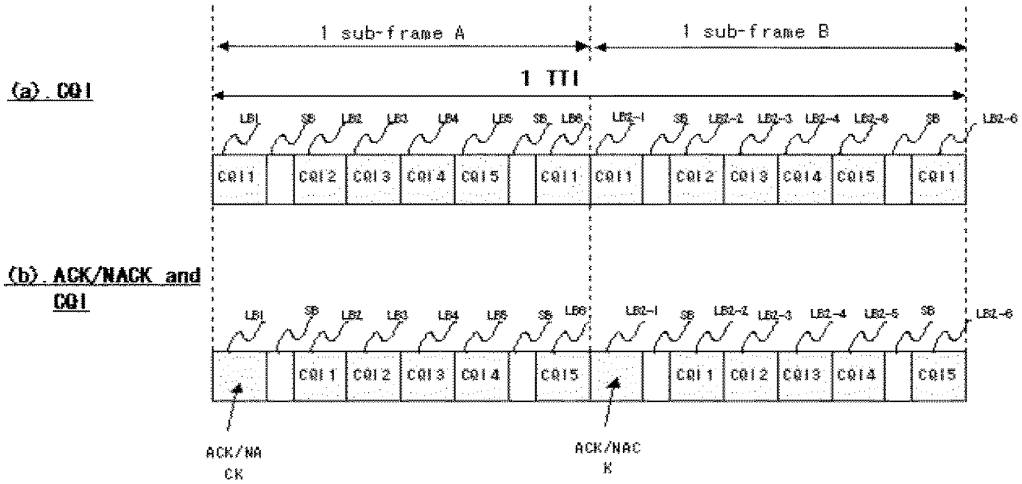
【図８】


UE
Node-B
ST801
Access Preamble
ST802
SR Resource Allocation
ST803
Scheduling Request
ST804
Uplink Data Resource Allocation
ST805
Uplink Data Transmission

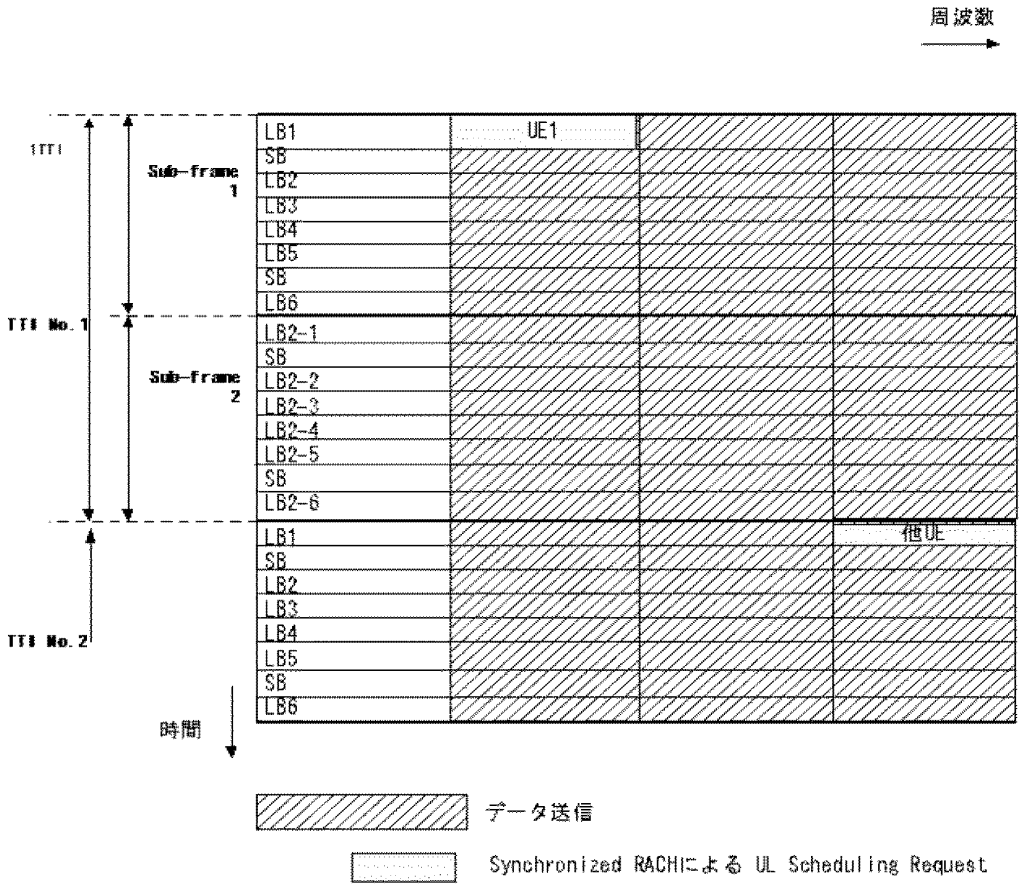
【図９】


1 sub-frame A
1 sub-frame B
1 TTI
(a) ACK/NACK
LB
SB
ACK
NACK
(b). CQI
(c). ACK/NACK and CQI

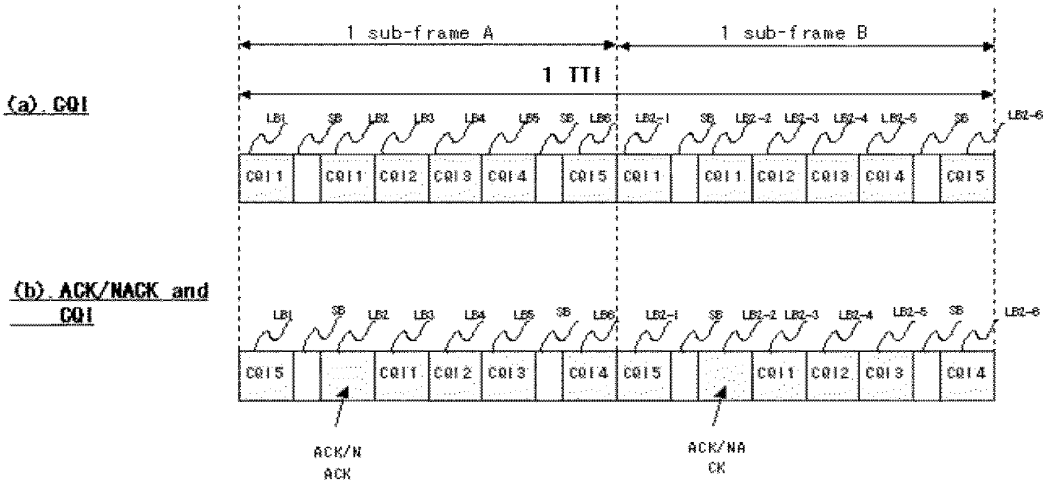
【図１０】


1 sub-frame A
1 sub-frame B
1 TTI
(a). CQI
(b). ACK/NACK and CQI
ACK/NACK
ACK/NACK

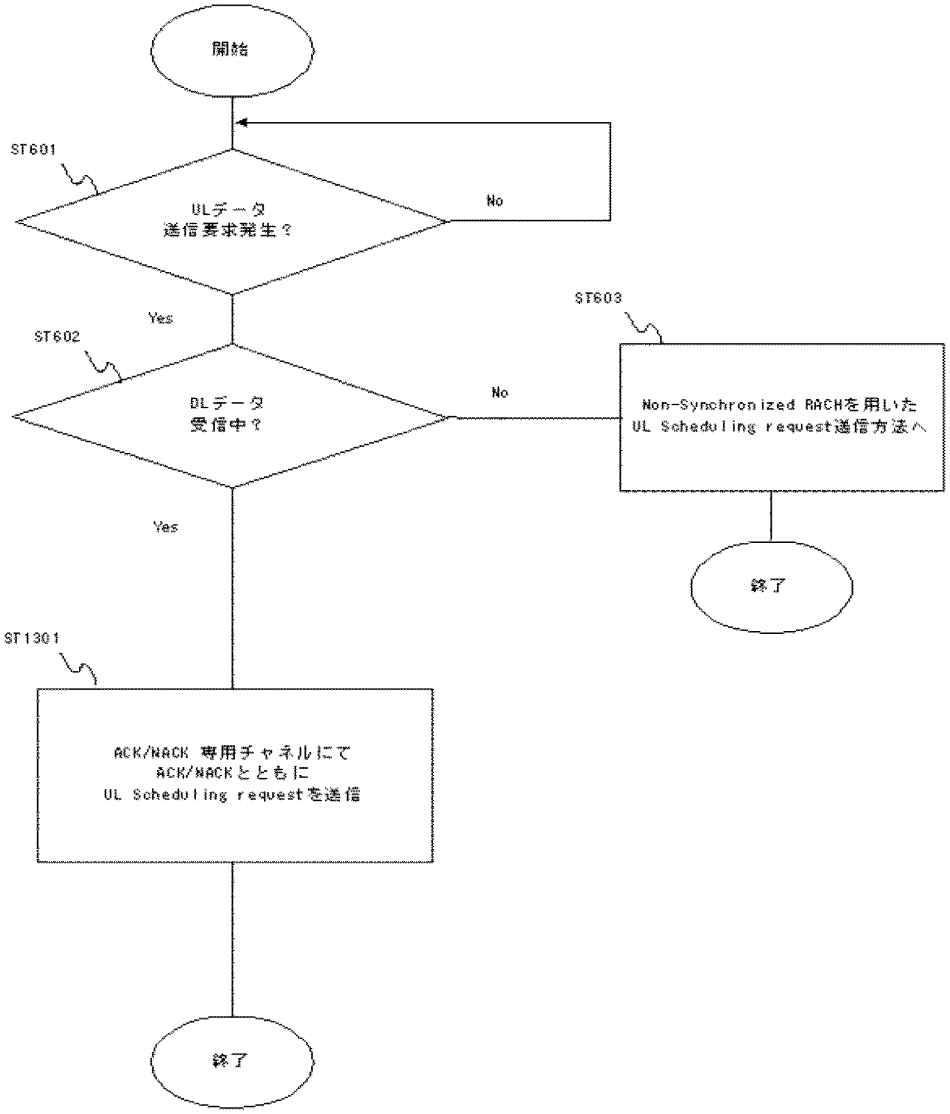
【図１１】


周波数
1TTI
Sub-frame 1
TTI No.1
Sub-frame 2
TTI No.2
LB1
SB
LB2
LB3
LB4
LB5
SB
LB6
LB2-1
SB
LB2-2
LB2-3
LB2-4
LB2-5
SB
LB2-6
LB1
SB
LB2
LB3
LB4
LB5
SB
LB6
UE1
他UE
時間
データ送信
Synchronized RACHによる UL Scheduling Request

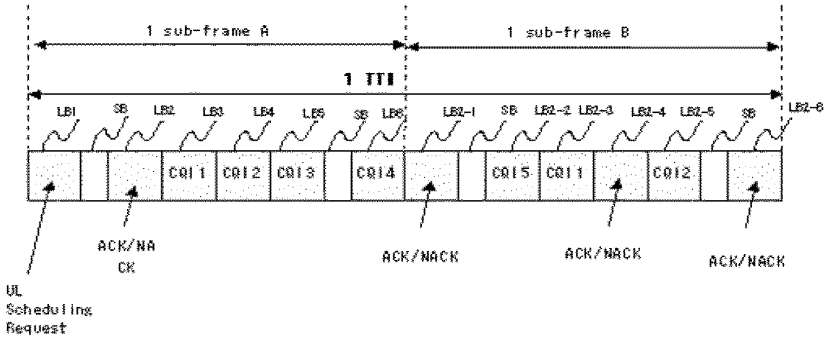
【図１２】


1 sub-frame A
1 sub-frame B
1 TTI
(a). CQI
(b). ACK/NACK and CQI
ACK/NACK
ACK/NACK

【図１３】


開始
ST601
ULデータ
送信要求発生？
No
Yes
ST602
DLデータ
受信中？
No
ST603
Non-Synchronized RACHを用いた
UL Scheduling request送信方法へ
終了
Yes
ST1301
ACK/NACK 専用チャネルにて
ACK/NACKとともに
UL Scheduling requestを送信
終了

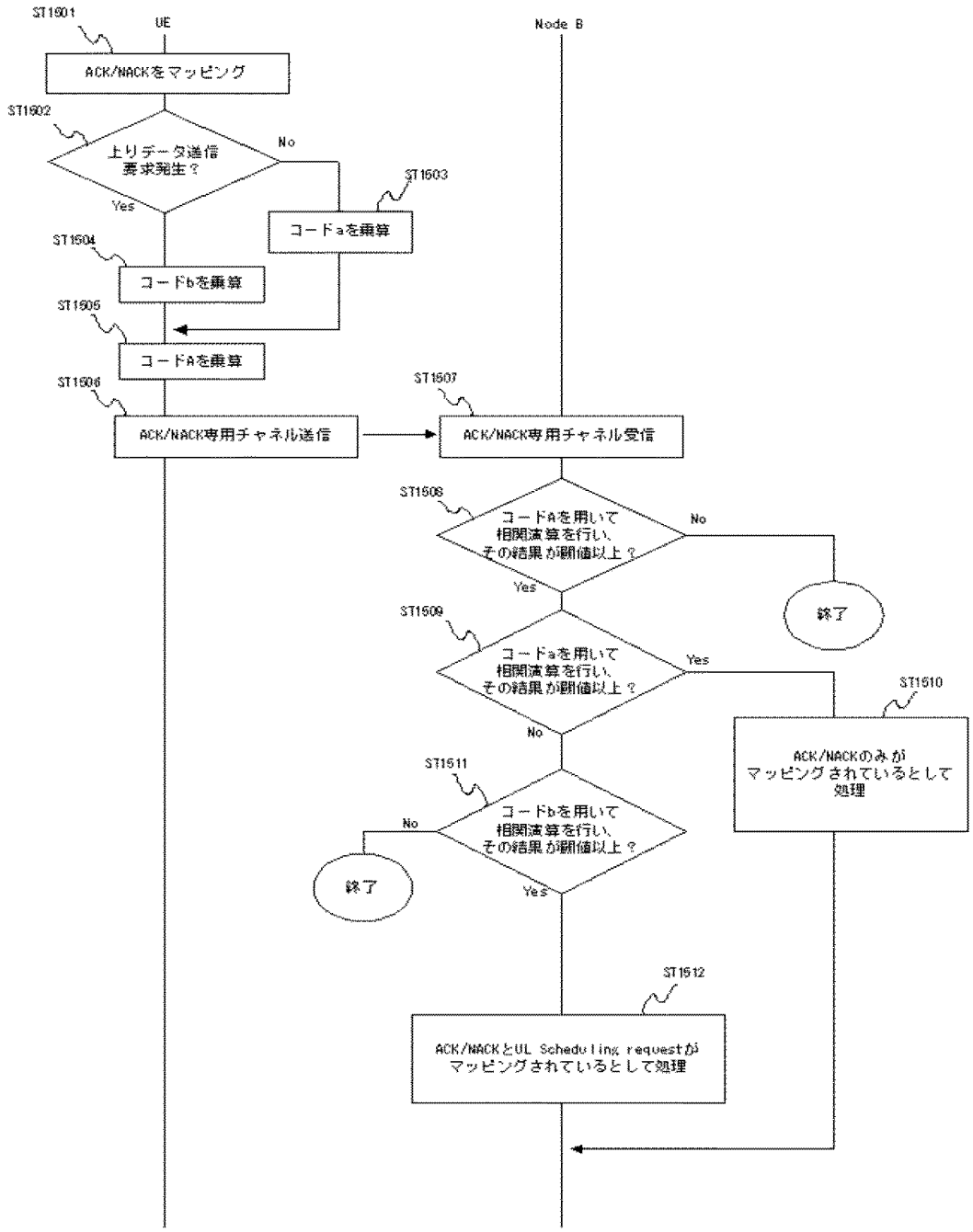
【図１４】



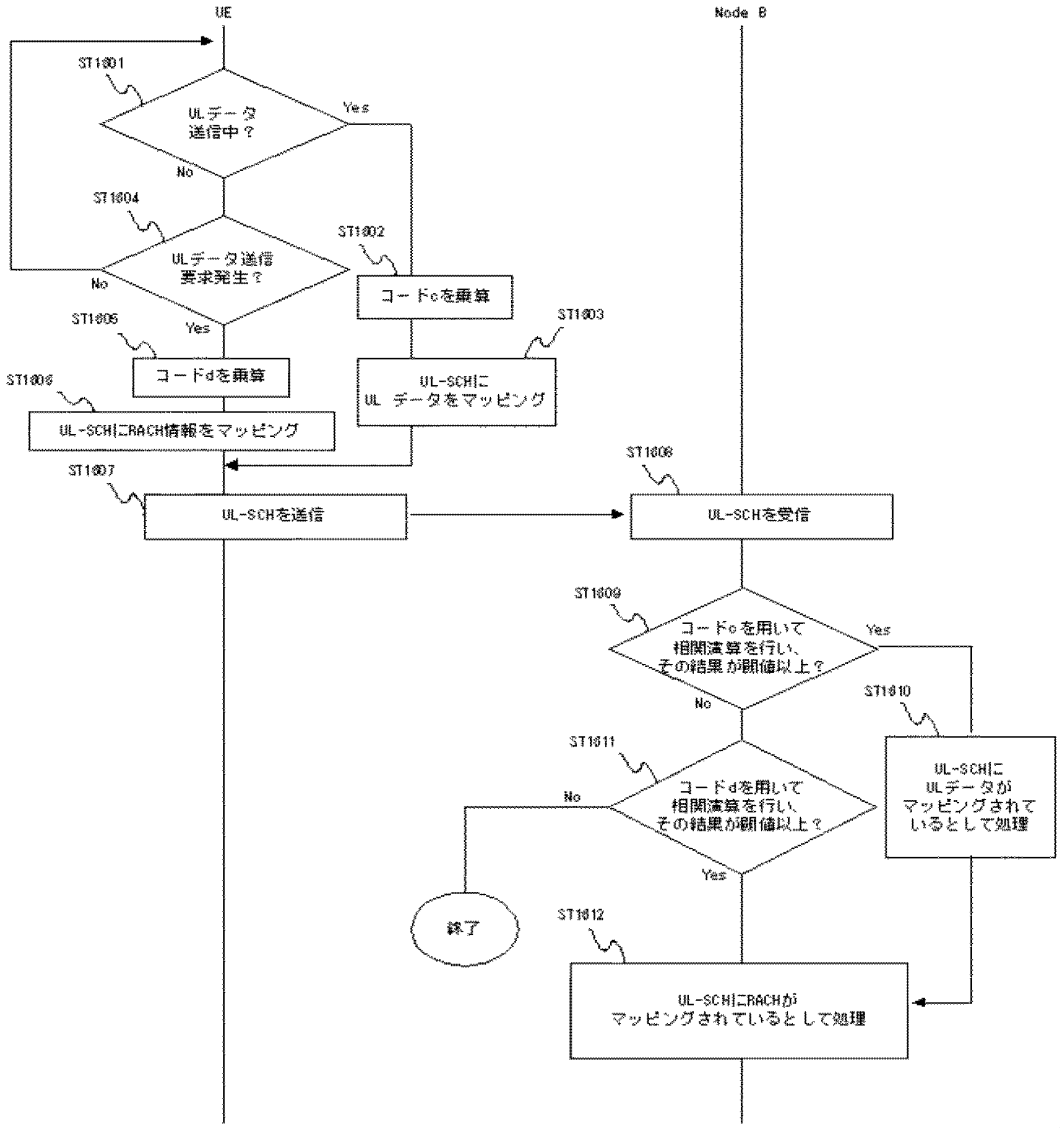
UL Scheduling Request

1	リクエスト有
0	リクエスト無

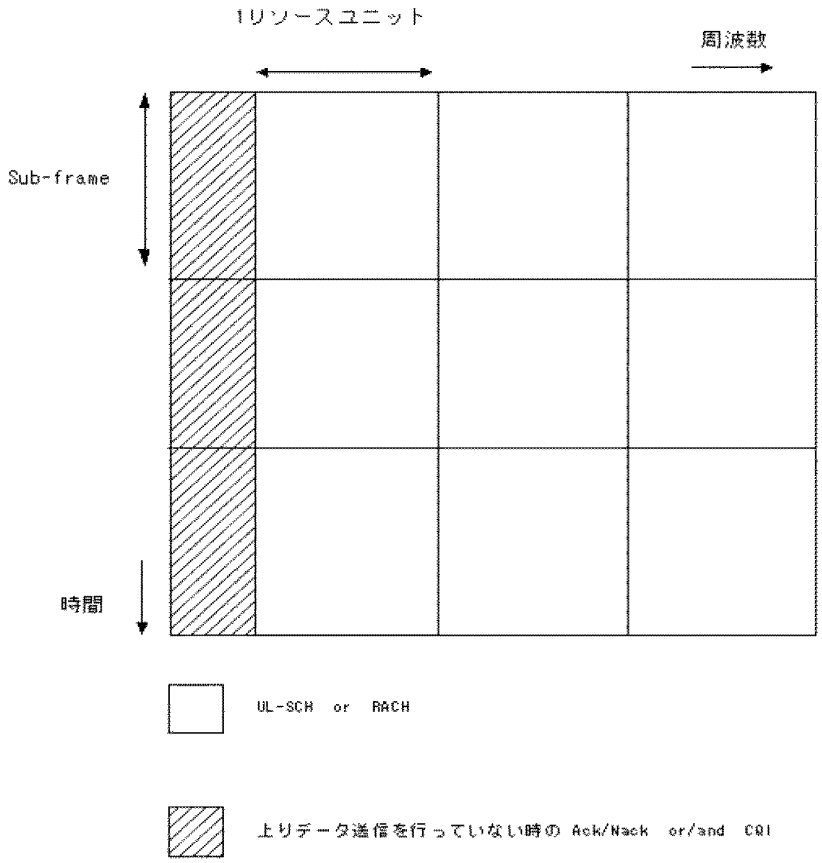
【図１５】


ST1501
UE
Node B
ACK/NACKをマッピング
ST1502
上りデータ送信
要求発生？
No
Yes
ST1503
コードaを乗算
ST1504
コードbを乗算
ST1505
コードAを乗算
ST1506
ACK/NACK専用チャネル送信
ST1507
ACK/NACK専用チャネル受信
ST1508
コードAを用いて
相関演算を行い、
その結果が閾値以上？
No
Yes
終了
ST1509
コードaを用いて
相関演算を行い、
その結果が閾値以上？
Yes
No
ST1510
ACK/NACKのみが
マッピングされているとして
処理
ST1511
コードbを用いて
相関演算を行い、
その結果が閾値以上？
No
Yes
終了
ST1512
ACK/NACKとUL Scheduling requestが
マッピングされているとして処理

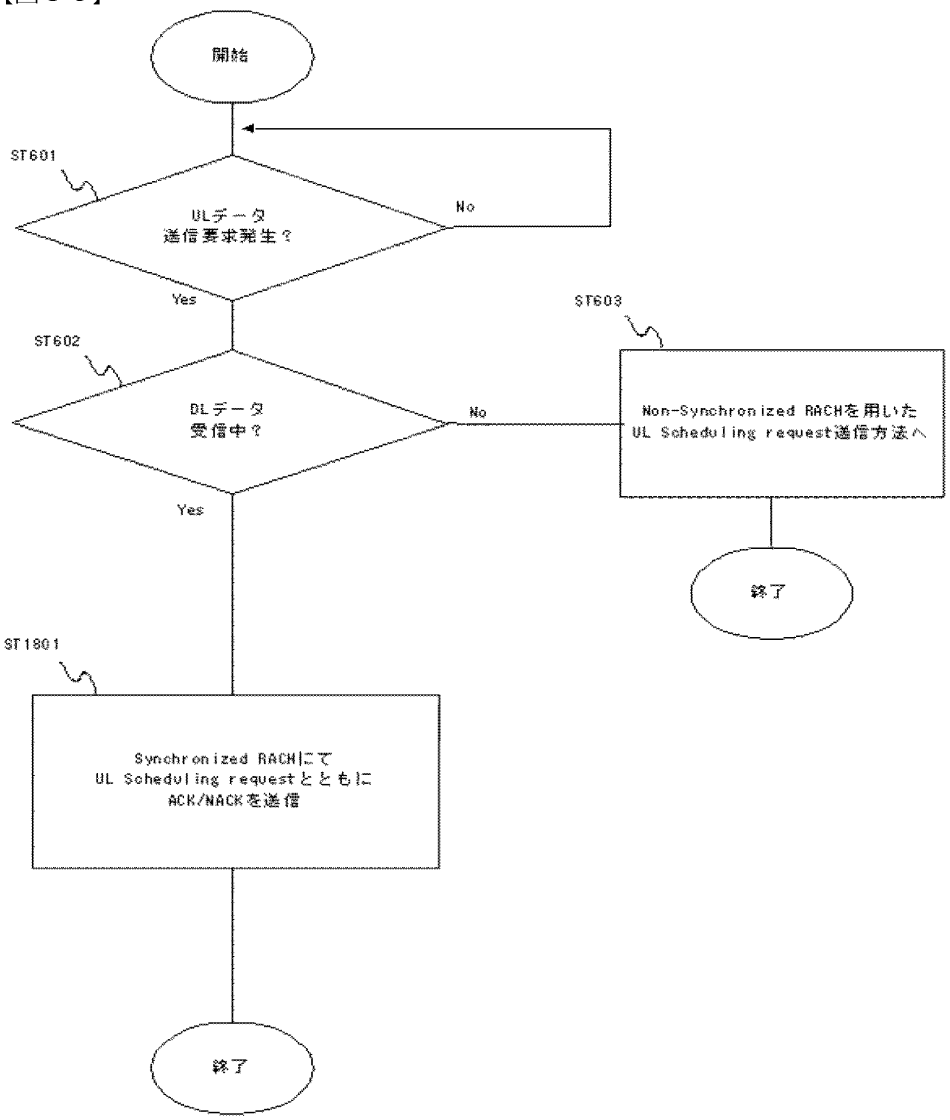
【図１６】


UE
Node B
ST1601
ULデータ
送信中？
Yes
No
ST1604
ULデータ送信
要求発生？
No
Yes
ST1602
コードcを乗算
ST1603
UL-SCHに
UL データをマッピング
ST1605
コードdを乗算
ST1606
UL-SCHにRACH情報をマッピング
ST1607
UL-SCHを送信
ST1608
UL-SCHを受信
ST1609
コードcを用いて
相関演算を行い、
その結果が閾値以上？
Yes
No
ST1610
UL-SCHに
ULデータが
マッピングされて
いるとして処理
ST1611
コードdを用いて
相関演算を行い、
その結果が閾値以上？
No
Yes
終了
ST1612
UL-SCHにRACHが
マッピングされているとして処理

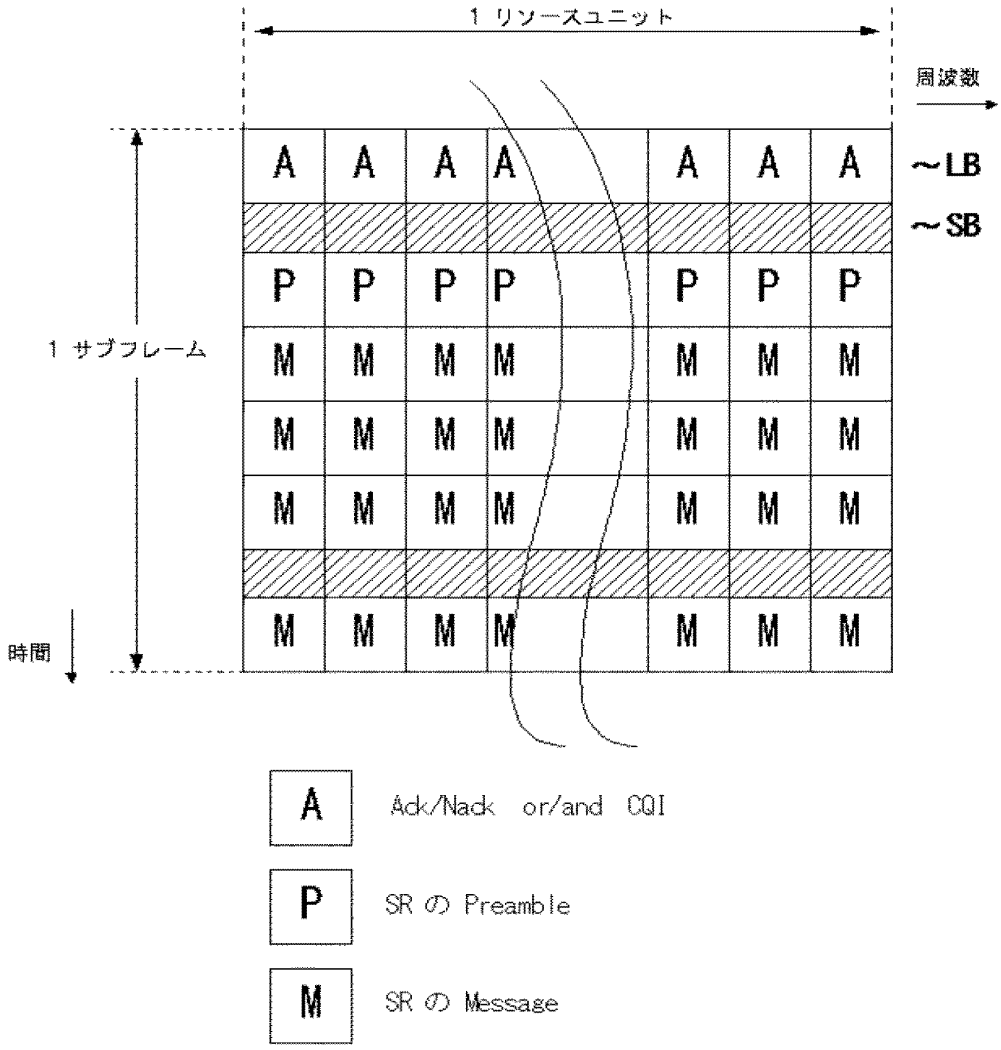
【図１７】


1リソースユニット
周波数
Sub-frame
時間
UL-SCH or RACH
上りデータ送信を行っていない時の Ack/Nack or/and CQI

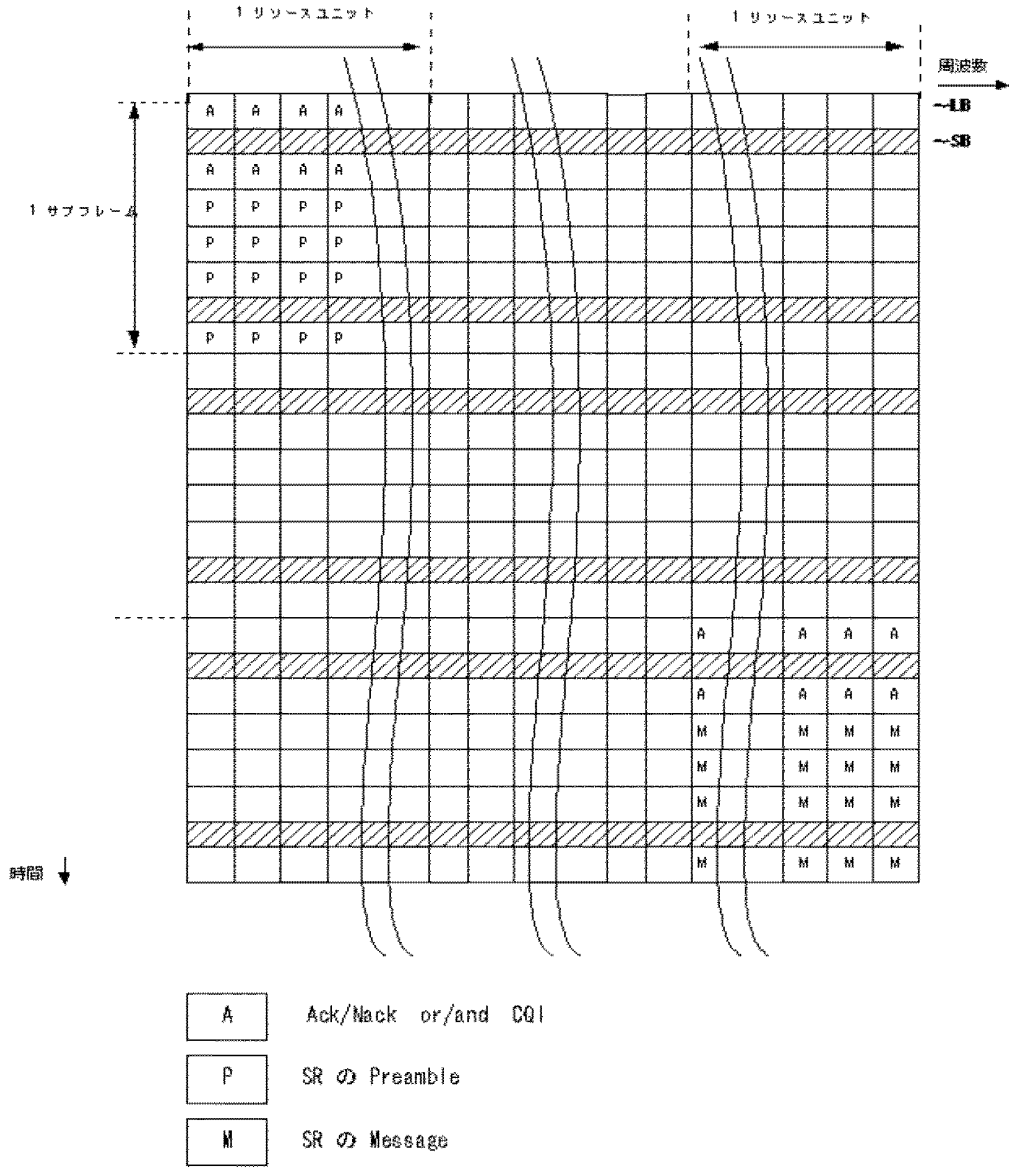
【図１８】


開始
ST601
ULデータ
送信要求発生？
No
Yes
ST602
DLデータ
受信中？
No
ST603
Non-Synchronized RACHを用いた
UL Scheduling request送信方法へ
終了
Yes
ST1801
Synchronized RACHにて
UL Scheduling requestとともに
ACK/NACKを送信
終了

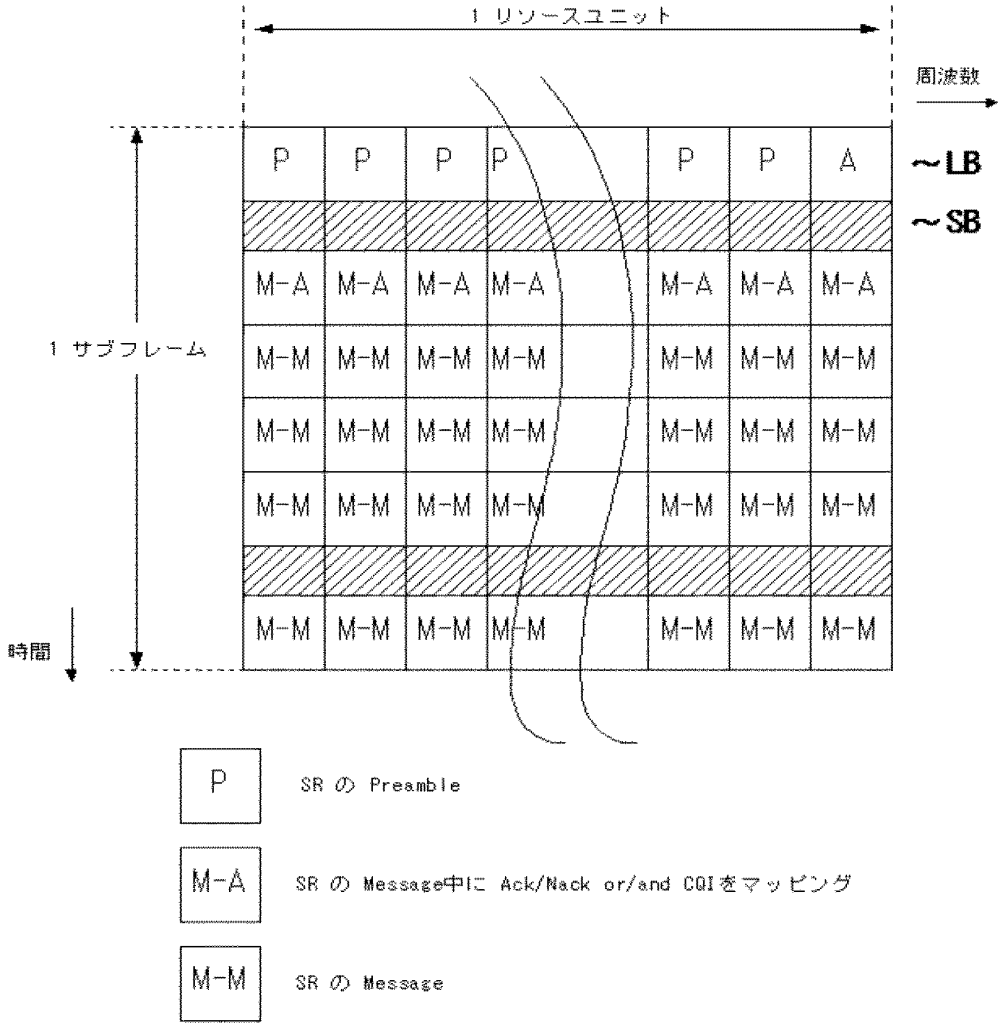
【図１９】


1 リソースユニット
周波数
A A A A A A A
～LB
～SB
P P P P P P P
1 サブフレーム
M M M M M M M
M M M M M M M
M M M M M M M
M M M M M M M
時間
A Ack/Nack or/and CQI
P SR の Preamble
M SR の Message

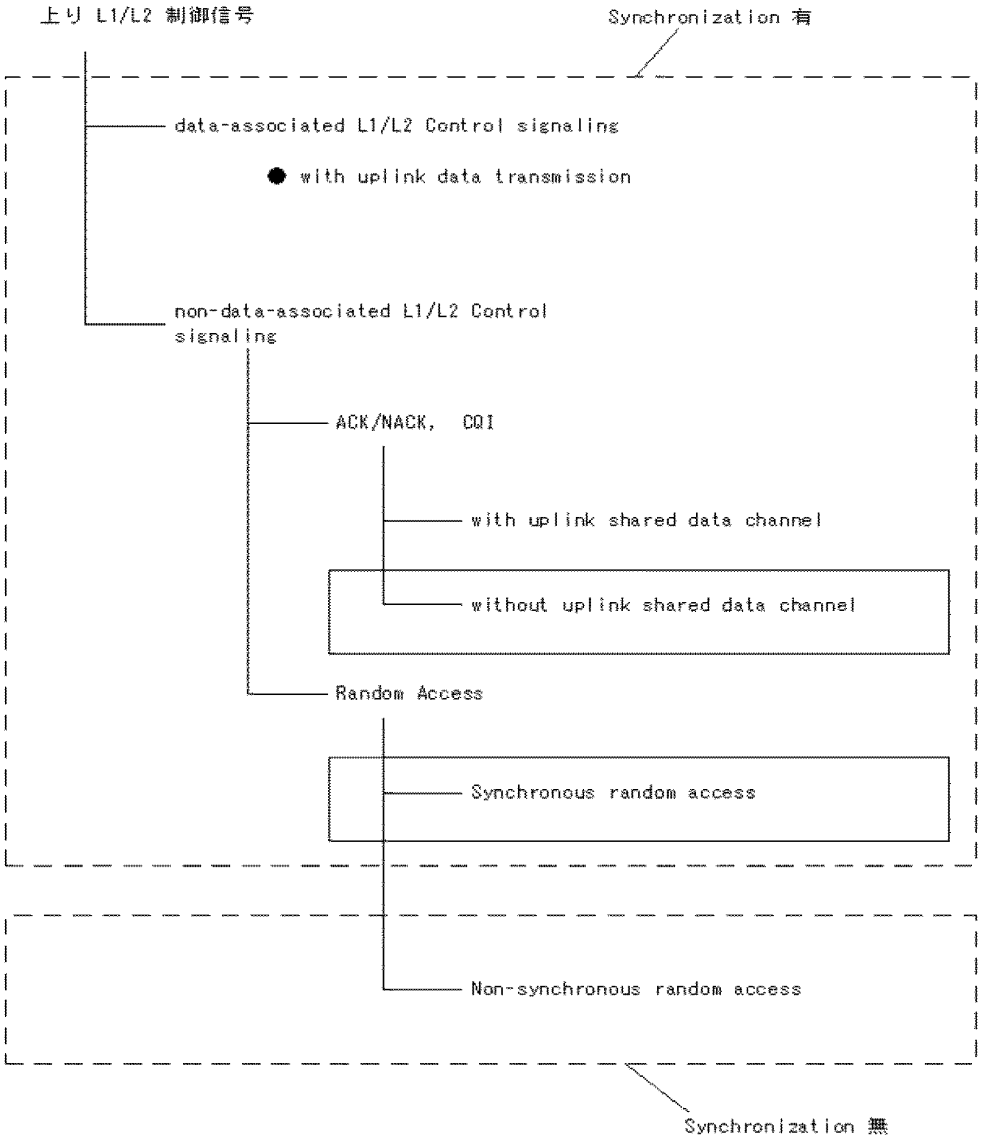
【図２０】


１リソースユニット
１リソースユニット
周波数
LB
SB
１サブフレーム
時間
A
P
M
A Ack/Nack or/and CQI
P SR の Preamble
M SR の Message

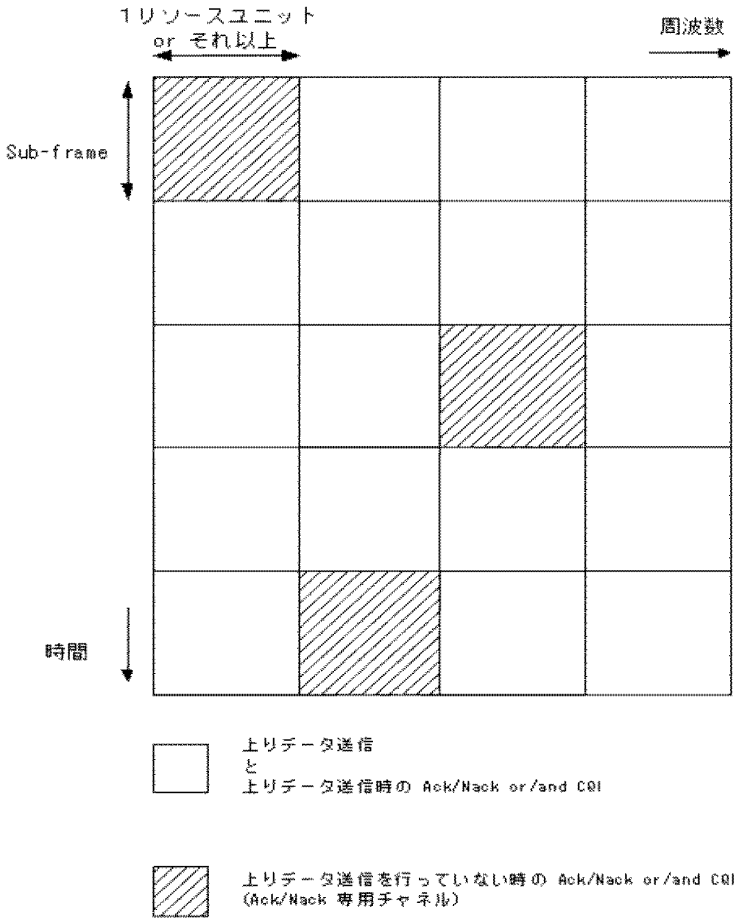
【図２１】


1 リソースユニット
周波数
P P P P P P A
～LB
～SB
M-A M-A M-A M-A M-A M-A M-A
1 サブフレーム
M-M M-M M-M M-M M-M M-M M-M
M-M M-M M-M M-M M-M M-M M-M
M-M M-M M-M M-M M-M M-M M-M
時間
M-M M-M M-M M-M M-M M-M M-M
P SR の Preamble
M-A SR の Message中に Ack/Nack or/and CQIをマッピング
M-M SR の Message

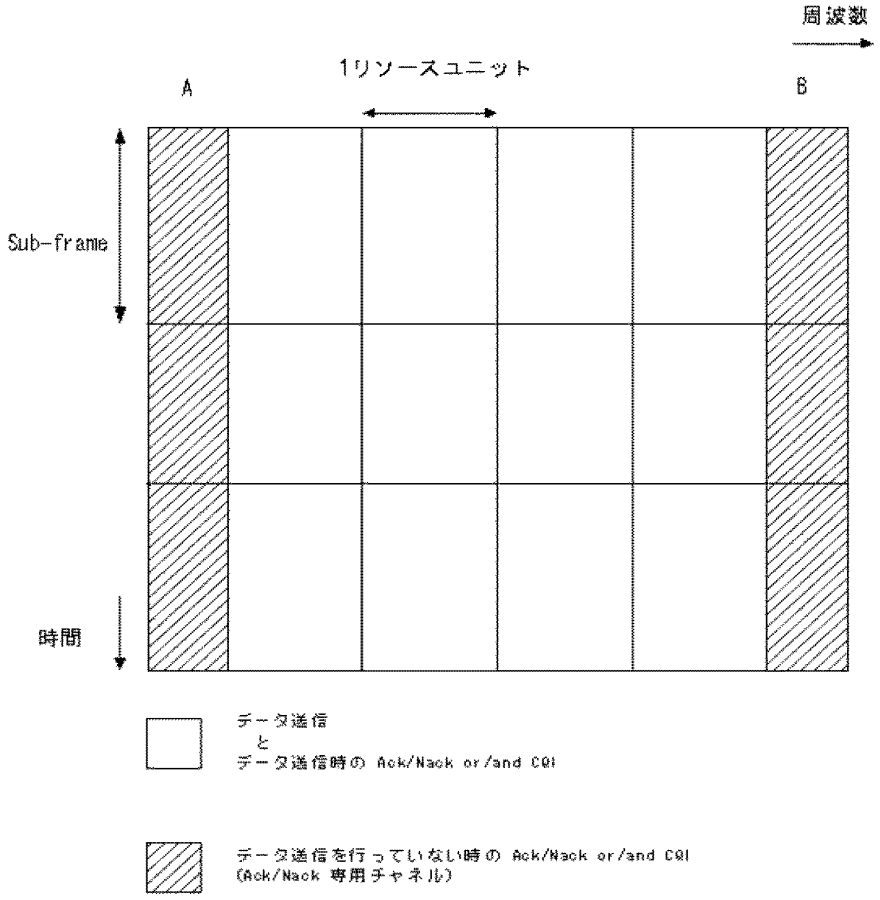
【図２２】


上り L1/L2 制御信号
Synchronization 有
data-associated L1/L2 Control signaling
with uplink data transmission
non-data-associated L1/L2 Control signaling
ACK/NACK, CQI
with uplink shared data channel
without uplink shared data channel
Random Access
Synchronous random access
Non-synchronous random access
Synchronization 無

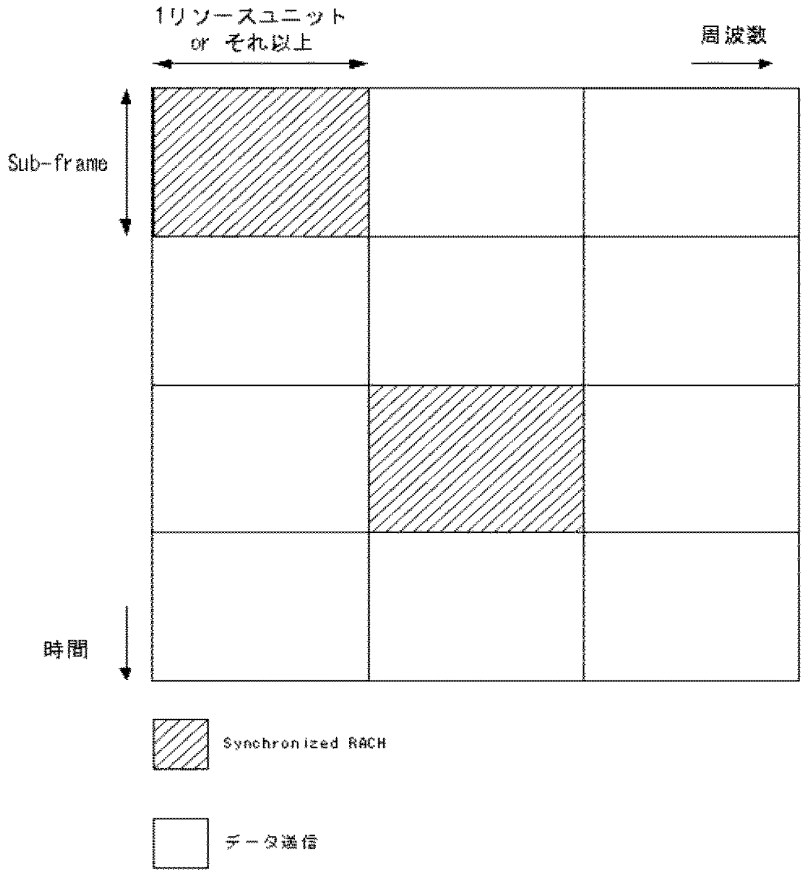
【図２３】


1リソースユニット
or それ以上
周波数
Sub-frame
時間
上りデータ送信
と
上りデータ送信時の Ack/Nack or/and CQI
上りデータ送信を行っていない時の Ack/Nack or/and CQI
(Ack/Nack 専用チャネル)

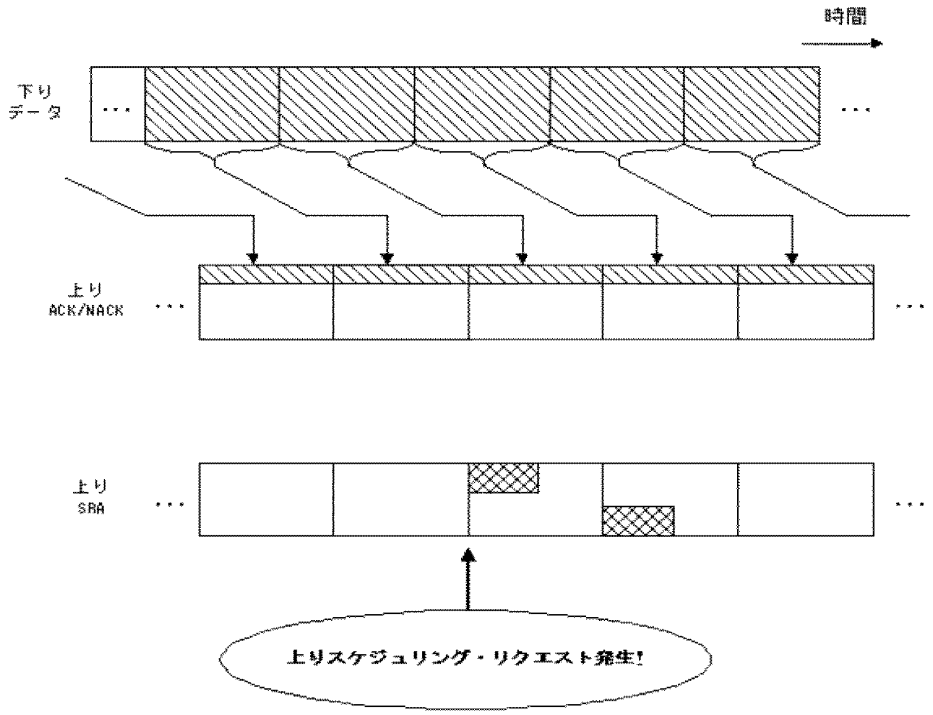
【図２４】


周波数
1リソースユニット
A
B
Sub-frame
時間
データ送信
と
データ送信時の Ack/Nack or/and CQI
データ送信を行っていない時の Ack/Nack or/and CQI
(Ack/Nack 専用チャネル)

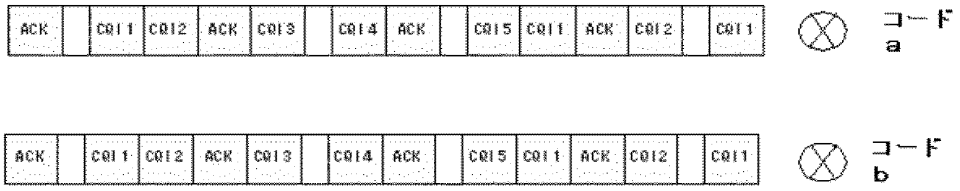
【図２５】



【図２６】



【図２７】



UL Scheduling Request

コードb	リクエスト有
コードa	リクエスト無

【書類名】要約書
【要約】
【課題】　上りＡｃｋ／ＮａｃｋやＣＱＩを送信する処理と、Ｓ－ＲＡＣＨを用いてＳＲＡを送信する処理とを同時に実行すると、送信信号の時間波形のピークが高くなるため、ＰＡＰＲが高くなってしまうという課題がある。
【解決手段】　本発明は、下りアクセス方式としてOFDM（Orthogonal Frequency Division Multiplexing）方式を用いてデータの送信を行う基地局２と移動端末３とを含むＬＴＥの通信システムにおいて、Ａｃｋ／Ｎａｃｋ専用チャネルを用いてＡｃｋ／Ｎａｃｋ信号を送信しているときに、Ｓ－ＲＡＣＨを用いて上りスケジューリング要求信号ＳＲを送信する場合、上りスケジューリング要求信号ＳＲを送信している間、Ａｃｋ／Ｎａｃｋ信号の送信を停止するものである。２種類の帯域に割り当てた２つの物理チャネルのデータを同時に送信するマルチキャリア方式を使用しないので、ＰＡＲＲ（ピーク対平均電力比）を低減できる。
【選択図】　図１

出願人履歴

０００００６０１３

20051026

住所変更

東京都千代田区丸の内二丁目７番３号

三菱電機株式会社

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
14/587,726	12/31/2014	2414	2540	445600US20CONT	3	3

CONFIRMATION NO. 6371

22850
OBLON, MCCLELLAND, MAIER & NEUSTADT, L.L.P.
1940 DUKE STREET
ALEXANDRIA, VA 22314

UPDATED FILING RECEIPT

OC000000074251418

Date Mailed: 03/27/2015

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**

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Assignment For Published Patent Application

MITSUBISHI ELECTRIC CORPORATION, Chiyoda-ku, JAPAN

Power of Attorney: The patent practitioners associated with Customer Number 22850

Domestic Priority data as claimed by applicant

This application is a CON of 12/375,574 01/29/2009
which is a 371 of PCT/JP2006/326117 12/27/2006

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.)
JAPAN 2006-292641 10/27/2006

Request to Retrieve - This application either claims priority to one or more applications filed in an intellectual property Office that participates in the Priority Document Exchange (PDX) program or contains a proper **Request to Retrieve Electronic Priority Application(s)** (PTO/SB/38 or its equivalent). Consequently, the USPTO will attempt to electronically retrieve these priority documents.

If Required, Foreign Filing License Granted: 01/21/2015

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 14/587,726**

Projected Publication Date: 07/02/2015

Non-Publication Request: No

Early Publication Request: No
Title

DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL

Preliminary Class

370

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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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).

Ex. 1002 - TCL Comm Tech Holdings Ltd.
TCL Comm Tech Holdings Ltd. v. Mitsubishi Electric Corp. - IPR2023-00957
Page 220

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 14/587,726

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	600
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))	3 minus 20 =	*			OR	x 80 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	*				x 420 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						800
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	2400

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 =	
AMENDMENT A	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
AMENDMENT A	Application Size Fee (37 CFR 1.16(s))									
AMENDMENT A	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($)	ADDITIONAL FEE($)		RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
AMENDMENT B	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
AMENDMENT B	Application Size Fee (37 CFR 1.16(s))									
AMENDMENT B	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.

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/587,726	12/31/2014	Miho Maeda	445600US20CONT

CONFIRMATION NO. 6371

22850
OBLON, MCCLELLAND, MAIER & NEUSTADT, L.L.P.
1940 DUKE STREET
ALEXANDRIA, VA 22314

POA ACCEPTANCE LETTER

OC000000074251350

Date Mailed: 03/27/2015

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 02/13/2015.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

/mtegene/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

DOCKET NO: 445600US20CONT

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF		:
MIHO MAEDA, ET AL.		: EXAMINER: UNASSIGNED
SERIAL NO: 14/587,726		:
FILED:	DECEMBER 31, 2014	: GROUP ART UNIT: 2414
FOR:	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL	:

STATEMENT UNDER 37 C.F.R. § 1.125(b)

COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313

Commissioner:

In response to the Notice to File Corrected Application Papers dated January 22, 2015, Applicant respectfully submits the enclosed substitute specification, along with a marked-up copy, that includes the amendments to the specification presented in the Preliminary Amendment filed on January 2, 2015. The Preliminary Amendment included a correction of a typographical error in a brief description of the drawing [Fig. 8], which addresses a requirement in the Notice. No new matter has been added. Claims 2-4 presented in the Preliminary Amendment are pending in this application.

An early and favorable action is therefore respectfully requested.

Respectfully Submitted,

OBLON, McCLELLAND,
MAIER & NEUSTADT, L.L.P.

Eckhard H. Kuesters
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(OMMN 10/09)

Ex. 1002 - TCL Comm Tech Holdings Ltd.
TCL Comm Tech Holdings Ltd. v. Mitsubishi Electric Corp. - IPR2023-00957
Page 225

Specification

DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM, AND MOBILE TERMINAL

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. Patent Application Serial No. 12/375,574, filed January 29, 2009, which is a National Stage Application of PCT Application No. PCT/JP2006/326117, filed December 27, 2006, which claims priority to Japanese Patent Application No. 2006-292641, filed October 27, 2006. The entire contents of U.S. Patent Application Serial No. 12/375,574 are incorporated herein by reference in their entirety.

Field of the Invention

[0001]

The present invention relates to a communication system which is called "Long Term Evolution" (LTE), a mobile terminal which constructs this communication system, and a communication method for an uplink control signal which this mobile terminal transmits to a base station.

Background of the Invention

[0002]

Commercial services which employ a W-CDMA (Wideband Code division Multiple Access) method which is included in communication methods called a third generation were started in Japan since 2001. Furthermore, a start of a service with HSDPA (High Speed Down Link Packet Access) which implements a further improvement in the speed of data transmission using

downlinks (an individual data channel and an associated control channel) by adding a channel for packet transmission (HS-DSCH: High Speed-Downlink Shared Channel) to the downlinks has been planned. In addition, an HSUPA (High Speed Up Link Packet Access) method has also been suggested and studied in order to speed up uplink data transmission.

The W-CDMA is a communication method which was determined by the 3GPP (3rd Generation Partnership Project) which is the organization of standardization of mobile communication systems, and the technical specification of the release 6 has been being organized currently.

[0003]

In the 3GPP, as a communication method different from the W-CDMA, a new communication method having a wireless section, which is referred to as "Long Term Evolution" (LTE), and a whole system structure including a core network, which is referred to as "System Architecture Evolution" (SAE), has been studied.

The LTE has an access method, a radio channel configuration, and protocols which are different from those of the current W-CDMA (HSDPA/HSUPA). For example, while the W-CDMA uses, as its access method, code division multiple access (Code Division Multiple Access), the LTE uses, as its access method, OFDM (Orthogonal Frequency Division Multiplexing) for the downlink direction and uses SC-FDMA (Single Career Frequency Division Multiple Access) for the uplink direction. Furthermore, while the W-CDMA has a bandwidth of 5MHz, the LTE can have a bandwidth of 1.25/2.5/5/10/15/20MHz. In addition, the LTE uses only a packet communication method, instead of a circuit switching method which the W-CDMA uses.

[0004]

According to the LTE, because a communication system is constructed using a new core network different from a core network (General Packet Radio System GPRS) which complies with the W-CDMA, the communication system is defined as an independent radio access network which is separate from a W-CDMA network. Therefore, in order to distinguish from a communication system which complies with the W-CDMA, in a communication system which complies with the LTE, a base station (Base station) which communicates with a mobile terminal UE (User Equipment) is called eNB (E-UTRAN NodeB, eNodeB, or eNode-B), a base station control apparatus (Radio Network Controller) which performs exchange of control data and user data with a plurality of base stations and is called an aGW (Access Gateway).

This communication system which complies with the LTE carries out point-to-multipoint (Point to Multipoint) communications, such as a multicast and broadcast type multimedia service called a E-MBMS (Evolved Multimedia Broadcast Multicast Service), and also provides a communication service such as a unicast (Unicast) service for each mobile terminal among a plurality of mobile terminals.

In the case of the LTE, because no individual channels (Dedicated Channel and Dedicated Physical Channel) destined for each mobile terminal exist in transport channels and physical channels, transmission of data to each mobile terminal is carried out by using a common channel (Shared channel), unlike in the case of the W-CDMA.

[0005]

When receiving data, via a downlink, from a base station, a mobile terminal transmits a signal indicating whether the mobile terminal has received the data perfectly, and a signal indicating either the quality of the received data or the quality of the downlink communication path to the base station via an uplink. The response signal indicating whether the mobile terminal could receive the data correctly from the base station is referred to as an Ack/Nack, and the quality information indicating the quality of the received data or the quality of the downlink communication path is referred to as a CQI (Channel Quality Indicator).

An Ack/Nack is a signal with which, when the mobile terminal has received downlink data, the mobile terminal notifies information indicating whether the mobile terminal could receive the downlink data correctly to the base station, and the base station uses the Ack/Nack for retransmission control.

A CQI is a signal with which the mobile terminal notifies the downlink channel's state (the communication path's state) which the mobile terminal has measured to the base station, and the base station uses the CQI for downlink scheduling. Furthermore, when data which the mobile terminal has to transmit to the base station occur, the mobile terminal transmits a signal with which to make a request for allocation of uplink radio resources to the base station. Such a request signal is called a scheduling request, an uplink resource request, or an uplink scheduling request signal (SR: Scheduling Request). The Ack/Nack, the CQI, and the SR as mentioned above are called "uplink L1/L2 control signals" (an L1/L2 control signaling).

[0006]

Fig. 22 is an explanatory drawing for explaining uplink L1/L2 control signals.

As shown in Fig. 22, uplink L1/L2 control signals are roughly divided into two types of L1/L2 control signals. They are uplink-data-associated L1/L2 control signals (a data-associated L1/L2 control signaling), and uplink-data-non-associated L1/L2 control signals (a data-non-associated L1/L2 control signaling).

An uplink-data-associated L1/L2 control signal is information required for uplink data transmission (reception by a base station), such as a transport format, and is transmitted together with uplink data. Uplink-data-non-associated L1/L2 control signals include an Ack/Nack and a CQI which are relevant to a downlink, and random access (Random Access) signals, such as a scheduling request (SR, UL SR) which is transmitted before uplink data transmission is started.

Although an Ack/Nack and a CQI are transmitted regardless of uplink data transmission because they are relevant to a downlink, there is a case in which they are transmitted at the same time when uplink data are transmitted. On the other hand, random access signals include a synchronous random access (Synchronous Random Access which is referred to as SRA from here on) signal and a non-synchronous random access (Non-Synchronous Random Access which is referred to as NSRA from here on) signal.

An SRA is transmitted in a state in which uplink time synchronization is established, whereas an NSRA is transmitted in a state in which uplink time synchronization is not

established.

Not only uplink-data-associated L1/L2 control signals but also an Ack/Nack and a CQI are transmitted in a state in which uplink time synchronization is established. Hereafter, the fact that there is a state in which an Ack/Nack and/or a CQI, and an SRA in a case in which no uplink data transmission is carried out are transmitted simultaneously will be mentioned, and a problem with this state and a solution of this problem will be mentioned.

[0007]

An uplink Ack/Nack and an uplink CQI are relevant to a downlink. For allocation of an Ack/Nack and a CQI to physical resources to in the case in which no uplink data transmission is carried out, a method of monopolistically allocating one certain time-frequency region or a method of monopolistically allocating a plurality of time-frequency regions having separated narrow bands is used (for example, refer to nonpatent reference 1).

Hereafter, these regions are referred to as an Ack/Nack exclusive channel.

That is, in a state in which uplink data transmission is not performed, an Ack/Nack and a CQI are transmitted by using an Ack/Nack exclusive channel.

In further explaining in detail, (1) in a case in which both an Ack/Nack and a CQI have to be transmitted, the Ack/Nack and the CQI are transmitted by using an Ack/Nack exclusive channel, (2) in a case in which an Ack/Nack has to be transmitted, but a CQI does not have to be transmitted, the Ack/Nack is transmitted by using an Ack/Nack exclusive channel, and (3) in

a case in which an Ack/Nack does not have to be transmitted, but a CQI has to be transmitted, the CQI is transmitted by using an Ack/Nack exclusive channel. It can also be considered that, (4) even in a case in which an Ack/Nack does not have to be transmitted, and a CQI does not have to be transmitted, an Ack/Nack exclusive channel is allocated to them. In this case, both no Ack/Nack and no CQI are transmitted by using the above-mentioned channel.

Fig. 23 is an explanatory drawing showing radio resources to which an Ack/Nack and a CQI are allocated in the case in which uplink data transmission is carried out or in the case in which no uplink data transmission is carried out. Fig. 23 shows the method of monopolistically allocating one certain time-frequency region.

An Ack/Nack and a CQI in the case in which no uplink data transmission is carried out are allocated to a region having one or more subframes with respect to time and are allocated to a region having one or more resource units with respect to frequency. In contrast, uplink data, and an Ack/Nack and a CQI in the case in which transmission of either an uplink-data-associated L1/L2 control signal or the uplink data is carried out are allocated to another region.

[0008]

By allocating an Ack/Nack and a CQI in the case in which no uplink data transmission is carried out, i.e., signals associated with only an Ack/Nack and a CQI to a monopolistic region intended only for the signals, a time during which the Ack/Nack and CQI signals are transmitted can be increased, and therefore a large coverage can be acquired.

Fig. 24 is an explanatory drawing showing radio resources in which an Ack/Nack and a CQI are allocated to an Ack/Nack exclusive channel. Fig. 24 shows the method of monopolistically allocating a plurality of time-frequency regions (A and B in Fig. 24) having separated narrow bands for an Ack/Nack and a CQI.

An Ack/Nack and a CQI in the case in which no uplink data transmission is carried out are allocated to some separated regions in units of a subframe with respect to time and are allocated to some separated regions in units of a subcarrier with respect to frequency. By separating the frequency region into some parts (e.g., A and B in Fig. 24), a frequency diversity gain can be acquired.

When using either of the methods, an Ack/Nack and a CQI of one or more mobile terminals can be allocated to one region. It has been studied to, in order to implement a method of multiplexing an Ack/Nack and a CQI of one or more mobile terminals into one region, establish the orthogonality of each mobile terminal by using FDM (Frequency Division Multiplex) / TDM (Time Division Multiplex) / CDM (Code Division Multiplex). In order to ensure the quality of reception of an Ack/Nack and a CQI by a base station, it has been studied to increase the power by carrying out repetition (repetition) transmission of the Ack/Nack and the CQI. More specifically, there are a method of repeatedly transmitting the same subframe twice within one transmission time interval (Transmission Time Interval TTI), a method of repeatedly including a bit of an Ack/Nack and a bit of a CQI to a plurality of LBs (Long Block) in a subframe so as to transmit them, and so on.

[0009]

A synchronous random access (Synchronous Random Access SRA) is a signal used for a scheduling request (SR) which a mobile terminal transmits before starting uplink data transmission, which the mobile terminal transmits when the mobile terminal is placed in a state in which uplink time synchronization is established (in other words, the mobile terminal is placed in an Active mode). As a method of allocating an SRA to physical resources, there is provided a method of monopolistically allocating one certain time-frequency region (Nonpatent reference 3: TR25.814V7.0.0). Fig. 25 is an explanatory drawing showing radio resources in which an uplink scheduling request signal is allocated to an S-RACH. Fig. 25 shows the method of monopolistically allocating one certain time-frequency region.

An SRA is allocated to a region in units of a subframe with respect to time and is allocated to a region in units of one or more resource units with respect to frequency. Hereafter, these regions are referred to as an S-RACH (Synchronous Random Access CHannel). In contrast, uplink data are allocated to other regions. Therefore, an SRA and data are multiplexed with respect to either or both of time and frequency.

With which region a mobile terminal transmits an SRA is predetermined or is notified in advance from a base station. An SRA of one or more mobile terminals is allocated to one region. When transmissions of SRAs of a plurality of mobile terminals occur with an identical region, the signals from the plurality of mobile terminals will collide with one another.

When the SRAs from the plurality of mobile terminals

collide with one another and therefore the base station cannot receive them, each of the plurality of mobile terminals generally repeats transmission of its SRA again with either or both of a different periodicity and a different region. In order to reduce the probability that SRAs from a plurality of mobile terminals collide with one another, a method of establishing the orthogonality of each mobile terminal by using FDM/TDM/CDM has been studied.

[0010]

Use of a scheduled channel has been also studied as allocation of a synchronous random access SRA to physical resources (nonpatent reference 4).

A scheduled channel is scheduled to be allocated to each target mobile terminal, unlike a channel, such as an S-RACH, in which collision (or referred to as competition) of signals from a plurality of mobile terminals is allowed. In this case, because a region which is allocated in advance to each mobile terminal is decided, there is no competition between signals from a plurality of mobile terminals, and therefore there is no necessity for the ID number (the UE-ID) of each mobile terminal which is effective within the cell of the base station to be mapped onto an SR signal which each mobile terminal has transmitted. Therefore, in a case in which an uplink SRA is transmitted by using a scheduled channel, the amount of information of the uplink SR signal can be reduced.

[0011]

A process of transmitting an Ack/Nack and a CQI, and an synchronous random access (an SR or the like) simultaneously in the case in which no uplink data transmission is carried out

will be explained.

An uplink Ack/Nack and an uplink CQI are the ones which, when a mobile terminal is receiving downlink data from a base station, the mobile terminal transmits to the base station according to the status of the reception. In contrast, an SRA is the one which the mobile terminal transmits to the base station for an SR or the like before starting transmission of uplink data. Because the descriptions of these signals are independent from one another, there can be a case in which the mobile terminal transmits them simultaneously.

Fig. 26 shows an example in which a mobile terminal transmits an Ack/Nack and an SRA simultaneously in the case in which the mobile terminal is not carrying out any uplink data transmission.

This example is a case in which transmission of uplink data occurs while the mobile terminal carries out continuous reception of downlink data. The mobile terminal is receiving downlink data continuously. The data are demodulated and decoded in units of each TTI. The mobile terminal transmits result information (Ack/Nack) indicating a result of judgment of the reception to the base station according to the status of the reception of the downlink data. When receiving the transmission data normally from the base station, the mobile terminal transmits an Ack signal to the base station. The base station which has received the Ack transmits new data next time. In contrast with this, when not being able to receive the transmission data transmitted normally from the base station, the mobile terminal transmits a Nack signal to the base station. The base station which has received the Nack retransmits the

data which the mobile terminal was not able to receive normally to the mobile terminal.

[0012]

Allocation of the uplink Ack/Nack to physical resources is implemented by monopolistically allocating a plurality of time-frequency regions having separated narrow bands, as previously explained. Therefore, the uplink Ack/Nack is also transmitted continuously. In contrast, when uplink data occurs in the mobile terminal, the mobile terminal transmits a scheduling request SR to the base station before transmitting the uplink data. Allocation of the SR to physical resource is implemented by monopolistically allocating one certain time-frequency region, as previously explained. Therefore, as shown in the figure, when uplink data occur at a certain time, an SR occurs with a short time delay.

When the base station is not able to receive the SR signal which the mobile terminal has transmitted, the mobile terminal transmits the SR signal again. As can be seen from the above explanation, there occurs a status in which, when transmission of uplink data occurs while, for example, a mobile terminal carries out continuous reception of downlink data, the mobile terminal has to transmit an uplink Ack/Nack and an uplink SRA simultaneously. Furthermore, even though the mobile terminal does not receive the downlink data continuously, but receives the downlink data discontinuously, it is apparent that there may be a case in which the mobile terminal carries out the transmission of the uplink SR signal simultaneously if the mobile terminal transmits the uplink Ack/Nack which is a response to the received data.

[0013]

Similarly, it can be considered that, also when a scheduled channel is allocated as allocation of the scheduling request SR, which the mobile terminal transmits to the base station, to physical resources, there occurs a status in which the mobile terminal have to transmit the uplink Ack/Nack and the uplink SRA simultaneously.

Nonpatent reference 4 describes nothing about what type of channel is used as a scheduled channel and how to allocate a time-frequency region as a physical resource. It is therefore understood that even if there is provided, for example, a channel in which a 1-bit physical resource intended only for a scheduling request SR is allocated, the mobile terminal has to transmit an uplink Ack/Nack continuously when carrying out continuous reception of downlink data, and therefore there occurs a status in which, when transmission of uplink data occurs at that time, the mobile terminal has to transmit an uplink Ack/Nack and an uplink SRA simultaneously.

[0014]

Furthermore, the nonpatent reference 4 suggests nothing about "the problems of the invention" and "the advantages of the invention" which will be shown in the specification of the present invention.

Nonpatent reference 5 discloses transmitting an uplink scheduling request by using an individual uplink control channel, such as an existing channel (CQICH) for CQI transmission or an existing channel (ACHCH) for Ack/Nack transmission. The reference shows that, as a result, a transmission procedure of transmitting an uplink scheduling

request with little delay (Delay) can be established.

However, the nonpatent reference 5 suggests nothing about "the problems of the invention" and "the advantages of the invention" which will be shown in the specification of the present invention.

[0015]

The nonpatent reference 5 discloses only transmitting an uplink scheduling request by using either a channel (CQICH) for CQI transmission or a channel (ACHCH) for Ack/Nack transmission, but discloses nothing about how to allocate the CQICH and the ACHCH, as physical resources, to a time-frequency region. It is therefore understood that even if a case in which an uplink scheduling request is transmitted by using, for example, a channel (CQICH) for CQI transmission, is considered, when a mobile terminal is carrying out continuous reception of downlink data, the mobile terminal has to transmit an uplink Ack/Nack continuously, and therefore there occurs a status in which, when transmission of uplink data occurs at that time, the mobile terminal has to transmit an uplink Ack/Nack (ACHCH) and an uplink scheduling request (CQICH) simultaneously.

It is therefore understood that the nonpatent reference 5 does not solve "the problems of the invention" shown in the specification of the present invention.

[0016]

[Nonpatent reference 1] 3GPP contributions R1-062741

[Nonpatent reference 2] 3GPP contributions R1-062742

[Nonpatent reference 3] 3GPP TR25.814V7.0.0

[Nonpatent reference 4] 3GPP contributions R1-062719

[Nonpatent reference 5] 3GPP contributions R1-062571

[0017]

Because conventional communication systems which comply with the LTE are constructed as mentioned above, an SC-FDMA (Single Career Frequency Division Multiple Access which is also referred to as DFT-spread OFDM) is used as an uplink access method. Because the SC-FDMA is single carrier transmission, compared with multi carrier transmission, such as OFDM, in which symbolic data are transmitted with them being piggybacked onto each subcarrier, the SC-FDMA has a feature of being able to reduce the PAPR (Peak to Average Power Ratio peak to average power ratio). Therefore, because the power consumption of a mobile terminal can be reduced at a time when the mobile terminal carries out transmission and the transmit power which satisfies defined adjacent channel leakage power can be increased, there is provided an advantage of widening the cell coverage. However, there may be a case in which a mobile terminal has to simultaneously carry out a process of transmitting an uplink Ack/Nack and an uplink CQI by using an Ack/Nack exclusive channel and a process of transmitting an uplink scheduling request signal (SR) by using an S-RACH or a scheduled channel, or a CQICH and an ACHCH according on its status. In this case, because those signals have no correlation among them, when transmitted simultaneously, they are not transmitted with single carrier transmission, but are transmitted with multi carrier transmission. In the case in which such signals having no correlation among them are transmitted simultaneously, the PAPR becomes high because the time waveforms of the transmission signals have a high peak. A problem is that as the PAPR becomes high, the power consumption of the mobile terminal increases

and therefore the cell coverage becomes narrow. A further problem is that as the PAPR becomes high, those signals become an interference wave to other mobile terminals and the communication system.

[0018]

The present invention is made in order to solve the above-mentioned problems, and it is therefore an object of the present invention to provide a data communication method, a communication system, and a mobile terminal which can prevent increase in the radio resources load due to temporary increase in the physical channels and can also reduce the PAPR (peak to average power ratio).

Disclosure of the Invention

[0019]

In accordance with the present invention, there is provided a data communication method with which a mobile terminal carries out a response signal transmission process of transmitting a response signal to a base station by using an uplink control channel in an uplink direction from the mobile terminal to the base station, a scheduling request signal transmission process of transmitting a scheduling request signal to the base station by using a physical channel different from the uplink control channel when transmission data to be transmitted to the base station occur, and a control process of, when a processing timing of the response signal transmission process coincides with that of the scheduling request signal transmission process, stopping the response signal transmission process during a time interval during which the mobile terminal transmits the scheduling request signal.

[0020]

As a result, because it is not necessary to use a multi carrier method of simultaneously transmitting data associated with two physical channels (an Ack/Nack exclusive channel an S-RACH) which are allocated to two types of bands, there is provided an advantage of being able to prevent the increase in the radio resource load of the communication system due to temporary increase in the physical channels, and to reduce the PAPR (peak to average power ratio).

[0021]

In accordance with the present invention, there is provided a communications system in which a mobile terminal includes: a transmitting unit for transmitting a response signal to a base station by using an uplink control channel in an uplink direction from the mobile terminal to the base station, and for transmitting a scheduling request signal to the base station by using a physical channel different from the uplink control channel when transmission data to be transmitted to the base station occur; and a control unit for, when a transmission timing of the response signal coincides with that of the scheduling request signal in the transmitting unit, stopping the transmission process of transmitting the response signal during a time interval during which the transmitting unit transmits the scheduling request signal.

[0022]

As a result, because it is not necessary to use a multi carrier method of simultaneously transmitting data associated with two physical channels (an Ack/Nack exclusive channel an S-RACH) which are allocated to two types of bands, there is

provided an advantage of being able to prevent the increase in the radio resource load of the communication system due to temporary increase in the physical channels, and to reduce the PAPR (peak to average power ratio).

[0023]

In accordance with the present invention, there is provided a data communication method with which a mobile terminal carries out a control signal generation process of generating an uplink control signal including at least a response signal, while, when transmission data to be transmitted to a base station occur, performing time division multiplexing of a scheduling request signal and the response signal to generate the uplink control signal, and a control signal transmission process of transmitting a control signal including the uplink control signal generated through the control signal generation process to the base station by using an uplink control channel in an uplink direction from the mobile terminal to the base station.

[0024]

As a result, because it is not necessary to use a multi carrier method of simultaneously transmitting data associated with two physical channels (an Ack/Nack exclusive channel an S-RACH) which are allocated to two types of bands, there is provided an advantage of being able to prevent the increase in the radio resource load of the communication system due to temporary increase in the physical channels, and to reduce the PAPR (peak to average power ratio).

[0025]

In accordance with the present invention, there is

provided a data communication method with which a mobile terminal selectively carries out either a process of coding individual data by using a first code or a process of coding the individual data including a scheduling request signal by using a second code when transmission data to be transmitted the base station occur, and also carries out a process of transmitting the coded individual data by using an uplink common channel.

[0026]

As a result, because it is not necessary to use a multi carrier method of simultaneously transmitting data associated with two physical channels (an Ack/Nack exclusive channel an S-RACH) which are allocated to two types of bands, there is provided an advantage of being able to prevent the increase in the radio resource load of the communication system due to temporary increase in the physical channels, and to reduce the PAPR (peak to average power ratio).

[0027]

In accordance with the present invention, there is provided a data communication method with which a mobile terminal carries out a control signal generation process of, when transmission data to be transmitted to a base station occur, performing time division multiplexing of at least a scheduling request signal and a response signal to generate an uplink control signal, and a control signal transmission process of transmitting a control signal including the uplink control signal generated through the control signal generation process to the base station by using a random access channel which is a physical channel.

[0028]

As a result, because it is not necessary to use a multi carrier method of simultaneously transmitting data associated with two physical channels (an Ack/Nack exclusive channel an S-RACH) which are allocated to two types of bands, there is provided an advantage of being able to prevent the increase in the radio resource load of the communication system due to temporary increase in the physical channels, and to reduce the PAPR (peak to average power ratio).

Brief Description of the Figures

[0029]

[Fig. 1] Fig. 1 is an explanatory drawing showing the structure of a mobile communication system mobile communication system which complies with LTE;

[Fig. 2] Fig. 2 is an explanatory drawing showing the structure of channels for use with the communications system which complies with LTE;

[Fig. 3] Fig. 3 is a block diagram showing the structure of a mobile terminal;

[Fig. 4] Fig. 4 is a block diagram showing the structure of a base station;

[Fig. 5] Fig. 5 is an explanatory drawing for explaining radio resources which are allocated to an Ack/Nack exclusive channel and an S-RACH for transmission of an uplink scheduling request signal SR;

[Fig. 6] Fig. 6 is a flow chart explaining processing carried out by a mobile terminal, including up to a process of transmitting an uplink scheduling request signal;

[Fig. 7] Fig. 7 is a flow chart explaining a series of processes

including from the process of transmitting an uplink scheduling request signal up to a process of starting transmission of uplink data;

[Fig. 8] Fig. 8 is a flow chart explaining the series of processes including from the process of transmitting an uplink scheduling request signal up to the process of starting transmission of uplink data;

[Fig. 9] Fig. 9 is an explanatory drawing for explaining examples of mapping of Ack/Nack symbols to be transmitted by using an Ack/Nack exclusive channel;

[Fig. 10] Fig. 10 is an explanatory drawing for explaining examples of mapping of Ack/Nack symbols to be transmitted by using an Ack/Nack exclusive channel;

[Fig. 11] Fig. 11 is an explanatory drawing for explaining radio resources which are allocated to an Ack/Nack exclusive channel and an S-RACH for transmission of an uplink scheduling request signal SR;

[Fig. 12] Fig. 12 is an explanatory drawing for explaining examples of mapping of Ack/Nack symbols to be transmitted by using an Ack/Nack exclusive channel;

[Fig. 13] Fig. 13 is a flow chart explaining processing carried out by a mobile terminal, including up to a process of transmitting an uplink scheduling request signal;

[Fig. 14] Fig. 14 is an explanatory drawing for explaining an example of mapping of an uplink scheduling request signal which is transmitted by using an Ack/Nack exclusive channel;

[Fig. 15] Fig. 15 is a flow chart for explaining processing carried out by a mobile terminal which transmits an uplink scheduling request signal, and processing carried out by a base

station which receives the uplink scheduling request signal;

[Fig. 16] Fig. 16 is a flow chart for explaining processing carried out by a mobile terminal which transmits an uplink scheduling request signal, and processing carried out by a base station which receives the uplink scheduling request signal;

[Fig. 17] Fig. 17 is an explanatory drawing showing allocation of radio resources of a UL-SCH and an RACH;

[Fig. 18] Fig. 18 is a flow chart explaining processing carried out by a mobile terminal, including up to a process of transmitting an uplink scheduling request signal;

[Fig. 19] Fig. 19 is an explanatory drawing showing radio resources in which a preamble and a message, an Ack/Nack, a CQI, and an SR are mapped onto an S-RACH;

[Fig. 20] Fig. 20 is an explanatory drawing showing radio resources in which a preamble and a message, an Ack/Nack, a CQI, and an SR are mapped onto an S-RACH;

[Fig. 21] Fig. 21 is an explanatory drawing showing radio resources in which a preamble and a message, an Ack/Nack, a CQI, and an SR are mapped onto an S-RACH;

[Fig. 22] Fig. 22 is an explanatory drawing for explaining an uplink L1/L2 control signal;

[Fig. 23] Fig. 23 is an explanatory drawing showing radio resources to which an Ack/Nack and a CQI are allocated in the case in which uplink data transmission is carried out or in the case in which no uplink data transmission is carried out;

[Fig. 24] Fig. 24 is an explanatory drawing showing radio resources in which an Ack/Nack and a CQI are allocated to an Ack/Nack exclusive channel;

[Fig. 25] Fig. 25 is an explanatory drawing showing radio

resources in which an uplink scheduling request signal is allocated to an S-RACH;

[Fig. 26] Fig. 26 is an explanatory drawing showing an example in which a mobile terminal transmits an Ack/Nack and an SRA simultaneously in a case in which the mobile terminal is not carrying out any uplink data transmission;

[Fig. 27] Fig. 27 is an explanatory drawing for explaining an example of mapping of an uplink scheduling request signal which is transmitted by using an Ack/Nack exclusive channel;

[Fig. 28] Fig. 28 is a sequence diagram in a case of a first example of a setting;

[Fig. 29] Fig. 29 is a flow diagram of processing carried out by a mobile terminal in the case of the first example of the setting;

[Fig. 30] Fig. 30 is a flow diagram of processing carried out by a base station in the case of the first example of the setting;

[Fig. 31] Fig. 31 is a sequence diagram in a case of a second example of the setting;

[Fig. 32] Fig. 32 is a flow diagram of processing carried out by a mobile terminal in the case of the second example of the setting;

[Fig. 33] Fig. 33 is a flow diagram of processing carried out by a base station in the case of the second example of the setting;

[Fig. 34] Fig. 34 is a detailed block diagram of a mobile terminal which transmits an uplink scheduling request signal;

[Fig. 35] Fig. 35 is an explanatory drawing of allocation of radio resources for a Sounding RS during transmission of uplink data in Embodiment 7;

[Fig. 36] Fig. 36 is a concrete sequence diagram in a case in which an uplink transmission request occurs in a state where no data communications are carried out via both an uplink and a downlink;

[Fig. 37] Fig. 37 is a flow chart showing a flow in a case in which a transmission request occurs in a state in which a mobile station is synchronized with a base station and is not carrying out transmission of uplink data;

[Fig. 38] Fig. 38 is an explanatory drawing showing a method of allocating radio resources in a case in which a base station sets up a plurality of BWs for a usual Sounding RS, and the circumstances of allocation of radio resources to a mobile terminal UE1;

[Fig. 39] Fig. 39 is a flow chart showing a setting of the BW of a Sounding RS by a base station eNodeB;

[Fig. 40] Fig. 40 is a flow chart showing a judging method in a case in which the base station eNodeB selects the BW;

[Fig. 41] Fig. 41 is a flow chart showing a judging method in a case in which a mobile terminal selects the BW;

[Fig. 42] Fig. 42 is an explanatory drawing of allocation of radio resources in a plurality of UEs in one UE group;

[Fig. 43] Fig. 43 is an explanatory drawing in a case of a Sounding RS region for each UE group;

[Fig. 44] Fig. 44 is an explanatory drawing of a generation method of generating a reference signal for sounding having the functions of an uplink scheduling request signal;

[Fig. 45] Fig. 45 is a diagram of sequences between a mobile terminal and a base station;

[Fig. 46] Fig. 46 is an explanatory drawing of an allocation

method of allocating a pilot for sounding and a mobile-terminal-specific code in a case in which a mobile terminal transmits a reference signal for sounding;

[Fig. 47] Fig. 47 is an explanatory drawing showing a pilot pattern in which a part of a sounding pilot is symbols for scheduling request;

[Fig. 48] Fig. 48 is a diagram of sequences between a mobile terminal and a base station;

[Fig. 49] Fig. 49 is an explanatory drawing of an example of generation of a reference signal for sounding;

[Fig. 50] Fig. 50 is a diagram of sequences between a mobile terminal and a base station;

[Fig. 51] Fig. 51 is an explanatory drawing of an example of generation of a reference signal for sounding;

[Fig. 52] Fig. 52 is a diagram of sequences between a mobile terminal and a base station;

[Fig. 53] Fig. 53 is an explanatory drawing in a case in which a reference signal for sounding is transmitted at certain time intervals;

[Fig. 54] Fig. 54 is an explanatory drawing in a case in which a reference signal for sounding which is transmitted at certain time intervals serves as an uplink scheduling request signal;

[Fig. 55] Fig. 55 is an explanatory drawing of a time-frequency resource in a case in which there is an Ack/Nack exclusive channel region;

[Fig. 56] Fig. 56 is an explanatory drawing of a time-frequency resource in a case of allocating a region of RS for sounding to all of the entire band of the system;

[Fig. 57] Fig. 57 is an explanatory drawing of a time-frequency

resource;

[Fig. 58] Fig. 58 is an explanatory drawing of a time-frequency resource;

[Fig. 59] Fig. 59 is an explanatory drawing of transmission symbol mapping in a mobile terminal in a case of transmitting an uplink scheduling request signal with a region for sounding RS;

[Fig. 60] Fig. 60 is an explanatory drawing of a transmission signal of a mobile terminal when a scheduling request occurs;

[Fig. 61] Fig. 61 is an explanatory drawing of a transmission signal of a mobile terminal when a scheduling request occurs;

[Fig. 62] Fig. 62 is a diagram of sequences between a mobile terminal and a base station;

[Fig. 63] Fig. 63 is an explanatory drawing of a transmission signal of a mobile terminal when an uplink scheduling request occurs;

[Fig. 64] Fig. 64 is a diagram of sequences between a mobile terminal and a base station;

[Fig. 65] Fig. 65 is an explanatory drawing of a transmission signal of a mobile terminal when an uplink scheduling request occurs; and

[Fig. 66] Fig. 66 is a diagram of sequences between a mobile terminal and a base station.

Preferred Embodiments of the Invention

[0030]

Hereafter, in order to explain this invention in greater detail, the preferred embodiments of the present invention will be described with reference to the accompanying drawings.

Embodiment 1.

Fig. 1 is an explanatory drawing showing the structure of a mobile communication system which complies with LTE. In Fig. 1, an aGW 1 performs transmission and reception of control data and user data with a plurality of base stations (eNodeB) 2, and a base station 2 transmits and receives data to and from a plurality of mobile terminals 3. Between a base station 2 and a mobile terminal 3, broadcast information, information used for processing a call, individual control data, individual user data, control data for E-MBMS, user data, and so on are transmitted. It has also been studied that base stations 2 communicate with each other.

A base station 2 has uplink and downlink schedulers. These schedulers of a base station 2 enable transmission and reception of data between the base station 2 and each mobile terminal 3, and carry out scheduling for improvements in the throughput of each mobile terminal 3 and that of the whole mobile communication system.

[0031]

A E-MBMS provides a broadcast type point-to-multipoint (Point to Multipoint PtoM) communication service with which data are transmitted at a time from a certain base station toward a plurality of mobile terminals. Concretely, an information service, such as news or weather forecast, and a large-volume broadcast service, such as mobile TV, have been studied.

The aGW 1 communicates with a service center 5 via a PDN 4 (Packet Data Network).

The service center 5 stores and distributes a content used for providing a service for users. A content provider transmits E-MBMS data, such as mobile TV broadcast data, to the service

center 5. The service center 5 stores the E-MBMS data therein and also transmits the E-MBMS data to base stations 2 via the PDN 4 and the aGW 1.

[0032]

Fig. 2 is an explanatory drawing showing the structure of channels. Mapping of logical channels (Logical channels) and transport channels (Transport channels) is shown in Fig. 2.

The logical channels are classified according to the functions and logical characteristics of transmission signals. The transport channels are classified according to transmission forms. Broadcast information is piggybacked onto a BCCH (Broadcast Control Channel). A BCCH is mapped to a BCH (Broadcast Channel) and is transmitted from a base station to mobile terminals.

Information used for processing a call is piggybacked onto a PCCH (Paging Control Channel). A PCCH is mapped to a PCH (Paging Channel) and is transmitted from a base station to mobile terminals in the cell of the base station. Individual control data destined for each mobile terminal are piggybacked onto a DCCH (Dedicated Control Channel).

[0033]

Individual user data destined for each mobile terminal are piggybacked onto a DTCH (Dedicated Traffic Channel). A DCCH and a DTCH are mapped to a DL-SCH (Downlink Shared Channel), and are transmitted individually from a base station to each mobile terminal. In contrast with this, it is individually transmitted from each mobile terminal to a base station by using a UL-SCH (Uplink Shared Channel).

A DL-SCH and a UL-SCH are shared channels (Shared Channels).

Control data for E-MBMS and user data are piggybacked onto an MCCH (Multicast Control Channel) and an MTCH (Multicast Traffic Channel), respectively, and are mapped to a DL-SCH or an MCH (Multicast Channel) and are transmitted from a base station to a mobile terminal.

A connection request signal from a mobile terminal, e.g., a scheduling request signal SR is transmitted from each mobile terminal to a base station by using a random access channel (Random Access Channel RACH). An S-RACH is one of RACHs.

[0034]

Fig. 3 is a block diagram showing the structure of a mobile terminal. A transmitting process of the mobile terminal 3 is carried out as follows.

First, control data from a protocol processing unit 6 and user data from an application unit 7 are stored in a transmission data buffer unit 8.

The data stored in the transmission data buffer unit 8 are delivered to an encoder unit 9, and the encoder unit performs an encoding process, such as an error correction, on the data. There can exist data on which no encoding process is performed and which are directly outputted from the transmission data buffer unit 8 to a modulating unit 10.

The modulating unit 10 performs a modulation process on the data on which the encoding process has been performed by the encoder unit 9. After the modulated data are converted into a baseband signal, this baseband signal is outputted to a frequency converting unit 11 and is then converted into a signal

having a radio transmit frequency. After that, the transmission signal is transmitted to a base station 2 from an antenna 12.

[0035]

A receiving process of the mobile terminal 3 is carried out as follows. A radio signal from the base station 2 is received by the antenna 12. The received signal having a radio receive frequency is converted into a baseband signal by the frequency converting unit 11, and a demodulating unit 13 performs a demodulation process on the baseband signal. Data which the demodulating unit obtains after demodulating the baseband signal are delivered to a decoder unit 14, and the decoder unit performs a decoding process, such as an error correction, on the data. Control data among the decoded data are delivered to the protocol processing unit 6, while user data among the decoded data are delivered to the application unit 7. The series of transmission and reception processes of the mobile terminal is controlled by a control unit 15.

[0036]

Fig. 4 is a block diagram showing the structure of a base station. A transmitting process of the base station 2 is carried out as follows.

An aGW communication unit 16 transmits and receives data between the base station 2 and an aGW 1. An other base station communication unit 17 transmits and receives data to and from another base station.

Each of the aGW communication unit 16 and the other base station communication unit 17 receives and sends information from and to a protocol processing unit 18. Control data from

the protocol processing unit 18 and user data from the aGW communication unit 16 and the other base station communication unit 17 are stored in a transmission data buffer unit 19.

The data stored in the transmission data buffer unit 19 are delivered to an encoder unit 20, and the encoder unit performs an encoding process, such as an error correction, on the data. There can exist data on which no encoding process is performed and which are directly outputted from the transmission data buffer unit 19 to a modulating unit 21. The modulating unit 21 performs a modulation process on the data on which the encoding process has been performed by the encoder unit.

[0037]

After the modulated data are converted into a baseband signal, this baseband signal is outputted to a frequency converting unit 22 and is then converted into a signal having a radio transmit frequency. After that, the transmission signal is transmitted from an antenna 23 to one or more mobile terminals 1.

A receiving process of the base station 2 is carried out as follows.

A radio signal from one or more mobile terminals 3 is received by the antenna 23. The received signal having a radio receive frequency is converted into a baseband signal by the frequency converting unit 22, and a demodulating unit 24 performs a demodulation process on the baseband signal. Data which the demodulating unit obtains after demodulating the baseband signal are delivered to a decoder unit 25, and the decoder unit performs a decoding process, such as an error

correction, on the data. Control data among the decoded data are delivered to the protocol processing unit 18, and user data among the decoded data are delivered to the aGW communication unit 16 and the other base station communication unit 17. The series of transmission and reception processes of the base station 2 is controlled by a control unit 26.

[0038]

Hereafter, the operation of a mobile terminal in accordance with the present invention will be explained.

When a mobile terminal is not performing uplink data transmission and is receiving downlink data, the mobile terminal transmits an Ack/Nack signal indicating the result of the reception of the downlink data (whether the mobile terminal has received the data properly) to the base station by using an Ack/Nack exclusive channel.

The mobile terminal also transmits a downlink communication path quality (CQI) signal for the downlink scheduling by the base station, as well as the Ack/Nack signal indicating the result of the reception of the downlink data, to the base station by using the Ack/Nack exclusive channel.

Furthermore, regardless of whether the mobile terminal has received the downlink data, in order to enable the downlink scheduling by the base station or maintain the synchronization between the base station and the mobile terminal, the mobile terminal transmits a CQI signal to the base station by using the Ack/Nack exclusive channel.

[0039]

When the mobile terminal starts transmission of uplink data in a state in which the mobile terminal transmits an

Ack/Nack signal and/or a CQI signal to the base station, as mentioned, the mobile terminal has to transmit an uplink scheduling request signal SR independently from the above-mentioned Ack/Nack and/or the above-mentioned CQI to the base station. In this embodiment, a method of, when transmitting an uplink scheduling request signal SR to the base station by using a physical channel (S-RACH) different from the Ack/Nack exclusive channel, transmitting the uplink scheduling request signal by using an SC-FDMA method which implements a wider coverage and a lower PAPR will be explained.

[0040]

In this Embodiment 1, in a case in which a mobile terminal desires to start transmission of uplink data in a state in which the mobile terminal transmits an Ack/Nack signal and/or a CQI signal by using an uplink Ack/Nack exclusive channel while receiving downlink data without performing transmission of uplink data, the mobile terminal transmits an uplink scheduling request signal SR for setting up a channel for uplink data transmission by using a physical channel (in this Embodiment 1, by using an S-RACH) to which a frequency band different from that of the Ack/Nack exclusive channel is allocated.

At that time, the mobile terminal does not use a multi carrier method of simultaneously transmitting data associated with two physical channels which are allocated to two types of bands, respectively, the mobile terminal does not transmit an Ack/Nack signal and/or a CQI signal by using the Ack/Nack exclusive channel (DTX Discontinuous Transmission) while transmitting an SR (preamble/message) which the mobile terminal temporarily transmits to the base station when starting

transmission of uplink data.

As a result, increase in the radio resource load on the system due to temporary increase in the physical channels of one mobile terminal can be prevented, while transmission with a single carrier method which guarantees a low PAPR can be implemented.

[0041]

Fig. 5 is an explanatory drawing for explaining radio resources which are allocated to an Ack/Nack exclusive channel and an S-RACH for transmission of an uplink scheduling request signal SR. Fig. 6 is a flow chart explaining processing carried out by a mobile terminal, including up to a process of transmitting an uplink scheduling request signal.

Figs. 7 and 8 are flow charts explaining a series of processes including from the process of transmitting an uplink scheduling request signal up to a process of starting transmission of uplink data. In Fig. 5, it is assumed that at the same time when the mobile terminal UE1 is not carrying out transmission of uplink data, such as user data, but is receiving only downlink data, the mobile terminal is transmitting an Ack/Nack and/or a CQI to these received data by using an Ack/Nack exclusive channel.

The modulating unit 10 of the mobile terminal shown in Fig. 3 performs a CDM multiplexing process (can alternatively perform an FDM multiplexing process or a TDM multiplexing process), which is specific to the mobile terminal, on the Ack/Nack signal, and transmits the Ack/Nack signal by using the Ack/Nack exclusive channel. Therefore, there can be a case in which the mobile terminal UE1 transmits the Ack/Nack signal

continuously with respect to time by using the Ack/Nack exclusive channel.

[0042]

In this case, when an uplink data transmission request in ST601 of Fig. 6 occurs (if Yes in ST601), the mobile terminal, in ST602, checks the receiving state of the downlink data (DL data).

In this Embodiment 1, because the mobile terminal is receiving the downlink data, the mobile terminal advances to ST604 in which the mobile terminal determines the timing at which the mobile terminal transmits an uplink scheduling request signal SR (preamble or/and message) by using an S-RACH. If the mobile terminal is not receiving any downlink data and the synchronization with the base station is not established (if No in ST602), the mobile terminal, in ST603, carries out an algorithm of transmitting an uplink scheduling request signal SR by using a physical channel called a Non-S-RACH.

After, in ST604, determining the transmission timing of the uplink scheduling request signal SR, at the same time when the mobile terminal UE1 transmits the uplink scheduling request signal SR by using the S-RACH, the mobile terminal, in ST605, stops the transmission of a predetermined Ack/Nack symbol (or LB) of the uplink Ack/Nack exclusive channel or a CQI symbol (or LB), which the mobile terminal was originally scheduled to transmit at the same timing, and suspends the transmission while the mobile terminal transmits the uplink scheduling request signal SR (symbol DTX or DTX of LB). This stop (DTX) of the transmission of the Ack/Nack symbol is performed by the modulating unit 10 under the control of the control unit 15.

[0043]

Fig. 5 shows an example of the allocation of radio resources to an S-RACH which is a physical channel via which an uplink scheduling request signal SR is transmitted, and an Ack/Nack exclusive channel.

In Fig. 5, the radio resources are divided into a plurality of time-frequency regions. In each time-frequency region, the time axis is divided into units of each subframe (=0.5ms), and the frequency axis is divided into units having different bands according to the amount of transmission data associated with the physical channel.

[0044]

In the allocation of the radio resources according to this Embodiment 1, the S-RACH and the channel for uplink data transmission use time-frequency unit regions having the same size, respectively, whereas the Ack/Nack exclusive channel uses a frequency band unit region narrower than the time-frequency unit regions (the same time division). A subframe 1 of one subcarrier in the Ack/Nack exclusive channel is comprised of six long blocks (Long Blocks LB1 to LB6) and two short blocks (Short Blocks SB, small blocks).

A symbol for physical channel synchronization (a symbol for demodulation) is included in a short block SB. While the mobile terminal UE1 transmits the uplink scheduling request signal SR with the length of one subframe by using the time-frequency region of the S-RACH which is allocated as shown in Fig. 5, the mobile terminal stops the modulation and transmission of the symbol data of the long blocks LB1 to LB6 and the two short blocks SB which are currently allocated to

the Ack/Nack exclusive channel (the mobile terminal carries out DTX).

[0045]

However, because, in the next subframe 2, there is no transmission of the uplink scheduling request signal SR using the S-RACH and there is also no transmission of uplink data such as user data, the mobile terminal transmits symbol data (LB2-1 to LB2-6) for the subframe 2 by using the Ack/Nack exclusive channel. Furthermore, in the next subframe (a subframe 1 during TTI No.2), an uplink scheduling request signal SR from another mobile terminal UE occurs, an S-RACH for this SR is allocated to a time-frequency region which exists in a frequency band different from that of the mobile terminal UE1.

In this case, the S-RACH of the other mobile terminal UE is transmitted, and Ack/Nack symbol data and/or CQI symbol data from the mobile terminal UE1 during this subframe interval are transmitted by using the Ack/Nack exclusive channel. The sequence including from the transmission of an uplink scheduling request signal SR by using the S-RACH up to the uplink data transmission is shown in Figs. 7 and 8.

[0046]

Fig. 7 shows a flow chart in a case (ST701) in which the mobile terminal transmits an uplink scheduling request signal SR (preamble and message) in only one step.

Fig. 8 shows a flow chart in a case (ST801 and ST803) in which the mobile terminal transmits an uplink scheduling request signal SR by sequentially transmitting its preamble (preamble) and its message (message) in two steps.

In Fig. 7, after the mobile terminal notifies the uplink

scheduling request to the base station with the preamble and the message, the mobile terminal receives information "uplink data resource allocation (Uplink Data Resource Allocation)" about allocation of radio resources for uplink data transmission and timing by using a downlink L1/L2 control signal from the base station.

In Fig. 8, the mobile terminal receives "scheduling request resource allocation (SR Resourece Allocation)" after transmitting the preamble, and, after notifying a message part of the scheduling request to the base station by using a resource which is allocated thereto with the scheduling request resource allocation, receives information (Uplink Data Resource Allocation) about radio resources allocation for uplink data transmission and timing by using a downlink L1/L2 control signal from the base station.

[0047]

The mobile terminal then starts transmission of uplink data by using a UL-SCH (Uplink Shared channel). In this Embodiment 1, the example in which one subframe is allocated to transmission of an uplink scheduling request signal SR is explained. However, because there is a case in which a preamble and a message are sent at a time during a long transmission time, as shown in Fig. 7, and a case in which a preamble is sent at a time during short transmission time and a message is sent at a time during another short transmission time, as shown in Fig. 8, the length of a transmission time during which an Ack/Nack cannot be transmitted, and the occurrence frequency can be changed according to the length and frequency of the transmission time of the uplink scheduling request signal SR.

The structure of long blocks and short blocks in a subframe shown in Fig. 5 is only an example, and, even if the structure of the subframe changes, the concept of the present invention can be applied.

[0048]

Hereafter, the preamble and message of an uplink scheduling request signal SR will be explained. It is considered that, for example, a "random ID (random ID (UE ID))" which is specific identifying information for identifying the terminal is allocated to the preamble. As the message, the amount of uplink transmission data (a buffer state in the UE), the QoS of the uplink transmission data, or a transmission power margin of the terminal, in addition to the "UE ID" previously shown, can be considered.

[0049]

In conventional communication methods (FDMA, TDMA, and CDMA), a stop (DTX) of transmission of symbols via an uplink provides an advantage of reducing the power consumption of a mobile terminal, reducing the highest transmit power of the mobile terminal to within a power range indicated by a base station, and also reducing the transmit power of the whole system to within a fixed range. In contrast, by using the method of stopping transmission of symbols (DTX) in accordance with the present invention, because, for an uplink, not only the PAPR in the mobile terminal can be reduced, but single carrier transmission can be carried out, unlike in the case of using DTX of a conventional communication method, the scale of the implementation of the modulation and demodulation processes can be reduced in both the mobile terminal and the base station,

and the processing load on the whole system can be reduced compared with the case of using a multi carrier transmission method.

[0050]

As mentioned above, by using Embodiment 1, there can be provided an advantage of, in a case in which a mobile terminal is not carrying out transmission of uplink data, but is receiving downlink data, enabling the mobile terminal which has to transmit an uplink scheduling request signal SR together with an Ack/Nack to perform the transmission of these signals simultaneously without increasing the PAPR in the mobile terminal.

[0051]

In contrast, there can be a case in which in the mobile communication system, even when a mobile terminal does not receive downlink data, an Ack/Nack exclusive channel is allocated to the mobile terminal.

More specifically, there can be considered a case in which even when there exist no downlink data in a base station, in order to prepare future downlink scheduling or maintain the synchronization between the base station and a mobile terminal, the result (CQI) of measurement of the quality of a downlink communication path is notified from the mobile terminal to the base station. Also in such a case, there can be considered a case in which the transmission of the CQI using an Ack/Nack exclusive channel and an uplink scheduling request signal SR occur simultaneously. In such a mobile communication system, it is preferable that when performing judgment as shown in ST602, a mobile terminal judges whether or not an Ack/Nack exclusive

channel is allocated thereto. In addition, even a mobile communication system in which when a mobile terminal does not receive downlink data no Ack/Nack exclusive channel is allocated to the mobile terminal can adopt this judgment.

[0052]

Embodiment 2.

In above-mentioned Embodiment 1, in a case in which a mobile terminal transmits an uplink scheduling request signal SR by using an S-RACH while transmitting an Ack/Nack signal and/or a CQI signal by using an Ack/Nack exclusive channel, the mobile terminal stops the transmission of the Ack/Nack signal and/or the CQI signal while transmitting the uplink scheduling request signal SR.

By stopping the transmission of the Ack/Nack signal and/or the CQI signal while transmitting the uplink scheduling request signal SR, the mobile terminal does not have to use a multi carrier method with which to simultaneously transmit data associated with the two physical channels (the Ack/Nack exclusive channel and the S-RACH) which are allocated to two types of bands, respectively. Therefore, increase in the radio resources load on the communication system due to temporary increase in the physical channels can be prevented, and transmission with a single carrier method which guarantees a low PAPR can be implemented.

In contrast, in Embodiment 2 which will be explained hereafter, a mapping method for an Ack/Nack exclusive channel of, when performing a stop (DTX) of transmission of an Ack/Nack symbol, preventing a bad influence from being exerted upon the performance of communications of symbols on the Ack/Nack

exclusive channel will be explained.

[0053]

In Embodiment 1, the processing including from the process of transmitting an uplink scheduling request signal SR by using an S-RACH up to a process of transmitting uplink data is explained with reference to Fig. 52. More specifically, the transmission of an uplink scheduling request signal SR (a preamble or/and a message) includes a case, as shown in Fig. 7, in which a long transmission time is needed in order to send the preamble and the message at a time and a case, as shown in Fig. 8, in which the preamble is transmitted at a time and the message is transmitted at another time and therefore their respective transmission time become short.

In the case in which the transmission time of an uplink scheduling request signal SR is long, the time during which an Ack/Nack and/or a CQI cannot be transmitted (the DTX of the Ack/Nack symbol and/or the CQI symbol) becomes long, whereas in the case in which the transmission time of an uplink scheduling request signal SR are short, the time interval during which an Ack/Nack and/or a CQI cannot be transmitted becomes short. For each of the cases, a method of preventing the degradation of the communication quality because no transmission of the Ack/Nack symbol information and/or the CQI symbol information is carried out during the time during which the uplink scheduling request signal SR is transmitted will be explained hereafter.

[0054]

First, the process in the case of Fig. 7 will be explained. Because the preamble and the message are collectively

transmitted at a time in the transmission of the uplink scheduling request signal SR shown in Fig. 7, the time interval during which the Ack/Nack and/or the CQI cannot be transmitted becomes long, and can have a length of about one subframe as shown in Fig. 5. In order to prevent the degradation in the communication quality due to errors in the transmission of the Ack/Nack symbol information and/or the CQI symbol information which can occur during this time interval, in accordance with this Embodiment 2, a pattern of symbols to be sent by using the Ack/Nack exclusive channel is mapped in such a way that a pattern having a length of one subframe is repeated twice and is updated during each transmission time interval (TTI).

Furthermore, in order to ensure communication quality, a symbol pattern having a length of one subframe is formed to be a combination of symbols in which important information (higher-order bits) are given a higher priority and the number of repetitions of the important information is increased. Concrete examples of the mapping of symbol information which is to be transmitted by using an Ack/Nack exclusive channel are shown in Figs. 9 and 10.

[0055]

Fig. 9 is an explanatory drawing explaining examples of the mapping of Ack/Nack symbols to be transmitted by using an Ack/Nack exclusive channel. Fig. 9 shows an example of the mapping of symbols to the Ack/Nack exclusive channel, which has been proposed by the 3GPP (3rd Generation Partnership Project) until now (refer to the nonpatent reference 2).

For each of a case in which only Ack/Nack symbols are mapped to long blocks LB (Fig. 9(a)), a case in which only CQI

symbols are mapped to long blocks (Fig. 9(b)), and a case in which CQI symbols and Ack/Nack symbols are multiplexed and are mapped to long blocks LB (Fig. 9(c)), a symbol mapping structure with a transmission time interval length (TTI) is shown.

[0056]

A symbol pattern which is proposed in this Embodiment 2 is formed in such a way that even in a case in which an Ack/Nack and/or a CQI cannot be transmitted for a long period of time (= 1 subframe), a symbol pattern having a length of one subframe is repeated twice within 1 TTI for the purpose of preventing occurrence of errors in the transmission of the Ack/Nack and/or the CQI, thereby improving the communication quality.

In the symbol pattern shown in Fig. 9 in the case of CQI symbols, for one subframe A, CQI1, CQI2, CQI3, CQI4, CQI5, and CQI1 are mapped to long blocks, whereas for one subframe B, CQI2, CQI3, CQI4, CQI1, CQI2, and CQI1 are mapped to long blocks, and the CQI symbols are not arranged with the same symbol pattern in the subframes.

Therefore, when, for example, the one subframe A is DTXed, CQI5 is not transmitted once (one LB) during 1 TTI.
Also in the symbol pattern in which CQIs and Acks/Nacks are multiplexed with respect to time, they are not arranged with the same symbol pattern in both the one subframe A and the one subframe B.

[0057]

A mapping example of mapping the CQI symbols and a mapping example of multiplexing and mapping the CQI and the Ack/Nack, which are proposed by the present invention, are shown in Fig. 10.

First, in the mapping example of mapping the CQI symbols of Fig. 10(a), the same symbol mapping pattern is repeated in both a first subframe (single sub-frame A) and a second subframe (single sub-frame B) within 1 TTI. Furthermore, in the mapping of the symbols to each subframe length, symbols with a higher priority (i.e., symbols showing a higher-order digit of the CQI: in this example, CQI1) are repeated a larger number of times.

Furthermore, also in the mapping example of multiplexing and mapping the CQI symbols and the Ack/Nack symbol of Fig. 10(b), the same symbol mapping pattern is repeated in both a first subframe (single sub-frame A) and a second subframe (single sub-frame B) within 1 TTI, and, in the mapping of the symbols to each subframe length, symbols with a higher priority (the Ack/Nack and so on) are placed in a vicinity of a short block SB.

[0058]

In this Embodiment 2, an Ack/Nack and the higher-order bits of a CQI (CQI1 is the most significant bit) are considered as symbols having a higher priority. An Ack/Nack indicates the result of reception of downlink data, and therefore there arises a problem that retransmission of corresponding packet data occurs when this bit cannot be received properly by the base station. It is therefore necessary to increase the priority of the Ack/Nack in the symbol arrangement. It is further necessary to place the higher-order ones of the CQI bits indicating the reception state of the downlink data on a priority basis so as to enable the base station to cope with transmission errors and so on.

[0059]

Thus, it is not necessary to limit the mapping pattern in the symbol mapping method of taking into consideration a risk of the Ack/Nack information not being transmitted while the uplink scheduling request signal SR is transmitted and the importance of the symbols to the pattern of Fig. 10 which is explained in this Embodiment 2.

Even though the symbol mapping is not performed as shown in Fig. 10, this Embodiment 2 can be implemented. Therefore, the concept about the symbol mapping will be mentioned hereafter.

(1) Repeat symbols having a higher priority a larger number of times. (2) Place symbols having a higher priority in a vicinity of a short block SB.

In general, an Ack/Nack and the higher-order bits of a CQI (CQI1 is the most significant bit) are symbols having a higher priority.

[0060]

An Ack/Nack indicates the result of reception of downlink data, and therefore there arises a problem that, when this symbol cannot be received properly by the base station, retransmission of the corresponding packet data occurs and the throughput of the downlink data falls as a result. It is therefore necessary to increase the priority of the Ack/Nack in the symbol arrangement.

Also in the case of the higher-order ones of the CQI bits indicating the state of the reception of the downlink data, when a transmission error occurs, the erroneous difference between the downlink communication path quality which is measured by the mobile terminal and the downlink communication path quality

which the base station has received becomes large, and therefore appropriate scheduling cannot be carried out by the base station and this results in reduction in the downlink throughput of the whole mobile communications system. It is therefore necessary to increase the priority of the higher-order ones of the CQI bits indicating the state of the reception of the downlink data in the symbol arrangement.

[0061]

The priority of the Ack/Nack and that of the CQI depend on the desired error rates of their respective signals.

Because increase in the number of repetitions (repetition) can increase the receive power of the base station, the larger number of repetitions (repetition) a symbol has the more rarely an error occurs in the symbol.

Because it can be considered that a short block is used for phase compensation when receiving the short block and then demodulating the short block, the phase compensation is carried out more correctly as the difference between the transmission timing of the short block and that of the corresponding symbol decreases. Therefore, an error occurs more rarely in a symbol which is placed nearer to a short block. Some predetermined patterns exist in the mapping of the symbols of Ack/Nack information (an Ack/Nack and/or a CQI), and the mobile station can select one pattern from among the predetermined patterns, one pattern can be selected and notified by the base station, or one pattern can be dynamically allocated to the mobile station. As previously explained, when transmission of an Ack/Nack symbol and/or CQI symbols using an Ack/Nack exclusive channel cannot be carried out temporarily for a long period of

time (= during one subframe) because of transmission of an uplink scheduling request signal SR by using an S-RACH, an transmission error can be preventing from occurring in the information symbols of the Ack/Nack exclusive channel and therefore high communication quality can be maintained.

[0062]

Next, a case in which the transmission time during which an uplink scheduling request signal SR is transmitted once is sufficiently short, like the sequence of Fig. 8, will be explained.

In a case in which a mobile terminal, in ST605 of Fig. 6, transmits an uplink scheduling request signal SR, as shown in the flow chart of Fig. 8, by dividing it into a preamble and a message or sending the preamble and the message of a small size together, the time interval during which the mobile terminal transmits the uplink scheduling request signal SR becomes short. Therefore, the transmission stop time interval during which transmission of an Ack/Nack symbol and/or a CQI symbol in the Ack/Nack exclusive channel is stopped during the transmission of the uplink scheduling request signal SR also becomes short.

An example of how, in such a case, the S-RACH used for the transmission of the uplink scheduling request signal SR and the Ack/Nack exclusive channel are allocated in time-frequency is shown in Fig. 11.

[0063]

Because the amount of information of the uplink scheduling request signal SR in the sequence diagram of Fig. 8 is sufficiently small, in Fig. 11, a region to which the S-RACH

of the mobile terminal UE1 is allocated in time-frequency is only one leading data symbol block included in one time-frequency unit region. An Ack/Nack symbol or a CQI symbol which is transmitted at the same timing as this block is a symbol in a long block LB1 of the Ack/Nack exclusive channel. While the uplink scheduling request signal SR using the S-RACH of the mobile terminal UE1 is transmitted, the Ack/Nack information symbol or the CQI symbol in the block which is the long block LB1 is not transmitted.

[0064]

Fig. 12 is an explanatory drawing for explaining examples of the mapping of an Ack/Nack symbol and CQI symbols which are transmitted by using the Ack/Nack exclusive channel.

Unlike Fig. 10, Fig. 12 shows cases in each of which different symbols are mapped in a first subframe (one sub-frame A) and a second subframe (one sub-frame B) within 1 TTI, respectively, and either the Ack/Nack or higher-order CQI bits having a higher priority are placed a larger number of repetitions within the TTI.

As shown in Fig. 12(a), in a case in which only CQI symbols are transmitted, when transmission of an uplink scheduling request signal SR occurs, a symbol CQI1 having a higher priority is allocated to the position of a long block LB (e.g., LB1) having a possibility of not being transmitted and the same symbol CQI1 is also allocated to the next long block LB2.

As a result, even in a case in which transmission of an uplink scheduling request signal SR occurs, the most important symbol CQI1 can be transmitted with the second long block LB2, and, even in a case in which no transmission of an uplink

scheduling request signal SR occurs, the degradation in the quality at the time of occurrence of a communication error can be prevented by transmitting the most important symbol CQI1 four times.

[0065]

Furthermore, in a case in which the CQI symbols and the Ack/Nack symbol are multiplexed and mapped, as shown in Fig. 12(b), even when transmission of an uplink scheduling request signal SR occurs through allocation of a low-priority symbol CQI5 to the position of an LB (LB1) having a possibility of not being transmitted, and the CQI5 symbol cannot be transmitted, other symbols having a higher priority can be sent without their repetition numbers being reduced, and therefore the communication quality can be maintained.

[0066]

It is not necessary to limit the mapping pattern in the symbol mapping method according to the importance of the symbols to the pattern which is explained in this Embodiment 2. Because the concept of the symbol mapping is already explained, the explanation of this concept will be omitted hereafter. Either the mobile terminal or the base station can select one pattern from among some predetermined patterns of the mapping of the symbols of Ack/Nack information (an Ack/Nack and/or a CQI), or one of them can be dynamically selected and allocated to the mobile terminal.

[0067]

As a case in which a region to which the S-RACH of the mobile terminal UE1 is allocated in time-frequency is only a part of data symbol blocks with respect to time, as shown in

Fig. 11, there can be not only a case in which the information which is to be transmitted by using the S-RACH as shown in the flow chart of Fig. 8, but also a case in which the amount of information of the uplink scheduling request signal SR is large as shown in the flow chart of Fig. 7.

In this case, the uplink scheduling request signal can be sent in a small amount of time by allocating the S-RACH to the time-frequency region whose band is extended in the frequency direction, and transmitting the uplink scheduling request signal by using the S-RACH. More specifically, compared with the case of allocation of Fig. 11, either a wider time-frequency region in the frequency direction or a plurality of time-frequency unit regions which are continuous in the frequency direction are allocated to the transmission of the uplink scheduling request signal SR.

[0068]

Embodiment 1 and Embodiment 2 are based on the CDM multiplexing of the Ack/Nack information which is carried out for each mobile terminal in the Ack/Nack exclusive channel. As an alternative, there can be another method of carrying out TDM multiplexing or FDM multiplexing of the pieces of Ack/Nack information about a plurality of mobile terminals. Also in such a case, the invention explained in above-mentioned Embodiment 1 can be applied.

By doing in the above-mentioned way, also in a case in which an uplink Ack/Nack symbol and/or CQI symbols which are allocated to the same timing as the time-frequency region to which the symbols of the uplink transmission request signal SR are allocated with the S-RACH cannot be modulated and

transmitted (DTX) during the transmission time of the uplink scheduling request signal SR, there can be provided an advantage of being able to use the radio resources effectively and to maintain the communication quality of the uplink or reduce the degradation in the communication quality of the uplink to a minimum.

[0069]

Embodiment 3.

In above-mentioned Embodiment 1, by stopping transmission of an Ack/Nack signal and/or a CQI signal while transmitting an uplink scheduling request signal SR by using an S-RACH, and by no using a multi carrier method with which to simultaneously transmit data associated with the two physical channels (the Ack/Nack exclusive channel and the S-RACH) which are allocated to two types of bands, respectively, increase in the radio resources load on the communication system due to temporary increase in the physical channels can be prevented, and transmission with a single carrier method which guarantees a low PAPR can be implemented.

In this Embodiment 3, a method of implementing transmission using an SC-FDMA method which implements a wider coverage and a lower PAPR (peak to average power ratio) by transmitting an Ack/Nack and/or a CQI and an uplink scheduling request signal SR by using an identical physical channel will be explained hereafter.

[0070]

In accordance with this Embodiment 3, a mobile terminal transmits an uplink scheduling request signal SR by mapping the uplink scheduling request signal SR to an Ack/Nack exclusive

channel instead of an S-RACH. By transmitting an uplink scheduling request signal SR by using an Ack/Nack exclusive channel, increase in the radio resources load on the communication system due to temporary increase in the physical channels can be prevented, and transmission with a single carrier method which guarantees a low PAPR can be implemented. As a result, even when the number of control signals (L1/L2 control signalings) which have to be temporarily transmitted increases in a certain mobile terminal, increase in the radio resources load on the communication system can be prevented, and transmission with a single carrier method which guarantees a low PAPR and high communication quality can be implemented.

[0071]

In this case, the Ack/Nack exclusive channel is a scheduled channel for which radio resources are scheduled in advance. As mentioned above, in the nonpatent reference 4, allocation of an synchronous random access SRA to a scheduled channel is studied. However, because the nonpatent reference 4 describes nothing about what type of channel is used as the scheduled channel and how a time-frequency region is allocated as a physical resource, in a case in which there is disposed a channel to which a 1-bit physical resource used for a scheduling request SR is allocated to a time-frequency region different from the Ack/Nack exclusive channel, a status in which an uplink Ack/Nack and/or a CQI and an uplink SR have to be transmitted simultaneously occurs, and these signals are transmitted simultaneously with respect to time. In this case, because they are not transmitted with single carrier transmission, but are transmitted with multi carrier

transmission, there arises a problem that the PAPR increases.

[0072]

In order to solve this problem, in accordance with this Embodiment 3, a mobile terminal transmits an uplink scheduling request signal SR by mapping an Ack/Nack and a CQI with the uplink scheduling request signal SR, to an Ack/Nack exclusive channel.

An important thing to satisfy request for a single carrier transmission from a mobile terminal is that the mobile terminal transmits all of an "Ack/Nack", a "CQI", and an "uplink scheduling request signal SR", which are signals having a possibility of having to be transmitted simultaneously, by using an Ack/Nack exclusive channel in a state in which uplink time synchronization is established and the mobile terminal is not transmitting uplink data. By transmitting an Ack/Nack and a CQI with an uplink scheduling request signal SR, by using an Ack/Nack exclusive channel, increase in the radio resources load on the communication system due to temporary increase in the physical channels can be prevented, and transmission with a single carrier method which guarantees a low PAPR can be implemented.

As a result, even when the number of control signals (L1/L2 control signalings) which has to be temporarily transmitted increases in a certain mobile terminal, increase in the radio resources load on the communication system can be prevented, and transmission with a single carrier method which guarantees a low PAPR and high communication quality can be implemented.

[0073]

Fig. 13 is a flow chart for explaining processing carried out by a mobile terminal, the processing including up to a

process of transmitting an uplink scheduling request signal. Fig. 14 is an explanatory drawing for explaining an example of mapping of an uplink scheduling request signal which is transmitted by using an Ack/Nack exclusive channel.

Hereafter, the operation of a mobile terminal in accordance with Embodiment 3 of the present invention will be explained with reference to Fig. 13. In Fig. 13, because the same reference numerals as those shown in Fig. 6 denote the same components or like components, the explanation of the components will be omitted hereafter.

[0074]

A mobile terminal is not carrying out uplink user data transmission, and, at the same time when receiving downlink data, is transmitting, via an uplink, an Ack/Nack and/or a CQI to the received data by using a physical channel for an Ack/Nack and /or a CQI.

For the Ack/Nack exclusive channel, multiplexing of signals from mobile terminals is carried out by using either one of a CDM method, an FDM method, and a TDM method. When a request for transmission of uplink data occurs in the mobile terminal (ST601), the state of the reception of the downlink data is checked in ST602.

In this Embodiment 3, because the mobile terminal is receiving the downlink data, the mobile terminal advances to ST1301 in which the mobile terminal transmits Ack/Nack information with an uplink scheduling request signal SR (only a part corresponding to a preamble or a part corresponding to the preamble and a message), by using the Ack/Nack exclusive channel.

[0075]

The sequence including from the transmission in ST1301 of the uplink scheduling request signal SR up to the transmission of the uplink data is shown in Fig. 8. In a case in which the information size of the uplink scheduling request signal SR is small and the transmission time is short, transmitting the uplink scheduling request signal SR by using the Ack/Nack exclusive channel is very effective from the viewpoint of the two following aspects: the efficiency of use of radio resources; and the attainment of the communication quality of transmission (an L1/L2 control signaling) of an L1/L2 control signal having a small size, like an Ack/Nack or an uplink scheduling request signal SR.

[0076]

A time-frequency region having a length of one subframe in the Ack/Nack exclusive channel is comprised of six data symbol blocks which are called long blocks LB and symbol blocks for physical channel synchronization which are called short blocks SB.

In this Embodiment 3, an example of the mapping of symbols at the time of carrying out multiplexing of an uplink scheduling request signal SR, Ack/Nack information and/or CQI information within a time-frequency region of 1 TTI (= two subframes) with a predetermined positional relationship will be shown.

[0077]

Fig. 14 is an example of the symbol mapping in a case in which CQI information and Ack/Nack information are multiplexed, and an uplink scheduling request signal SR is further allocated to these pieces of multiplexed information. In this case, it

is assumed that the Ack/Nack, the CQI, and the uplink scheduling request signal SR are multiplexed, and are mapped and updated in units of 1 TTI.

[0078]

First, the uplink scheduling request (UL scheduling request) is mapped to a leading symbol block (LB1) within the time-frequency region having a length of a transmission time interval (TTI) (= a length of two subframes). The number of times that the uplink scheduling request signal SR is mapped and transmitted is one time/two subframes at the fastest rate. The description of the SR symbol is 1 bit long, and is information indicating either with request or without request.

Even though the symbol mapping is not carried out as shown in Fig. 14, this Embodiment 3 can be implemented. Therefore, the concept about the symbol mapping will be mentioned hereafter.

[0079]

(1) Repeat symbols having a higher priority a larger number of times. (2) Place symbols having a higher priority in a vicinity of a short block SB.

In general, an Ack/Nack, the higher-order bits of a CQI (CQI1 is the most significant bit), and an uplink scheduling request signal SR are symbols having a higher priority.

An Ack/Nack indicates the result of reception of downlink data, and therefore there arises a problem that, when this symbol cannot be received properly by the base station, retransmission of the corresponding packet data occurs and the throughput of the downlink data falls as a result. It is therefore necessary to increase the priority of the Ack/Nack

in the symbol arrangement.

Also in the case of the higher-order ones of the CQI bits indicating the state of the reception of the downlink data, when a transmission error occurs, the erroneous difference between the downlink communication path quality which is measured by the mobile terminal and the downlink communication path quality which the base station has received becomes large, and therefore appropriate scheduling cannot be carried out by the base station and this results in reduction in the downlink throughput of the whole mobile communications system. It is therefore necessary to increase the priority of the higher-order ones of the CQI bits indicating the reception state of the downlink data in the symbol arrangement.

[0080]

Furthermore, a case in which an uplink scheduling request signal SR is accidentally received by the base station will be considered. When the base station erroneously receives "presence" of an uplink scheduling request SR from a mobile terminal even though the mobile terminal shows "absence" of the uplink scheduling request SR, an unnecessary uplink resource is allocated to the mobile terminal and hence the radio resource goes to waste.

In contrast, when the base station erroneously receives "absence" of an uplink scheduling request SR from a mobile terminal even though the mobile terminal shows "presence" of the uplink scheduling request SR, there arises a problem that the mobile terminal has to retransmit the uplink scheduling request SR and the uplink throughput decreases as a result.

The priorities of the Ack/Nack, the CQI, and the uplink

scheduling request SR depend on their error rates.

[0081]

Because increase in the number of repetitions (repetition) can increase the receive power of the base station, the larger number of repetitions (repetition) a symbol has the more rarely an error occurs in the symbol.

Because it can be considered that a short block is used for phase compensation when receiving data and then performing demodulation of the data, the phase compensation is carried out more correctly as the difference between the transmission timing of the short block and that of the corresponding symbol decreases. Therefore, an error occurs more rarely in a symbol which is placed nearer to a short block.

[0082]

In the explanation of the concept of the symbol mapping, which is made until now, the case in which the multiplexing of a CQI and an Ack/Nack in an Ack/Nack exclusive channel is carried out by using the TDM method is shown. Even in a case in which the multiplexing is carried out by using another method, the concept of the above-mentioned symbol mapping can be applied as the method of mapping an uplink scheduling request signal SR.

Furthermore, an uplink scheduling request signal SR has a value which is defined as follows: "with request = ('1')" and "without request = ('0')", as mentioned above. However, the definition is not limited to this example, and, for example, an uplink scheduling request signal SR can alternatively have a value which is defined as follows: "with request = ('0')" and "without request = ('1')". Further speaking, an uplink

scheduling request signal SR has only to show the presence or absence of an uplink scheduling request.

There can be considered the two following examples of the setting of the value of this bit.

[0083]

In the first example of the setting, when there is no uplink scheduling request signal SR, 0 is always transmitted. In contrast, in a case in which the mobile terminal transmits an uplink scheduling request signal SR, as shown in the flow chart of Fig. 8, the mobile terminal transmits "with request (= '1')", and then transmits 0 during the next transmission time interval (TTI).

If there does not occur any receiving error, when "uplink data resource allocation (Uplink Data Resource Allocation)" which the base station ought to have transmitted to the mobile station does not arrive thereat, the mobile terminal judges that an receiving error has occurred in the base station, and then transmits the uplink scheduling request signal SR indicating "with request ('1')" again.

[0084]

The first example of the setting will be explained in greater detail with reference to Figs. 28, 29, and 30.

Fig. 28 is a sequence diagram, and Fig. 29 is a flow diagram of processing carried out by the mobile terminal. Fig. 30 is a flow diagram of processing carried out by the base station.

In Fig. 28, a time T shows a time limit (an upper limit) by which the mobile terminal has to receive uplink resource allocation made by the base station, and the mobile terminal uses a timer or the like in order to implement the time T.

The operation of the first example of the setting will be explained by mainly referring to Fig. 29.

[0085]

First, a case in which no receiving error occurs when the base station receives an uplink scheduling request signal SR will be explained. As a sequence diagram, Fig. 28(i) shows the case in which no receiving error occurs.

The mobile terminal, in ST2901, judges whether a request for transmission of uplink data has occurred. When a request for transmission of uplink data has occurred, the mobile terminal advances to ST2902. In contrast, when no request for transmission of uplink data has occurred, the mobile terminal returns to the judgment of ST2901.

The mobile terminal, in ST2902, sets up information indicating the presence of an uplink scheduling request (UL Scheduling request= "1" currently allocated to LB1 in Fig. 14) in the Ack/Nack exclusive channel.

The mobile terminal then, in ST2903, transmits the information indicating the "presence" of uplink scheduling by using the Ack/Nack exclusive channel. This step corresponds to ST2801 in Fig. 28.

[0086]

After transmitting the information indicating the "presence" of uplink scheduling by using the Ack/Nack exclusive channel, the mobile terminal, in ST2904, sets up information indicating the absence of an uplink scheduling request (UL Scheduling request= "0" currently allocated to LB1 in Fig. 14) in the Ack/Nack exclusive channel.

The mobile terminal, in ST2905, judges whether the mobile

terminal has received uplink data resource allocation "Uplink Data Resource Allocation" from the base station. That is, the mobile terminal judges whether the mobile terminal has received uplink transmission allocation from the base station.

When, in ST2905, has received uplink data resource allocation, the mobile terminal advances to ST2906. This step corresponds to ST2804 in Fig. 28. The mobile terminal, in ST2906, transmits uplink data according to the allocation from the base station.

In contrast, when, in ST2905, has not received uplink data resource allocation, the mobile terminal advances to ST2907. The mobile terminal, in ST2907, judges whether the current time exceeds the time limit by which the mobile terminal has to receive "Uplink Data Resource Allocation" from the base station. More specifically, the mobile terminal judges whether the time which has elapsed since the mobile terminal transmitted the information indicating the "presence of an uplink scheduling request signal SR exceeds the time T as shown in Fig. 28.

[0087]

When, in ST2905, the elapsed time does not exceed the time T, the mobile terminal advances to ST2908. The mobile terminal, in ST2908, transmits the information indicating the "absence" of uplink scheduling by using the Ack/Nack exclusive channel (UL Scheduling request = "0" currently allocated to LB1 in Fig. 14).

After, in ST2908, transmitting the information indicating the "absence" of uplink scheduling by using the Ack/Nack exclusive channel, the mobile terminal returns to the judgment of ST2905. This step corresponds to ST2802 and ST2803

in Fig. 28.

[0088]

Next, a case in which an receiving error occurs when the base station receives an uplink scheduling request signal SR will be explained. As a sequence diagram, Fig. 28(ii) shows the case in which a receiving error occurs.

Because the explanation of the steps of ST2901 to ST2906 is the same as that in the above-mentioned case in which no receiving error occurs, the explanation will be omitted.

The mobile terminal, in ST2907, judges whether the current time exceeds the time limit by which the mobile terminal has to receive "Uplink Data Resource Allocation" from the base station, like in the above-mentioned case in which no receiving error occurs. More specifically, the mobile terminal judges whether the time which has elapsed since the mobile terminal transmitted the information indicating the "presence" of an uplink scheduling request signal SR exceeds the time T as shown in Fig. 28.

[0089]

In this case, as shown in Fig. 28(ii), an receiving error has occurred in the information indicating the presence or absence of an uplink scheduling request currently allocated, in ST2807, to the Ack/Nack exclusive channel. Therefore, at the timing (time '"t"' of (ii) of Fig. 28) at which the mobile terminal should have originally received "Uplink Data Resource Allocation" from the base station, the mobile terminal does not accept any uplink transmission allocation from the base station. As a result, the mobile terminal, in ST2907, judges that the time which has elapsed since the mobile terminal, in ST2811 of

Fig. 28, transmitted the information indicating the "presence" of an uplink scheduling request signal SR exceeds the time T.

In this case, the mobile terminal returns to ST2902, sets up information indicating the presence of an uplink scheduling request (UL Scheduling request= "1" currently allocated to LB1 in Fig. 14) in the Ack/Nack exclusive channel, and then retransmits the uplink scheduling request signal SR (ST2903). This step corresponds to ST2811 in Fig. 28.

[0090]

Next, a flow of processing performed by the base station in the first example of the setting will be explained with reference to Fig. 30.

The base station, in step ST3001, judges whether the information indicating the presence or absence of an uplink scheduling request currently allocated to the Ack/Nack exclusive channel in ST3001 shows the "presence." When the information indicates the "absence," the base station returns to the judgment of ST3001.

When the base station, in step ST3001, judges that the information indicates the "presence", the base station performs an uplink scheduling process for the mobile terminal which, in step ST3002, has transmitted the uplink scheduling request thereto by using the Ack/Nack exclusive channel. This step corresponds to ST2801 or ST2811 in Fig. 28.

In order to perform uplink transmission allocation for the mobile terminal, the base station, in ST3003, transmits the result as "Uplink Data Resource Allocation." This step corresponds to ST2804 or ST2814 in Fig. 28.

[0091]

In the second example of the setting, when not receiving any uplink scheduling request signal SR, the base station always transmits 0, like in the case of the first example of the setting. In contrast, in the flow chart of Fig. 8, when the mobile terminal transmits an uplink scheduling request signal SR, the mobile terminal continues transmitting the information indicating "the presence of a request (= '1')" until "Uplink Data Resource Allocation" is transmitted thereto from the base station, and, after receiving "Uplink Data Resource Allocation", the mobile terminal transmits the information indicating "the absence of a request (= '0')".

[0092]

The second example of the setting will be explained in greater detail with reference to Figs. 31, 32, and 33.

Fig. 31 is a sequence diagram, and Fig. 32 is a flow diagram showing processing carried out by the mobile terminal. Fig. 33 is a flow diagram showing processing carried out by the base station.

The operation of the second example of the setting will be explained by mainly referring to Fig. 32.

First, a case in which no receiving error occurs when the base station receives an uplink scheduling request signal SR will be explained. As a sequence diagram, Fig. 31(i) shows the case in which no receiving error occurs.

[0093]

The mobile terminal, in ST3201, judges whether a request for transmission of uplink data has occurred. When a request for transmission of uplink data has occurred, the mobile terminal advances to ST3202. In contrast, when no request for

transmission of uplink data has occurred, the mobile terminal returns to the judgment of ST3201.

The mobile terminal, in ST3202, sets up information indicating the presence of an uplink scheduling request (UL Scheduling request= "1" currently allocated to LB1 in Fig. 14) in the Ack/Nack exclusive channel.

The mobile terminal then, in ST3203, transmits an uplink scheduling request by using the Ack/Nack exclusive channel. This step corresponds to ST3101 in Fig. 31.

[0094]

The mobile terminal, in ST3204, judges whether the mobile terminal has received "uplink data resource allocation (Uplink Data Resource Allocation)" from the base station. That is, the mobile terminal judges whether the mobile terminal has received uplink transmission allocation from the base station.

When, in ST3204, has received uplink transmission allocation, the mobile terminal advances to ST3205. In contrast, when has not received uplink transmission allocation, the mobile terminal returns to ST3202. This step corresponds to ST3104 in Fig. 31.

The mobile terminal, in ST3205, sets up information indicating the absence of an uplink scheduling request (UL Scheduling request= "0" currently allocated to LB1 in Fig. 14) in the Ack/Nack exclusive channel. This step corresponds to ST3105 in Fig. 31.

The mobile terminal, in ST3206, transmits uplink data according to the allocation from the base station.

[0095]

Next, a case in which a receiving error occurs when the

base station receives an uplink scheduling request signal SR will be explained. As a sequence diagram, Fig. 31(ii) shows the case in which a receiving error occurs.

Because the flow of the processing carried out by the mobile terminal in this case is the same as that in the above-mentioned case in which no receiving error occurs, the flow will be omitted.

The case (ii) shown in Fig. 31 will be explained.

A receiving error occurs in the information indicating the presence or absence of an uplink scheduling request currently allocated, in ST3107, to the Ack/Nack exclusive channel. Therefore, at the timing (time '"t"' in the case (ii) of Fig. 31) at which the mobile terminal should have originally received "Uplink Data Resource Allocation" from the base station, the mobile terminal does not accept any uplink transmission allocation from the base station.

[0096]

However, in the second example of the setting, following the step of ST3107, the mobile terminal, also in ST3108, transmits the information indicating the presence of an uplink scheduling request (UL Scheduling request= "1" currently allocated to LB1 in Fig. 14) by using the Ack/Nack exclusive channel. Therefore, when normally receiving the information indicating the presence or absence of an uplink scheduling request currently allocated to the Ack/Nack exclusive channel transmitted in ST3108, the base station, in ST3111, transmits "Uplink Data Resource Allocation." That is, the mobile terminal receives the uplink transmission allocation from the base station.

[0097]

Next, a flow of processing carried out by the base station in the second example of the setting will be explained with reference to Fig. 33.

The base station, in step ST3301, judges whether the information indicating the presence or absence of an uplink scheduling request currently allocated to the Ack/Nack exclusive channel shows the "presence". When the information indicates the "absence," the base station returns to the judgment of ST3301.

When the base station, in step ST3301, judges that the information indicates the "presence," the base station, in ST3302, judges whether or not the base station is performing an uplink scheduling process for the mobile terminal.

When, in ST3302, judging that the base station is performing an uplink scheduling process for the mobile terminal (corresponding to ST3102, ST3103, ST3109, and ST3110 in Fig. 31), the base station advances to ST3303. The base station, in ST3303, continues performing the uplink scheduling process which the base station has been performing.

[0098]

In contrast, when, in ST3302, judging that the base station is not performing any uplink scheduling process for the mobile terminal (corresponding to ST3101 and ST3108 in Fig. 31), the base station advances to ST3304. The base station, in ST3304, starts performing an uplink scheduling process for the mobile terminal.

When, in ST3303 or ST3304, completing the uplink scheduling process for the mobile terminal, the base station,

in ST3305, transmits the result of the process as "Uplink Data Resource Allocation" in order to perform uplink transmission allocation for the mobile terminal. This step corresponds to ST3104 or ST3111 in Fig. 31.

[0099]

The advantages of the first example of the setting and the second example of the setting will be explained.

Compared with the second example of the setting, the merits of the first example of the setting can be provided as follows:

(1) Because, when receiving an uplink scheduling request by using the Ack/Nack exclusive channel, the base station does not have to judge whether or not the base station is performing an uplink scheduling process for the mobile terminal (ST3302 in Fig. 33), the processing carried out by the base station can be simplified.

[0100]

Compared with the first example of the setting, the merits of the second example of the setting can be provided as follows:

(1) When a receiving error occurs in the information indicating the presence or absence of an uplink scheduling request currently allocated to the Ack/Nack exclusive channel, the time which has elapsed until the mobile terminal actually receives "Uplink Data Resource Allocation" from the timing at which the mobile terminal was expected to receive "Uplink Data Resource Allocation" from the base station becomes short. In the first example of the setting, the time is equal to "a", as shown in Fig. 28. In contrast, in the second example of the setting, the time is equal to "b," as shown in Fig. 31.

(2) Because the mobile terminal does not have to judge whether the current time exceeds the time limit by which the mobile terminal has to receive "Uplink Data Resource Allocation" from the base station (ST2907 in Fig. 29) in its internal processing, the processing carried out by the mobile terminal can be simplified.

[0101]

Each of the first and second examples of the setting of a scheduling request signal SR which are explained above can also be used in any one of Embodiment 1, Embodiment 6, Embodiment 7, Embodiment 8, Embodiment 9, and Embodiment 10.

Furthermore, in a case in which the mobile terminal does not have to transmit an Ack/Nack and/or a CQI, but has to transmit only a scheduling request signal, the mobile terminal does not transmit any information about the Ack/Nack and the CQI by using the Ack/Nack exclusive channel, but can transmit only the scheduling request by using the Ack/Nack exclusive channel.

[0102]

An Ack/Nack symbol and CQI symbols are mapped to long blocks (LB2 to LB6) other than the leading LB (LB1), to which an uplink scheduling request signal SR is mapped, during a transmission time interval (TTI). In this mapping, the Ack/Nack symbol and CQI symbols at higher-order digits with a higher priority among all the CQI symbols are given a higher priority so that they are repeatedly mapped. In Fig. 14, during 1 TTI (=2 subframes), the Ack/Nack symbol is repeatedly mapped three times, and CQI1 and CQI2 with a higher priority are repeatedly mapped twice.

[0103]

As previously explained, in a case in which the transmission time of an uplink scheduling request signal SR is sufficiently small as shown in the sequence of Fig. 8, the uplink scheduling request signal SR, and Ack/Nack information symbols (an Ack/Nack and/or a CQI), is mapped to the Ack/Nack exclusive channel. As a result, even when a plurality of "data-non-associated L1/L2 control signals" which have to be transmitted occur simultaneously in a mobile terminal, while the communication quality of these important control signals is attained, increase in the radio resources load on the communication system can be prevented, and transmission with a single carrier method which guarantees a low PAPR and high communication quality can be implemented.

[0104]

Furthermore, because the Ack/Nack exclusive channel is not a channel (contention based channel), such as an S-RACH, which allows communications competition among a plurality of mobile terminals, compared with the case of using an S-RACH, the use of this method can also provide an advantage of eliminating the necessity to transmit the identification number (UE-ID) of the mobile terminal through transmission of an uplink scheduling request signal SR.

Therefore, in a case in which the frequency of the transmission of an SR is high, it can be said that it is an effective means because the required number of bits for transmitting an SR is small. In addition, a plurality of time-frequency regions (A and B in Fig. 24) having narrow bands which are separated as shown in Fig. 24 are allocated to the Ack/Nack exclusive channel. As a result, a scheduling request

signal SR which is transmitted by using the Ack/Nack exclusive channel has high resistance to the frequency selective fading. In other words, a scheduling request signal SR can have a frequency diversity gain.

Furthermore, in a case in which a scheduling request signal SR is transmitted from the mobile terminal to the base station by not using an S-RACH, but using the Ack/Nack exclusive channel when the mobile terminal is not performing any transmission of uplink data, but is receiving downlink data, the radio resources (the frequency-time regions) which are beforehand allocated for the S-RACH can be released for a UL-SCH or the like, and the method is effective from the viewpoint of effective use of the radio resources.

[0105]

The Ack/Nack exclusive channel is a channel which the mobile terminal has been using in the state in which the mobile terminal is not performing any transmission of uplink data, but is receiving downlink data. Therefore, by mapping an Ack/Nack and a CQI with an uplink scheduling request signal SR, to the Ack/Nack exclusive channel, there is provided an advantage of being able to use the radio resources currently being used effectively, in addition to an advantage of being able to implement transmission by using a single carrier method which guarantees both a low PAPR and high communication quality.

Furthermore, as mentioned above, by using a scheduled channel like the Ack/Nack exclusive channel, there can be provided a further advantage of eliminating the necessity to transmit the identification number (UE-ID) of the mobile terminal through transmission of an uplink scheduling request

signal SR. Therefore, the processing load on the base station when receiving an uplink scheduling request signal can be reduced.

In addition, because the Ack/Nack exclusive channel is used with a frequency band narrower than usually being allocated thereto, the Ack/Nack exclusive channel has a small amount of information to be processed per a unit time. Therefore, because the processing time in each of the transmission and the reception also becomes short, the process delay (Latency) of the sequence (ST701 to ST703 of Fig. 7 and ST801 to ST804 of Fig. 8) including from the transmission of an uplink scheduling request signal SR up to a start of the transmission becomes short, and this can contribute to greater efficiency and a speedup of the processing of the whole communication system.

[0106]

On the other hand, there can be considered a mobile communication system in which even when a mobile terminal is not receiving any downlink data, an Ack/Nack exclusive channel is allocated to the mobile terminal. More specifically, there can be considered a case in which, in order to prepare for future downlink scheduling even when there exist no downlink data, or maintain synchronization between a base station and a mobile terminal, the mobile terminal notifies the result (CQI) of measurement of the quality of a downlink communication path. Also in such a case, there may be a case in which transmission of a CQI using an Ack/Nack exclusive channel and that of an uplink scheduling request signal SR occur simultaneously. In such a mobile communication system, in the judgment of ST602, the mobile terminal had better to makes the judgment by judging

whether the mobile terminal has received allocation of an Ack/Nack exclusive channel. In addition, even a mobile communication system in which when a mobile terminal is not receiving any downlink data no Ack/Nack exclusive channel is allocated to the mobile terminal can use this judgment.

In this Embodiment 3, an Ack/Nack exclusive channel to which a plurality of time-frequency regions having narrow bands which are separated as shown in Fig. 24 are allocated monopolistically is explained. However, this Embodiment 3 can also be adapted to an Ack/Nack exclusive channel not having a narrow band, as shown in Fig. 23.

[0107]

Embodiment 4.

In a case in which a mobile terminal is not transmitting any uplink data (Uplink data, UL data) such as user data, but is receiving downlink data (Downlink data, DL data) transmitted from a base station, the mobile terminal has to transmit an Ack/Nack signal, which is the result of the reception of the downlink data, and a CQI indicating the quality of a downlink communication path to the base station.

Furthermore, when a necessity for transmission of uplink data occurs in a mobile terminal, the mobile terminal has to transmit an uplink scheduling request signal SR to the base station.

Hereafter, a method of making a mobile terminal which has to transmit an Ack/Nack and an uplink scheduling request signal SR simultaneously perform these transmissions simultaneously without increasing the PAPR will be explained.

[0108]

In accordance with above-mentioned Embodiment 3, by transmitting an Ack/Nack and a CQI with a scheduling request signal SR, by using an Ack/Nack exclusive channel, transmission through use of a single carrier method which guarantees both a low PAPR and high communication quality can be implemented. However, in a case of an example shown in Fig. 14, in the transmission, it is necessary to map a symbol indicating the presence or absence of a scheduling request signal SR to the Ack/Nack exclusive channel. Therefore, in the case of using above-mentioned Embodiment 3 to multiplex an Ack/Nack, a CQI and an uplink scheduling request signal SR (SR) to the Ack/Nack exclusive channel by using a TDM method, the following two problems newly arise.

[0109]

The first problem will be explained hereafter.

Even in a case in which an SR does not have to be transmitted, an LB to which an SR is mapped has to be allocated in advance. Therefore, a radio resource must always be allocated to the information which does not have to be transmitted. The problem is therefore that there cannot be provided an advantage of making effective use of the radio resources.

The second problem will be explained hereafter.

Compared with a case in which an SR is not multiplexed to an Ack/Nack exclusive channel by using a TDM method, there is a disadvantage of reducing the number of repetitions that an Ack/Nack or a CQI is transmitted. In most cases, an encoding process with high error correction capability is not performed on an Ack/Nack and a CQI, unlike in the case of data. Therefore,

in order to prevent a receiving error from occurring in a base station, repeating the same information to increase the receive power of the base station is important to improve the reception quality (repetition). The problem is therefore that from the viewpoint of maintaining the reception quality of the base station, reduction in the number of LBs which can be used for the repetition has to be avoided as much as possible.

[0110]

A method of solving the first and second problems arising newly will be explained hereafter.

Fig. 15 is a flow chart for explaining processing carried out by a mobile terminal which transmits an uplink scheduling request signal, and processing carried out by a base station which receives the uplink scheduling request signal. Fig. 15 shows processing in a case in which the mobile terminal is not performing transmission of uplink data, but is receiving downlink data.

The mobile terminal, in ST1500, judges whether a request for transmission of uplink data has occurred. When no request for transmission of uplink data has occurred (if No in ST1500), the mobile terminal advances to ST1501. The mobile terminal, in ST1501, maps either or both of an Ack/Nack and a CQI to an Ack/Nack exclusive channel.

As an example of the mapping, the example shown in Fig. 9 can be used. The mobile terminal, in ST1503, multiplies the Ack/Nack exclusive channel by a code (code a) indicating that either or both of the Ack/Nack and CQI are mapped to the Ack/Nack exclusive channel.

[0111]

This multiplication by code is carried out by the modulating unit 10 or the encoder unit 9. After the multiplication by code is carried out, a process of ST1505 is carried out.

In contrast, when, in ST1500, a request for transmission of uplink data has occurred, a process of ST1502 is carried out. The mobile terminal, in ST1502, maps either or both of the Ack/Nack and the CQI to the Ack/Nack exclusive channel, and also maps an uplink scheduling request signal SR to the Ack/Nack exclusive channel.

As an example of the mapping, the example shown in Fig. 14 can be used. The mobile terminal, in ST1504, multiplies the Ack/Nack exclusive channel by a code (code b) indicating that either or both of the Ack/Nack and the CQI, and the uplink scheduling request signal SR are mapped to the Ack/Nack exclusive channel, the code being different from the code a. This multiplication by code is carried out by the modulating unit 10 or the encoder unit 9. After the multiplication by code is carried out, the process of ST1505 is carried out. As the codes a and b, codes which are perpendicular to each other can be used in order to reduce occurrence of an error in the judgment by the base station.

[0112]

In the mobile communication system, in a case in which code division multiplexing is used as multiplexing of signals from a plurality of mobile terminals in the Ack/Nack exclusive channel, the Ack/Nack exclusive channel is, in ST1505, multiplied by a code (a code A) for identifying the plurality of mobile terminals. This multiplication by code is carried

out by the modulating unit 10. After the multiplication by code is carried out, ST1506 is carried out.

Since the Ack/Nack exclusive channel is, in ST1505, multiplied by the code (the code A) for identifying the plurality of mobile terminals, the codes (the codes a and b) by which the Ack/Nack exclusive channel is multiplied in steps ST1503 and ST1504 can be used in common by the plurality of mobile terminals whose signals are multiplexed into the Ack/Nack exclusive channel. The order in which the Ack/Nack exclusive channel is multiplied by the codes a and A, and the order in which the Ack/Nack exclusive channel is multiplied by the codes b and A can be reverse. The mobile terminal, in ST1506, transmits the Ack/Nack exclusive channel to the base station.

[0113]

The base station, in ST1507, receives the signal transmitted thereto by using the Ack/Nack exclusive channel. The base station then performs a process of multiplying the signal by the codes which are used for the multiplexing of the signals from the plurality of mobile terminals in the Ack/Nack exclusive channel in order to demultiplex the signal transmitted thereto by using the Ack/Nack exclusive channel into the signals from the plurality of mobile terminals.

The base station, in ST1508, performs a correlation operation by using the code (code A) indicating the mobile terminal. When the result of the correlation operation is equal to or larger than a predetermined threshold (if Yes in ST1508), the base station judges that the reception is the one of the Ack/Nack exclusive channel from the mobile terminal, and carries out a process of ST1509.

[0114]

When the result of the correlation operation which the base station performed in step ST1508 is smaller than the predetermined threshold (if No in ST1508), the base station judges that the reception is not the one of Ack/Nack exclusive channel from the mobile terminal, and ends the processing. The correlation operation using the code A is carried out by the demodulating unit 24. The base station, in ST1509, performs a correlation operation by using the code a in order to judge whether or not only the Ack/Nack and the CQI are mapped to the Ack/Nack exclusive channel from the mobile terminal. When the result of the correlation operation is equal to or larger than the predetermined threshold (if Yes in ST1509), the base station judges that only the Ack/Nack and the CQI are mapped to the Ack/Nack exclusive channel from the mobile terminal (judges that any scheduling request signal SR is not mapped to the Ack/Nack exclusive channel), and carries out a process of ST1510.

The correlation operation using the code a is carried out by the demodulating unit 24 or the decoder unit 25. The base station, in ST1510, carries out the process by judging that only the Ack/Nack and the CQI are mapped to the received Ack/Nack exclusive channel from the mobile terminal.

[0115]

In contrast, when the result of the correlation operation which the base station, in ST1509, performed by using the code a is less than the predetermined threshold (if No in ST1509), the base station carries out ST1511. The base station, in ST1511, performs a correlation operation by using the code b

in order to judge whether or not the scheduling request signal SR, in addition to the Ack/Nack and the CQI, is mapped to the Ack/Nack exclusive channel from the mobile terminal. When the result of the correlation operation is equal to or larger than a predetermined threshold (if Yes in ST1511), the base station judges that the scheduling request signal SR, in addition to the Ack/Nack and the CQI, is mapped to the Ack/Nack exclusive channel from the mobile terminal, the base station carries out a process of ST1512.

The correlation operation using the code b is carried out by the demodulating unit 24 or the decoder unit 25. The base station, in ST1512, carries out the processing by judging that the scheduling request signal SR, in addition to the Ack/Nack and the CQI, is mapped to the received Ack/Nack exclusive channel from the mobile terminal. In contrast, when the result of the correlation operation which the base station, in ST1511, performed by using the code b is less than the predetermined threshold (if No in ST1511), the base station judges that a receiving error has occurred and ends the processing.

[0116]

As mentioned above, in Fig. 15, ST1503 in which the multiplication by the code a is performed, ST1504 in which the multiplication by the code b is performed, and ST1505 in which the multiplication by the code A is performed are carried out by the encoder unit 9 and the modulating unit 10 in the mobile terminal. A detailed block diagram showing the multiplication by the code a, the multiplication by the code b, and the multiplication by the code A is shown in Fig. 34.

A symbol pattern 3401 for the Ack/Nack exclusive channel

in the transmission buffer 8 or the encoder unit 9 is multiplied by either the code a 3402 indicating that either or both of the Ack/Nack and the CQI are mapped to the Ack/Nack exclusive channel, or the code b 3403 indicating that either or both of the Ack/Nack and the CQI and the scheduling request signal SR are mapped to the Ack/Nack exclusive channel.

[0117]

The multiplication by the code a 3402 and the multiplication by the code b 3403 are switched by a switch 3404. The switching condition of the switch 3404 is as shown in Fig. 34.

When a request for transmission of uplink data has occurred, i.e., when there is an uplink scheduling request, the switch operates in such a way that the symbol pattern 3401 for the Ack/Nack exclusive channel is multiplied by the code b. In contrast, when no request for transmission of uplink data has occurred, i.e., when there is no uplink scheduling request, the switch operates in such a way that the symbol pattern 3401 for the Ack/Nack exclusive channel is multiplied by the code a.

After multiplying the symbol pattern by the code a or b, the mobile terminal multiplies the symbol pattern by the code A 3405 for identifying the mobile terminal. After that, a modulation process is performed on the symbol pattern by the modulating unit 10.

[0118]

As previously explained, because the mobile terminal multiplies the Ack/Nack exclusive channel by a code which differs according to whether or not a scheduling request signal SR, in addition to an Ack/Nack and a CQI, is mapped to the

Ack/Nack exclusive channel, the mobile terminal does not have to reserve a symbol for the scheduling request signal SR in the Ack/Nack exclusive channel. For example, the scheduling request signal SR is mapped to the first long block LB1 shown in Fig. 14, though, when no scheduling request signal SR is transmitted, the Ack/Nack, the CQI, and so on can be mapped to the LB1. Furthermore, because the base station can identify easily whether a signal from a certain mobile terminal includes a scheduling request signal SR by using the code by which the signal is multiplied, the base station can perform an appropriate process on the signal according to whether or not the scheduling request signal SR is mapped.

[0119]

In accordance with the W-CDMA method which is a conventional technology, in order to enable a base station to demultiplex a received signal into signals associated with a plurality of channels transmitted simultaneously from a mobile terminal, a signal associated with each channel is multiplied by a different code (a channelization code) and the signals associated with the plurality of channels are simultaneously transmitted from the mobile terminal to the base station.

In contrast, in accordance with this Embodiment 4, in order to demultiplex the received signal into the several types of information: "Ack/Nack and CQI" or "Ack/Nack, CQI, and SR"), which are transmitted with the codes, the codes are used.

In this Embodiment 4, either "Ack/Nack and CQI" or "Ack/Nack, CQI, and SR" are transmitted from the mobile terminal to the base station, and both "Ack/Nack and CQI" and "Ack/Nack, CQI, and SR" which are demultiplexed with the codes are not

transmitted simultaneously. In the above-mentioned point, this Embodiment 4 differs from the conventional technology (W-CDMA) which uses codes in order to demultiplex a received signal into a plurality of channels transmitted simultaneously.

[0120]

By using this Embodiment 4, the following advantages can be provided, like in the case of using above-mentioned Embodiment 3.

There can be provided an advantage of enabling a mobile terminal which has to transmit, an uplink scheduling request signal SR and an Ack/Nack in a case in which the mobile terminal is not performing any transmission of uplink data, but is receiving downlink data to simultaneously transmit them without increasing the PAPR of the mobile terminal.

[0121]

There can be provided another advantage of eliminating the necessity to add a UE-ID to an uplink scheduling request signal SR through transmission of the uplink scheduling request signal SR by using an Ack/Nack exclusive channel. Therefore, in a case in which the frequency of the transmission of an SR is high, it can be said that it is an effective means because the required number of bits for transmitting an SR is small. In addition, a plurality of time-frequency regions (A and B in Fig. 24) having narrow bands which are separated as shown in Fig. 24 are allocated to the Ack/Nack exclusive channel. As a result, a scheduling request signal SR which is transmitted by using the Ack/Nack exclusive channel has high resistance to the frequency selective fading.

In other words, a scheduling request signal SR can have

a frequency diversity gain. Furthermore, in a case in which a scheduling request signal SR is transmitted from a mobile terminal to a base station by not using an S-RACH, but using an Ack/Nack exclusive channel when the mobile terminal is not performing any transmission of uplink data, but is receiving downlink data, the radio resources (the frequency-time regions) which are beforehand allocated for the S-RACH can be released for a UL-SCH or the like, and the method is effective from the viewpoint of effective use of the radio resources.

[0122]

By using this Embodiment 4, the following advantages can be provided in addition to the advantages offered in the case of using above-mentioned Embodiment 3.

In a case in which no SR has occurred in a mobile terminal, an LB which is beforehand allocated for transmitting an SR in an Ack/Nack exclusive channel can be eliminated, and therefore the radio resources can be used more effectively. Furthermore, because the allocation for mapping an SR can be eliminated, in the case in which no SR has occurred in the mobile terminal, it becomes unnecessary to reduce the number of repetitions of an Ack/Nack or a CQI in the conventional Ack/Nack exclusive channel. Therefore, there can be provided an advantage of improving the quality of reception of the Ack/Nack or the CQI by a base station.

There can be considered a case in which in the mobile communication system, even when a mobile terminal is not receiving any downlink data, an Ack/Nack exclusive channel is allocated to the mobile terminal. More specifically, there can be considered a case in which, in order to prepare for future

downlink scheduling even when there exist no downlink data, or maintain synchronization between a base station and a mobile terminal, the mobile terminal notifies the result (CQI) of measurement of the quality of a downlink communication path. Also in such a case, there may be a case in which transmission of a CQI using an Ack/Nack exclusive channel and that of an uplink scheduling request signal SR occur simultaneously. This Embodiment 4 can also be used for such a mobile communication system.

[0123]

Hereafter, variants will be explained.

As a first variant, there can be considered a case in which in order to judge whether only an Ack/Nack and a CQI are mapped to an Ack/Nack exclusive channel, only one of the code a or the code b indicating that an uplink scheduling request signal SR is furthermore mapped to the Ack/Nack exclusive channel is used.

As a concrete example, the mobile terminal multiplies the Ack/Nack exclusive channel by the code a when only an Ack/Nack and a CQI are mapped to the Ack/Nack exclusive channel, whereas when an uplink scheduling request signal SR, in addition to an Ack/Nack and a CQI, is mapped to the Ack/Nack exclusive channel, the mobile terminal carries out the process of ST1505 without multiplying the Ack/Nack exclusive channel by the code b (ST1504 is omitted).

[0124]

The base station, in ST1509, performs a correlation operation by using the code a. When the result of the correlation operation is equal to or larger than a predetermined threshold, the base station judges that only an Ack/Nack and

a CQI are mapped to the Ack/Nack exclusive channel and advances to ST1510.

In contrast, when the result of the correlation operation which the base station, in ST1509, performed is smaller than the predetermined threshold, the base station judges that a scheduling request signal SR, in addition to an Ack/Nack and a CQI, is mapped to the Ack/Nack exclusive channel and then carries out ST1512.

By using this first variant, the number of the codes can be reduced, and the process of multiplying the Ack/Nack exclusive channel by the codes in the mobile terminal, and the process of performing correlation operations using the codes in the base station can be reduced. Furthermore, because the number of the codes is reduced, there is provided an advantage of increasing the number of mobile terminals which can be allocated to the Ack/Nack exclusive channel.

[0125]

As a second variant, there can be considered a case in which for each mobile terminal whose signals are multiplexed into the Ack/Nack exclusive channel, two codes (a code A and a code B) indicating that only an Ack/Nack and a CQI is mapped to the Ack/Nack exclusive channel or an uplink scheduling request signal SR, in addition to the Ack/Nack and the CQI, is mapped to the Ack/Nack exclusive channel are allocated.

As a concrete example, the mobile terminal multiplies the Ack/Nack exclusive channel by the code A when only an Ack/Nack and a CQI are mapped to the Ack/Nack exclusive channel (ST1503), whereas when an uplink scheduling request signal SR, in addition to the Ack/Nack and the CQI, are mapped to the Ack/Nack exclusive

channel, the mobile terminal multiplies the Ack/Nack exclusive channel by the code B (ST1504) and advances to ST1506. That is, because the codes allocated for each mobile terminal are used, the mobile terminal, in ST1505, does not have to further multiply the Ack/Nack exclusive channel by a code indicating the mobile terminal.

[0126]

The base station, in ST1508, performs a correlation operation by using the code (the code A) indicating the mobile terminal. When the result of the correlation operation is equal to or larger than a predetermined threshold, the base station judges that only an Ack/Nack and a CQI are mapped to the Ack/Nack exclusive channel from the mobile terminal, and then advances to ST1510.

In contrast, when the result of the correlation operation is smaller than the predetermined threshold, the base station further, in ST1508, performs a correlation operation by using the code (the code B) indicating the mobile terminal. When the result of the correlation operation is equal to or larger than a predetermined threshold, the base station judges that an uplink scheduling request signal SR, in addition to the Ack/Nack and the CQI, are mapped to the Ack/Nack exclusive channel, and then advances to ST1512. That is, the steps ST1509 and ST1511 among the steps of Fig. 15 can be omitted.

[0127]

Furthermore, in this Embodiment 4, the entire Ack/Nack exclusive channel is multiplied by either of the code a indicating that only an Ack/Nack and a CQI are mapped to the Ack/Nack exclusive channel and the code b indicating that an

uplink scheduling request signal SR, in addition to the Ack/Nack and the CQI, is mapped to the Ack/Nack exclusive channel.

In a third variant, a long block on the Ack/Nack exclusive channel to which an Ack/Nack and a CQI are mapped is multiplied by the code a indicating that effect and a long block on the Ack/Nack exclusive channel to which an uplink scheduling request signal SR is mapped is multiplied by the code b indicating that effect.

[0128]

Concretely, the steps ST1503 and ST1504 among the steps shown in Fig. 15 are omitted, and, instead, a step of multiplying a long block on the Ack/Nack exclusive channel to which an Ack/Nack and a CQI are mapped by the code a indicating that effect, and multiplying a long block on the Ack/Nack exclusive channel to which an uplink scheduling request signal SR is mapped by the code b indicating that effect is added.

Furthermore, the steps of ST1509, ST1510, ST1511, and ST1512 among the steps carried out by the base station are omitted, and, instead, a process of performing a correlation operation by using the code a in order to judge whether or not a long block is the one to which an Ack/Nack and a CQI are mapped is added.

[0129]

When the result of the correlation operation is equal to or larger than a predetermined threshold, the base station judges that the long block is the one to which an Ack/Nack and a CQI are mapped, and then performs a subsequent process. In contrast, when the result of the correlation operation is smaller than the threshold, the base station performs a

correlation operation by using the code b in order to judge whether or not the long block is the one to which an uplink scheduling request signal SR is mapped.

When the result of the correlation operation is equal to or larger than a predetermined threshold, the base station judges that the long block is the one to which an uplink scheduling request signal SR is mapped, and then performs a subsequent process. In this case, in addition to the advantages provided by Embodiment 4, there can be provided an advantage of being able to freely choose the location of a long block on the Ack/Nack exclusive channel to which an uplink scheduling request signal SR is mapped.

[0130]

Hereafter, a fourth variant will be explained.

One type of mapping to the Ack/Nack exclusive channel is provided regardless of whether or not an SR is included in the mapping. The mapping can use the example of Fig. 9. Therefore, information which is, in ST1501 and ST1502, actually mapped to the Ack/Nack exclusive channel is only an Ack/Nack or/and a CQI.

Because subsequent processing carried out by the mobile terminal is the same as that of Fig. 15, the explanation of the subsequent processing will be omitted hereafter.

[0131]

The base station which has received the Ack/Nack exclusive channel, in ST1510, judges that the base station has not received an SR from the mobile terminal, and then performs a process on the Ack/Nack exclusive channel after judging that only an Ack/Nack or/and a CQI are mapped to the Ack/Nack exclusive channel.

The base station, in ST1512, judges that the base station has received an SR from the mobile terminal, and then performs the processing on the Ack/Nack exclusive channel by judging that only an Ack/Nack or/and a CQI are mapped to the Ack/Nack exclusive channel.

[0132]

Fig. 27 is an explanatory drawing for explaining an example of the mapping of information to the Ack/Nack exclusive channel according to the fourth variant of Embodiment 4. In accordance with the fourth variant of this Embodiment 4, it becomes unnecessary to map an SR to the Ack/Nack exclusive channel, and it becomes possible to make further effective use of the radio resources. Furthermore, even in a case in which an uplink scheduling request signal SR is transmitted from the mobile terminal, the number of repetitions of an Ack/Nack or/and a CQI can be maintained. Therefore, there can be provided an advantage of being able to maintain the quality of reception of an Ack/Nack or/and a CQI by the base station even in a case in which an uplink scheduling request signal SR is transmitted to the base station, like in a case in which no SR is transmitted to the base station. That is, the use of this method can offer an advantage of, when desiring to transmit an uplink scheduling request signal SR, being able to not only use physical channels and radio resources which have already been used, but also hardly affect the amount of information and the quality of other data which are being transmitted by using the radio resources. Therefore, when, for example, allocating an uplink Ack/Nack exclusive channel to a radio resource, the base station does not have to take into consideration the influence of

transmission of an uplink scheduling request signal SR upon selection of a condition of the radio resource (a frequency bandwidth or the like).

[0133]

In this Embodiment 4 and its variants, the case in which the multiplexing of a plurality of mobile terminals into an Ack/Nack exclusive channel is carried out by using a CDM method is explained. As an alternative, Embodiment 4 and the variants can also be applied to a case in which an FDM method or a TDM method is used as the multiplexing method. In this Embodiment 4 and its variants, an Ack/Nack exclusive channel to which a plurality of time-frequency regions having narrow bands separated as shown in Fig. 24 are allocated monopolistically is explained. However, this Embodiment 4 and its variants can also be applied to an Ack/Nack exclusive channel not having a narrow band, as shown in Fig. 23.

[0134]

Embodiment 5.

Fig. 16 is a flow chart for explaining processing carried out by a mobile terminal which transmits an uplink scheduling request signal, and processing carried out by a base station which receives the uplink scheduling request signal.

The mobile terminal, in ST1601, judges whether or not the mobile terminal is transmitting uplink data. When the mobile terminal is transmitting uplink data, the mobile terminal advances to ST1602. The mobile terminal which is transmitting uplink data, i.e., which is scheduled to have an uplink resource from the base station does not have to transmit an uplink scheduling request signal SR, and therefore, when the mobile

terminal is, in ST1601, transmitting uplink data, the mobile terminal can carry out a process of advancing to ST1602 without going via judgment of ST1604. In other words, it can be considered that in one mobile terminal, uplink data and an uplink scheduling request signal SR do not coexist in a UL-SCH, and the relation of SC-FDMA is not satisfied and hence no increase is produced in the PAPR in the mobile terminal.

[0135]

The mobile terminal, in ST1602, multiplies the UL-SCH by a code (a code c) indicating that a symbol mapped to the UL-SCH is uplink data. This multiplication by code is carried out by the modulating unit 10 or the encoder unit 9. After performing the multiplication by the code c, the mobile terminal advances to ST1603.

The mobile terminal, in ST1603, maps the uplink data to a resource included in the UL-SCH on which scheduling has been performed by the base station, and advances to ST1607. In contrast, when, in ST1601, the mobile terminal is not transmitting any uplink data, the mobile terminal advances to ST1604.

The mobile terminal, in ST1604, judges whether a request for transmission of uplink data has occurred. When no request for transmission of uplink data has occurred, the mobile terminal returns to ST1601. In contrast, when a request for transmission of uplink data has occurred, the mobile terminal advances to ST1605.

[0136]

The mobile terminal, in ST1605, multiplies the UL-SCH by a code (a code d) indicating that the symbol mapped to the UL-SCH

is an uplink scheduling request signal SR. This multiplication by code is carried out by the modulating unit 10 or the encoder unit 9. After performing the multiplication by the code d, the mobile terminal advances to ST1613. The mobile terminal, in ST1613, multiplies the UL-SCH by a code (a code A) for identifying the mobile terminal. This multiplication by code is carried out by the modulating unit 10. After performing the multiplication by the code, the mobile terminal carries out ST1606. The mobile terminal, in ST1606, maps an uplink scheduling request signal SR (a resource request, a preamble, a message, and so on) to a resource included in the UL-SCH, and advances to ST1607. The order in which the processes of ST1613 and ST1606 are carried out can be reverse. As the codes c and d, codes which are perpendicular to each other can be used in order to reduce occurrence of errors in the judgment by the base station.

[0137]

The mobile terminal, in ST1607, transmits the UL-SCH to the base station. The base station, in ST1608, receives the UL-SCH transmitted thereto from the mobile terminal. The base station, in ST1609, performs a correlation operation by using the code c in order to judge whether or not uplink data are mapped to the UL-SCH.

When the result of the correlation operation is equal to or larger than a predetermined threshold, the base station judges that uplink data are mapped to the UL-SCH, and then advances to ST1610. The correlation operation using the code c is implemented by the demodulating unit or the decoder unit. The base station, in ST1610, carries out the processing by

judging that uplink data are mapped to the UL-SCH.

[0138]

Because the mobile terminal transmits the uplink data by using a predetermined radio resource for the UL-SCH which the base station has allocated and notified, the base station can distinguish the reception of the UL-SCH channel from the mobile terminal from those from other mobile terminals. In contrast, when, in ST1609, the result of the correlation operation which the base station has carried out by using the code c is smaller than the predetermined threshold, the base station advances to ST1614.

The base station, in ST1614, performs a correlation operation by using the code (the code A) which is used for multiplexing of signals from mobile terminals into the UL-SCH. When the result of the correlation operation is equal to or larger than a predetermined threshold (if Yes in ST1614), the base station judges that the base station has received the UL-SCH from the mobile terminal, and then carries out a process of ST1611. In contrast, when the result of the correlation operation which the base station, in ST1614, carried out is smaller than the predetermined threshold (if No in ST1614), the base station judges that the base station has not received the UL-SCH from the mobile terminal, and ends the processing. The correlation operation using the code A is carried out by the demodulating unit 24.

[0139]

The base station, in ST1611, performs a correlation operation by using the code d in order to judge whether or not an uplink scheduling request signal SR is mapped to the UL-SCH.

When the result of the correlation operation is equal to or larger than a predetermined threshold, the base station judges that an uplink scheduling request signal SR is mapped to the UL-SCH, and then advances to ST1612. The correlation operation using the code d is implemented by the demodulating unit 24 or the decoder unit 25. The base station, in ST1612, carries out the processing by judging that an uplink scheduling request signal SR is mapped to the UL-SCH.

[0140]

As previously explained, because the base station can judge whether or not uplink data are mapped to the UL-SCH and whether or not an uplink scheduling request signal SR is mapped to the UL-SCH by using the codes c and d, there is provided an advantage of eliminating the necessity to reserve radio resources for the RACH (Non-S-RACH and S-RACH) transmission (Fig. 17). Therefore, there is provided an advantage of being able to use the uplink radio resources efficiently. Furthermore, when a request for transmission of an uplink scheduling request signal SR occurs in a mobile terminal, the use of a conventional method does not make it possible for the mobile terminal to transmit the SR to the base station until an uplink resource timing reserved for the RACH (Non-S-RACH and S-RACH). In contrast, according to the present invention, the mobile terminal can transmit an uplink scheduling request signal SR to the base station at all times.

Therefore, there is provided an advantage of being able to reduce the control delay in the mobile communication system. Furthermore, because in a case in which a mobile terminal maps an uplink scheduling request signal to a UL-SCH, multiplexing

is carried out by using a code (a code A) for identification of the mobile terminal, also when scheduling request signals SRs are simultaneously transmitted to the base station from a plurality of mobile terminals, the base station can receive the scheduling request signals from those terminals while discriminating them from one another. Therefore, collision among the scheduling request signals from the plurality of mobile terminals which can happen in the case of using an S-RACH can be prevented.

[0141]

In addition, this Embodiment 5 can also be applied to a multiplexing method of multiplexing transmission, via an uplink, of an Ack/Nack and a CQI for downlink data and uplink data (a UL-SCH) in a case in which a mobile terminal is receiving downlink data without performing any transmission of uplink data. Because the operation of the mobile communication system is the same as the processing shown in the flow chart of Fig. 16, the explanation of the operation will be omitted.

Like in the case of Embodiment 5, it can be considered that in one mobile terminal, transmission of an Ack/Nack and transmission of a CQI do not coexist in a case in which no uplink data exist in the UL-SCH and the mobile terminal is not performing any transmission of uplink data via the UL-SCH, but is receiving downlink data, and the relation of SC-FDMA is not satisfied and hence no increase is produced in the PAPR in the mobile terminal.

Therefore there is provided an advantage of, in a case in which a mobile terminal is receiving downlink data without performing any transmission of uplink data, eliminating the

necessity to dispose an Ack/Nack exclusive channel (Figs. 23 and 24) for transmission of an Ack/Nack for downlink data via an uplink. Furthermore, the radio resources which are allocated for the Ack/Nack exclusive channel can be released for the UL-SCH or the like. Therefore, there can be provided another advantage of being able to use the uplink radio resources efficiently.

[0142]

Embodiment 6.

In a case in which a mobile terminal is not transmitting any uplink data (Uplink data, UL data) such as user data, but is receiving downlink data (Downlink data, DL data) transmitted from a base station, the mobile terminal has to transmit an Ack/Nack, which is the result of the reception of the downlink data, and a CQI signal to the base station.

Furthermore, when a necessity for transmission of uplink data occurs in a mobile terminal, the mobile terminal has to transmit an uplink scheduling request signal SR to a base station. Hereafter, a method of making a mobile terminal which has to transmit an Ack/Nack and an uplink scheduling request signal SR simultaneously perform these transmissions simultaneously without increasing the PAPR in the mobile terminal will be explained.

[0143]

The nonpatent reference 1 discloses that in a case in which a mobile terminal is receiving downlink data without performing transmission of uplink data, an Ack/Nack or/and a CQI are transmitted by suing an Ack/Nack exclusive channel having a broad band as shown in Fig. 23.

The nonpatent reference 4 discloses that in the case in which a mobile terminal is receiving downlink data without performing transmission of uplink data, an SR is transmitted by using an S-RACH.

However, the above-mentioned two nonpatent references 1 and 4 suggest nothing about the problems of the present invention. The problems of the present invention will be explained hereafter, though they are already mentioned.

[0144]

There may be a case in which a mobile terminal has to simultaneously carry out a process of transmitting an uplink Ack/Nack and a CQI by using an Ack/Nack exclusive channel and a process of transmitting an SR by using an S-RACH. In this case, because those signals have no correlation among them, when transmitted simultaneously, they are not transmitted with single carrier transmission, but are transmitted with multi carrier transmission. In the case in which such signals having no correlation among them are transmitted simultaneously, the PAPR becomes high because the time waveforms of the transmission signals have a high peak. A problem is that as the PAPR becomes high, the power consumption of the mobile terminal increases and therefore the cell coverage becomes narrow. A further problem is that as the PAPR becomes high, those signals become an interference wave to other mobile terminals and the communication system.

[0145]

In a case in which a mobile terminal has to transmit an uplink Ack/Nack, a CQI, and an SR simultaneously, the mobile terminal should use single carrier transmission in order to

reduce the increase in the PAPR in the mobile terminal.

There can be considered a case in which, when a mobile terminal uses an Ack/Nack or/and a CQI which are transmitted by using an Ack/Nack exclusive channel having a broad band, which is disclosed by the conventional technology, and an SR which is transmitted by using an S-RACH, just as they are, a necessity for the mobile terminal to transmit those pieces of information simultaneously occurs.

Therefore, this Embodiment 6 presents multiplexing of an Ack/Nack or/and a CQI, and an SR into either one of an Ack/Nack exclusive channel to which one certain time-frequency region is allocated monopolistically, and an S-RACH.

[0146]

The multiplexing method will be explained hereafter. A method of transmitting an uplink scheduling request signal SR, an Ack/Nack, and a CQI together by using either an Ack/Nack exclusive channel to which one certain time-frequency region as shown in Fig. 23 is allocated monopolistically, or an S-RACH as shown in Fig. 25 will be explained.

Because a region in units of a subframe with respect to time and in units of one or more resource units with respect to frequency is allocated to each of the Ack/Nack exclusive channel and the S-RACH, the present invention can be applied to each of the channels.

[0147]

In this Embodiment 6, a case in which when a necessity to simultaneously transmit an Ack/Nack or/and a CQI, and an uplink scheduling request signal SR occurs in a mobile terminal, the mobile terminal transmits the Ack/Nack and/or the CQI, with

the uplink scheduling request signal SR together by using an S-RACH will be shown. In other words, it means that even a mobile terminal which receives downlink data and therefore has to transmit an Ack/Nack or/and a CQI does not use an Ack/Nack exclusive channel during a time interval during which the mobile terminal is performing transmission of an uplink scheduling request signal SR. Furthermore, during the time interval during which the mobile terminal is transmitting an uplink scheduling request signal SR, the mobile terminal can perform transmission of a CQI or transmission of an Ack/Nack and a CQI by using an S-RACH, and is therefore allowed not to use an Ack/Nack exclusive channel at that time.

[0148]

Fig. 18 is a flow chart for explaining processing carried out by a mobile terminal, the processing including up to a process of transmitting an uplink scheduling request signal. Hereafter, the operation of the mobile terminal will be explained with reference to Fig. 18. In Fig. 18, because each of the same steps as those shown in Fig. 6 denote the same step or a like step, the explanation of the steps will be omitted hereafter.

Steps ST601 to ST603 are the same as those shown in Fig. 6. When, in ST602, is receiving downlink data, the mobile terminal carries out ST1801. In ST1801, the mobile terminal, maps an Ack/Nack, and/or a CQI with an uplink scheduling request signal SR onto an S-RACH, and transmits them to the base station. Because the processing of the mobile communication system is the same as that shown in Fig. 52, the explanation of the processing will be omitted hereafter.

[0149]

Next, methods of mapping those pieces of information onto the S-RACH will be explained hereafter.

According to a first mapping method, a preamble and a message, an Ack/Nack, and a CQI are mapped onto the S-RACH. Fig. 19 is an explanatory drawing showing radio resources in which a preamble and a message, an Ack/Nack, and a CQI are mapped onto the S-RACH.

According to a second mapping method, a preamble, an Ack/Nack, and a CQI are mapped onto the S-RACH. Message information required for an uplink scheduling request signal SR is transmitted at the timing of the next S-RACH transmission or by using the uplink resources which are allocated to the mobile terminal by the base station.

[0150]

Fig. 20 is an explanatory drawing showing radio resources in which a preamble and a message, an Ack/Nack, and a CQI are mapped onto the S-RACH.

According to a third mapping method, a preamble and a message are mapped onto the S-RACH as usual. An Ack/Nack and a CQI are newly added into a message on the S-RACH which is transmitted in a state in which uplink time synchronization is established. Fig. 21 is an explanatory drawing showing radio resources in which a preamble and a message, an Ack/Nack, and a CQI are mapped onto the S-RACH.

[0151]

As previously explained, by mapping both an uplink scheduling request signal SR and Ack/Nack information symbols (an Ack/Nack and/or a CQI) not to an Ack/Nack exclusive channel,

but to an S-RACH with the uplink scheduling request signal SR and the Ack/Nack information symbols being separated with respect to time, they are not transmitted simultaneously because they are transmitted with them being separated with respect to time. As a result, even when a plurality of "data-non-associated L1/L2 control signals" which have to be transmitted occur simultaneously in one mobile terminal, while the communication quality of these important control signals is attained, increase in the radio resources load on the communication system can be prevented, and transmission with a single carrier method which guarantees a low PAPR and high communication quality can be implemented.

[0152]

Furthermore, compared with the case in which an Ack/Nack and a CQI are transmitted with a plurality of time-frequency regions having narrow bands which are separate from one another, in the case of using the method according to this embodiment of transmitting an Ack/Nack and a CQI by using either an Ack/Nack exclusive channel to which one certain time-frequency region as shown in Fig. 23 is allocated monopolistically, or an S-RACH as shown in Fig. 25, the bandwidth becomes large. Therefore, the amount of information which can be transmitted with the radio resources allocated monopolistically increases.

As a result, there can be provided an advantage of being able to change the repetition pattern of an Ack/Nack and a CQI (e.g., the number of repetitions) according to the environment of the communication path. By changing the repetition pattern under an instruction from the base station according to the environment of the communication path, the quality of reception

of an Ack/Nack and a CQI can be maintained constant regardless of the environment of the communication path.

[0153]

Embodiment 7.

In a case in which a mobile terminal is synchronized with a base station, and is carrying out neither transmission of uplink data (Uplink data, UL data) nor reception of downlink data (Downlink data, DL data), there exists no Ack/Nack exclusive channel because the mobile terminal does not have to transmit an Ack/Nack to downlink data via an uplink. A method of, when an uplink transmission request occurs in such a case, transmitting an uplink scheduling request signal SR by using a signal for uplink communication quality measurement, which is called "sounding reference signal" (sounding reference signal, Sounding Reference Signal (RS)) without using radio resources for an S-RACH will be disclosed.

The use of this method makes it possible to not only release the radio resources reserved for an S-RACH, but also make effective use of the resources because a radio resource region which is shared with other mobile terminals is used for transmission of a Sounding RS. Furthermore, one sounding reference signal (Sounding RS) can be made to have the two following functions: measurement of the communication quality of a channel via which transmission is started; and the functions of an uplink schedule request signal SR.

[0154]

A Sounding RS is transmitted from a mobile terminal UE to a base station eNB in order to enable the base station to measure the communication quality of the uplink. In the 3GPP,

the specifications of two types of reference signals: a reference signal for demodulation (a Demoduration RS); and a reference signal for uplink channel quality measurement (a Sounding RS) are currently under debate as uplink reference signals (Reference signals).

A plurality of suggestions are currently written together in the nonpatent reference 3, and the specifications have not been determined yet.

In this Embodiment 7, a case in which a sounding reference signal (a Sounding RS) is transmitted only during transmission of uplink data will be considered.

[0155]

A part of allocation of radio resources for a Sounding RS during transmission of uplink data in this Embodiment 7 is shown in Figs. 35(a) and 35(b).

First, Fig. 35(a) shows an example in which a sounding RS is allocated to two short blocks (SB) within 2 TTIs with the total bandwidth of one time-frequency region. A radio resource allocation method in a case in which two mobile terminals (UE1 and UE2) use a part of one time-frequency region is shown in Fig. 35(a).

In the figure, reference numeral 501 denotes a data symbol of the mobile terminal UE1, reference numeral 502 denotes a Sounding RS which the mobile terminals UE1 and UE2, and which all mobile terminals using this time-frequency region use in common, reference numeral 503 denotes a reference signal for demodulation (Demoduration) of the mobile terminal UE1, reference numeral 504 denotes a data symbol of the mobile terminal UE2, and reference numeral 505 denotes a reference

signal for demodulation (Demoduration) of the mobile terminal UE2. Among these, two SBs with the total bandwidth of one time-frequency region is allocated within two 2 TTIs as the region of the Sounding RS 502.

[0156]

Similarly, an example in which a Sounding RS is allocated to two long blocks (LB) within 2 TTIs with the total bandwidth of one time-frequency region is shown in Fig. 35(b). A radio resource allocation method in a case in which three mobile terminals (UE1, UE2, and UE3) use a part of one time-frequency region is shown in Fig. 35(b). In the figure, reference numeral 506 denotes a data symbol of the mobile terminal UE1, reference numeral 507 denotes a reference signal for demodulation of the mobile terminal UE1, reference numeral 508 denotes a data symbol of the UE2, reference numeral 509 denotes a reference signal for demodulation of the mobile terminal UE2, reference numeral 511 denotes a data symbol of the mobile terminal UE3, reference numeral 512 denotes a reference signal for demodulation of the mobile terminal UE3, and reference numeral 510 denotes a Sounding RS which the mobile terminals UE1, UE2, and UE3, and all other mobile terminals using this time-frequency region use in common.

As mentioned above, two LBs with the total bandwidth of one time-frequency region is made available for the radio resources for a Sounding RS.

[0157]

In either of the cases of Fig. 35(a) and 35(b), a Sounding RS is code-multiplexed for each UE. Because radio resources having a wide band can be shared and used for a Sounding RS by

a plurality of terminals, the base station can measure the status of the frequency selective fading and can therefore carry out appropriate uplink scheduling. Furthermore, because a signal of each of the plurality of mobile terminals is code-multiplexed, the base station can carry out high-accuracy quality measurement for each of the plurality of mobile terminals.

[0158]

As a case in which a mobile station is synchronized with a base station and a transmission request occurs in a state in which no transmission of uplink data is carried out, there can be considered a case in which the mobile terminal receives downlink data, and, in order for the mobile terminal to transmit an Ack/Nack and a CQI to the downlink received data via the uplink, an ACK/Nack exclusive channel is allocated to the mobile terminal, and a case in which the mobile terminal receives downlink data, but no ACK/Nack exclusive channel is allocated to the mobile terminal, as described in Embodiment 3. In a flow chart of Fig. 37, a method of transmitting an uplink scheduling request signal SR in each of the cases is shown.

[0159]

First, when recognizing occurrence of an uplink data transmission request (ST5201), the mobile terminal checks to see whether or not an Ack/Nack exclusive channel via which the mobile terminal transmits an Ack/Nack to downlink received data is allocated in the uplink (ST5202). When an Ack/Nack exclusive channel is allocated in the uplink, the mobile terminal transmits an uplink scheduling request signal SR, as well as an Ack/Nack and a CQI, by using the Ack/Nack exclusive channel

(ST5204). Processing in this case is the same as that explained in Embodiment 3. In contrast, when, in ST5202, no Ack/Nack exclusive channel is allocated in the uplink, the mobile terminal transmits a Sounding RS for uplink quality measurement (a Sounding Reference signal) which serves as an uplink scheduling request signal SR to the base station (ST5203).

[0160]

There can be considered a case in which in the mobile communication system, even when a mobile terminal is not receiving any downlink data, an Ack/Nack exclusive channel is allocated to the mobile terminal. More specifically, there can be considered a case in which, in order to prepare for future downlink scheduling even when there exist no downlink data, or maintain synchronization between a base station and a mobile terminal, the mobile terminal notifies the result (CQI) of measurement of the quality of the downlink communication path. In such a case, it can be considered that the judgment of ST5202 is suitable as mentioned above.

In contrast, there can be considered a case in which in the mobile communication system, only when there exist downlink data destined for a mobile terminal, an Ack/Nack exclusive channel is allocated to the mobile terminal. In such a case, in the judgment of ST5202, the mobile terminal can judge whether or not the mobile terminal is receiving downlink data.

[0161]

A concrete example of a sequence when an uplink transmission request occurs under a condition resulting in a "No" in a branch of ST5202 of Fig. 37, i.e., in a state in which there is no allocation of an ACK/Nack exclusive channel will

be explained in Fig. 36.

This embodiment is based on that synchronization is established between a mobile terminal and a base station. Therefore, synchronization has to be established between the mobile terminal and the base station by using a certain method before this embodiment is applied. As an example of the method, Fig. 36 shows a case in which a non-synchronous random access signal (Non-Synchronous Rrandom Access) is transmitted from the mobile terminal to the base station.

[0162]

The base station eNodeB, in ST5101, receives a synchronous request from the mobile terminal UE, specifies the mobile terminal which has made the request, and also establishes synchronization with this mobile terminal and then recognizes that the mobile terminal has changed to an Active state. Furthermore, the base station, in next ST5102, notifies the mobile terminal that synchronization with this mobile terminal is established, and also notifies the mobile station of L1/L2 control information which is required for settings of uplink and downlink communication paths and whose setting value is nearly fixed (semi-static) for the reason of being set to other UEs in common with the mobile terminal.

When transmitting an uplink scheduling request signal SR by using a sounding RS for measurement of the communication quality of the uplink, the base station notifies Sounding-RS-related control information as well as the notification of the synchronization establishment because the base station has to transmit a "Sounding RS which serves as an uplink scheduling request" if there is no transmission of uplink

data. Because the Sounding RS for measurement of the communication quality of the uplink also uses the radio resources which the mobile terminal shares with the other UEs, the base station eNodeB, in ST5102, notifies the mobile terminal UE of mobile terminal identifying information (a sequence number or a UE-ID) which is allocated to this mobile terminal and is used for the code division multiplexing, the mobile terminal identifying information being included in the L1/L2 control information for controlling the Sounding RS, the frequency bandwidth (BW) of a radio resource which is scheduled to be allocated to the transmission of the Sounding RS, and so on, thereby enabling the transmission of the Sounding RS also when any uplink data are not transmitted.

In a case in which the Sounding RS is not used for notification of an uplink scheduling request signal SR, but is transmitted only during transmission of uplink data, what is necessary is just not to carry out the transmission along with the notification of the synchronization establishment, but to notify the Sounding RS-related control information (the sequence number, the BW, etc.) at, for example, the time (ST5104) of resource allocation for uplink data, unlike in the above case. Furthermore, the above-mentioned transmission along with the notification of the synchronization establishment means that they do not have to be carried out at the same time.

[0163]

When an uplink transmission data request occurs in the mobile terminal, the mobile terminal UE transmits a Sounding RS according to the sequence number of the UE for the uplink

Sounding RS, which the mobile terminal, in ST5102, received from the base station, and/or the control information, such as the frequency band which is scheduled to be allocated to the Sounding RS transmission, so as to notify the base station that the specific mobile terminal UE has an uplink scheduling request (ST5103). Such a Sounding RS is called a "Sounding RS which serves as an uplink scheduling request."

A Sounding RS of each mobile terminal is multiplexed with a CAZAC sequence code which has occurred with the sequence number for the mobile terminal UE which the mobile terminal, in ST5102, received, and is transmitted with the frequency band and at the timing which are notified from the base station.

[0164]

By receiving the Sounding RS in the time-frequency region of the radio resources, which this mobile terminal uses, to correlate the reception, the base station can detect the reception of the Sounding RS of the mobile terminal. When detecting a Sounding RS from a mobile terminal which has not transmitted any uplink data through the reception detection, the base station can judge this Sounding RS to be an uplink scheduling request signal SR (ST5103). This is because this Embodiment 7 is based on that only during transmission of uplink data, a Sounding RS is transmitted.

In the above-mentioned example, the use of a CAZAC sequence code for the method of identifying a mobile terminal in a Sounding RS is shown. As an alternative, another method can be used.

[0165]

When judging that the sounding RS which the base station

has received from the mobile terminal is a scheduling request signal SR, the base station notifies the control information, such as radio resource allocation required for transmission of uplink data, by using an "Uplink Data Resource Allocation" message (ST5104). The mobile terminal then starts transmission of uplink data by using the radio resources received from the base station (ST5105).

A flow chart in the base station at the time when the base station eNodeB, in ST5102, notifies the BW is shown in Fig. 39.

First, a flow of instructions at the time when the base station eNodeB notifies the BW will be explained with reference to Fig. 39.

[0166]

The base station, in ST5401, checks whether or not synchronization is established with the mobile terminal UE, and, when synchronization is not established, waits until the base station receives a synchronous request via a Non-Sync RACH (ST5402). When receiving a synchronous request, the base station establishes synchronization with the mobile terminal, as shown in the explanation of ST5102 of Fig. 36 (ST5403), and then transmits L1/L2 control information for Sounding RS to the mobile terminal UE in semi-static mode (ST5404). The identification information (the sequence number or the UE-ID) of the UE for uplink Sounding RS, and the BW of uplink Sounding RS are included in this L1/L2 control information.

When judging that synchronization is established as a result of, in ST5401, checking synchronization with the UE, the base station, in ST5405, checks to see whether or not the mobile terminal is receiving downlink data. While receiving downlink

data, the base station notifies L1/L2 control information for Sounding RS to the mobile terminal UE in dynamic mode, and changes the frequency bandwidth (BW) dynamically (ST5406).

[0167]

In the flow chart of Fig. 39, the base station notifies the BW of uplink Sounding RS by using both the L1/L2 control information in semi-static mode and the one in dynamic mode. In practice, the base station can notify the BW of uplink Sounding RS by using either one of the two types of L1/L2 control information: the semi-static L1/L2 control information and the dynamic L1/L2 control information.

[0168]

As a method of retransmitting an uplink Sounding RS which serves as an uplink scheduling request signal SR in a mobile terminal, in accordance with this Embodiment 7, there are provided the following two methods: a method of setting up a timer which times a predetermined time interval in the mobile terminal, and, when an "Uplink Data Resource Allocation" message cannot be received in ST5104 from the base station by the time the timer times out, retransmitting an uplink Sounding RS, and a method of continuing transmitting an uplink Sounding RS continuously until, in ST5104, receiving an "Uplink Data Resource Allocation" message. Because these methods are already explained in detail with reference to the explanatory figures 28 to 30 of Embodiment 3, and Figs. 31 to 33, the explanation of the methods will be omitted hereafter.

[0169]

When, in ST5103, transmitting a Sounding RS which serves as an uplink scheduling request signal SR, the mobile terminal

naturally uses an SB or LB which the mobile terminal ought to use for Sounding RS for (usually) measurement of the communication quality of the uplink, and has to make the frequency band and bandwidth (BW: BandWidth) of the SB or LB be equal to those of a general Sounding RS. This is because since for a Sounding RS, a plurality of mobile terminals to which an identical time-frequency region is allocated in such a way as to use the identical time-frequency region carries out code division multiplexing of the same SB (or LB) region to use this, if one mobile terminal changes the ends of the frequency band which the mobile terminal uses for Sounding RS in common with other mobile terminals or uses another block (LB or SB), data and reference signals of other mobile terminals are crushed. Therefore, in a case in which, for example, a Sounding RS for measurement (usually) of the communication quality of the uplink has a bandwidth equal to the entire bandwidth of the base station, a Sounding RS which serves as an uplink scheduling request SR also has the same bandwidth, and, when the base station sets up a plurality of BWs (frequency bands) for a Sounding RS for measurement (usually) of the communication quality of the uplink, the mobile terminal uses the same BW as that of another mobile terminal to which the same time-frequency region as that of the mobile terminal itself is allocated as a radio resource.

[0170]

There can be a case in which the base station eNodeB judges and selects the BW for a Sounding RS which serves as an uplink scheduling request SR, the BW being used for the mobile terminal, and a case in which the mobile terminal UE can judge and select

the BW by itself.

A flow chart showing a judging method in the case in which the base station eNodeB selects the BW is shown in Fig. 40, and a flow of a judging method in the case in which the mobile terminal selects the BW is shown in Fig. 41.

[0171]

Next, a process flow in the case in which the base station eNodeB selects the BW of an uplink Sounding RS will be explained. This selection flow shows a method of determining the BW included in either the semi-static (semi-static) L1/L2 control information which is, in ST5404 of the flow chart shown in Fig. 39, notified to the UE, or the dynamic (dynamic) L1/L2 control information which is, in ST5406, notified to the UE.

Fig. 40 shows a process flow in the case in which the base station eNodeB selects the frequency bandwidth (Band Width: BW) of an uplink Sounding RS.

[0172]

First, the base station, in ST5501 of the figure, checks to see whether there exist two or more BWs with which an uplink Sounding RS is transmitted, and, if there exists only one BW, the base station sets the BW to be equal to the BWs of uplink Sounding RSs of all other mobile terminals UE (ST5502). In contrast, when there exist two or more BWs with which an uplink Sounding RS is transmitted, the base station checks whether or not the number of UEs each of which transmits a Sounding RS which serves as an uplink scheduling request signal SR with the same BW is appropriate (ST5504), checks whether or not one of the two or more BWs includes frequencies which can be allocated to the UE at the cell edge (ST5505), checks whether one of the two

or more BWs shows a good result of reporting the downlink CQI (the channel quality or the downlink communication path quality) (ST5506), and then searches through the two or more BWs for one BW which satisfies these conditions (ST5507). The base station then determines one BW which satisfies the conditions of ST5504 to ST5506 as the BW for uplink Sounding RS (ST5508).

[0173]

A process flow in the case in which the UE carries out the above-mentioned selection of one BW is shown in Fig. 41. The result of the selection of one BW for uplink Sounding RS which is carried out by the UE is reflected, referring to the flow chart of Fig. 39, in the BW notified by using the dynamic L1/L2 down control information when the mobile terminal is, in ST5405, receiving downlink data. First, the mobile terminal receives the number of BWs for uplink Sounding RS from the base station via a channel such as a BCH (ST5601). The mobile terminal checks to see whether there exist two or more BWs for uplink Sounding RS (ST5602), and, when there exist only one BW, selects the same BW as the BWs for uplink Sounding RSs of all other UEs (ST5603). In contrast, when there exist two or more BWs, the mobile terminal selects one BW from among them in order, and searches for one BW which satisfies the conditions "the quality of the downlink CQI is good" of ST5605 to determine one BW (ST5607). The mobile terminal then notifies the result of the determination to the base station.

[0174]

By using one of methods, such as the above-mentioned, the number of UEs which transmit with the same BW can be controlled,

and the increase in the total receive power of the base station can be prevented. Furthermore, a frequency which a UE at the cell edge can allocate as an uplink frequency can be set up beforehand, and the uplink communication path quality at a frequency band to actually know can be acquired. Furthermore, by expecting and selecting a good BW of the uplink from the downlink CQI, the uplink communication path quality can be acquired with radio resources which are most stabilized for the mobile terminal UE.

The above-mentioned determining method of determining one BW for a Sounding RS which serves as an uplink scheduling request SR which the mobile terminal uses (the method of determining one BW for Sounding RS in the case of notifying an uplink scheduling request SR by using a Sounding RS) can also be applied to Embodiment 8, Embodiment 9, and Embodiment 10.

[0175]

A concrete method of allocating radio resources for use in a base station and a mobile terminal, in ST5103 of the sequence of Fig. 36, will be explained.

Fig. 38 is a figure showing a method of allocating radio resources in a case in which the base station sets up a plurality of BWs for a Sounding RS for measurement (usually) of the communication quality of the uplink, and the circumstances of allocation of radio resources to the mobile terminal UE1 after a transmission request occurs. In Fig. 38, the radio resources which the base station manages are divided into three time-frequency regions whose bandwidths are expressed as BW#1, BW#2, and BW#3, respectively. A UE group A including a mobile terminal UE1 is allocated to the time-frequency region of BW#1,

a UE group B is similarly allocated to the time-frequency region of BW#2, and a UE group C is similarly allocated to the time-frequency region of BW#3. In the figure, reference numeral 531 denotes a data region of the UE group A, reference numeral 532 denotes a sounding (Sounding RS) region of the UE group A, reference numeral 533 denotes an RS region for demodulation (Demoduration) of the UE group A, reference numeral 534 denotes a data region of the UE group B, reference numeral 535 denotes a sounding (Sounding) RS region of the UE group B, and reference numeral 536 denotes an RS region for demodulation (Demoduration) of the UE group B. In this figure, the Sounding RS region is placed in two SBs within 2 TTIs, like in the example of Fig. 35(a), and its bandwidth is the same as the bandwidths (BW#1, BW#2, and BW#3) of the plurality of time-frequency regions respectively set for the plurality of UE groups. Each of the data region and the RS region for Demoduration in each UE group region is divided into a plurality of parts for the respective UEs in each UE group.

[0176]

A case in which, for example, the UE 1 included in the UE group A desires to transmit an uplink scheduling request signal SR in a subframe (1) of TTI #1 under the radio resources allocation conditions of Fig. 38 is shown in Fig. 38(b). Reference numeral 537 denotes a sounding (Sounding) RS region which serves as a scheduling request signal SR of the UE1, reference numeral 538 denotes a transmission data region after the UE1 starts data transmission, reference numeral 539 denotes an RS region for demodulation (Demoduration) of the UE1, and reference numeral 540 denotes a sounding (Sounding) RS region

for measurement (usually) of the uplink communication quality of the UE1. The UE1 transmits a Sounding RS which serves as a scheduling request SR with an SB1 (537) which is allocated as a Sounding RS of the UE group A. The BW of the SB 537 which is used for a Sounding RS which serves as a scheduling request signal SR of the UE1 is the same as the BW#1 of Sounding RS of the UE group A. Because the UE1 is not performing any transmission of uplink data in the subframe (1), the region which the UE1 uses at that time is only the SB1. That is, there is no transmission from the UE1 with LBs (LB1, LB2, LB3, LB4, and LB5) and SBs (SB2) other than the SB1 of the subframe (1). After that, the base station carries out an uplink scheduling process.

[0177]

In this case, while 3 TTIs elapse, allocation of radio resources for transmission of uplink data is notified from the base station to the UE1, and the UE1 starts transmission of uplink data from the subframe (7). After that, the data 538 for the UE1 are allocated to the LBs 1 to 6, the uplink Sounding RS 540 for measurement (usually) of the uplink communication quality of the UE1 is allocated to the SB1 in TTI#4 and the SB2 in TTI#5, and the RS for demodulation is allocated to the remaining SBs. As shown in the figure, the BW of the region of the uplink Sounding RS which serves as a scheduling request SR of the UE1, and the BW of the region of the uplink Sounding RS for measurement (usually) of the communication quality of the uplink are the same as the bandwidth BW#1 of the UE group A, and all mobile terminals UE of the UE group A in a data transmission state allocate the same region having the

completely same timing as this region for transmission of an uplink Sounding RS. In contrast, the bandwidth of the data region of the UE1 and that of the region allocated to a Demoduration RS are smaller than BW#1, and, as these regions, regions distinguished from those of other UEs are used.

[0178]

Thus, the timing of transmission of an uplink Sounding RS which serves as an uplink scheduling request signal SR has to be synchronized with that of transmission of an uplink Sounding RS of another UE (there can be two or more other UEs) under transmission to which the same BW is allocated.

[0179]

Fig. 42 shows in greater detail how each of a plurality of UEs is using radio resources allocated thereto at the same timing in the time-frequency region allocated to the UE group A. Unlike in the case of Fig. 38, in the case of Fig. 42, the region for uplink Sounding RS is placed in two LBs (LB1 in a first subframe, and LB6 in a second subframe) within 2 TTIs, like in the case of Fig. 35(b). In the figure, reference numeral 571 denotes a Sounding RS region of the UE group A, reference numeral 572 denotes an RS region for Demoduration of the UE group A, reference numeral 573 denotes a data region of the UE group A, reference numeral 574 denotes a Sounding RS region of the UE group B, reference numeral 575 denotes an RS region for Demoduration of the UE group B, reference numeral 576 denotes a data region of the UE group B, reference numeral 577 denotes a region of a Sounding RS which serves as an scheduling request signal SR of the UE1 for a start of transmission of uplink data, and a region of a Sounding RS of the UE2 under transmission,

reference numeral 578 denotes a Demoduration RS region of the UE2, reference numeral 579 denotes a data region of the UE2, reference numeral 580 denotes a general Sounding RS region of the UE1 and the UE2, reference numeral 581 denotes an RS region for Demoduration of the UE1, and reference numeral 582 denotes a data region of the UE1 under transmission.

[0180]

Hereafter, it is assumed that in the two mobile terminals UE1 and UE2 in the same UE group A, at a time, the UE1 tries to start uplink transmission and the UE2 has been transmitting uplink data. The LB1 577 which is allocated to the uplink Sounding RS region which all the mobile terminals of the UE group A use at the time of uplink transmission is used, in the UE1, for transmission of an uplink Sounding RS which serves as an uplink scheduling request signal SR notified from the mobile terminal to a base station for a start of uplink transmission, and is, in the UE2, used for transmission of an uplink Sounding RS used for usual measurement of the quality in a base station. As shown in the figure, these two UEs transmit uplink Sounding RSs having different meanings with the same block (LB) of the completely same bandwidth (=BW#1) at the completely same timing.

[0181]

When receiving this LB1, the base station demodulates the block with codes which are respectively generated from the sequence numbers of the UEs to receive the uplink Sounding RSs from the UE1 and the UE2. The base station then uses the Sounding RS signal from the UE1 from which the base station has not received any uplink data signal until now for measurement

of the uplink quality of the UE1, and judges that this Sounding RS signal is a notification (an uplink scheduling request signal SR) of a start of transmission by the UE1. In contrast, the base station uses the Sounding RS signal from the UE2 from which the base station has so far received an uplink data signal at regular intervals for measurement of the uplink quality of the UE2.

[0182]

The region for data and the region for a Demoduration RS which are allocated while each of the UE1 and the UE2 carries out transmission are allocated to regions which are separated from each other, respectively, as shown in Fig. 42, unlike that for an uplink Sounding RS.

[0183]

Furthermore, a time-frequency region via which an uplink Sounding RS can be transmitted is not configured similarly for any UE group, as explained with reference to Figs. 38 and 42, and therefore there is also provided a method of configuring a different time-frequency region for each UE group. Figs. 43(a) and 43(b) show examples in each of which the region to which an uplink Sounding RS is allocated is configured for each UE group in such a way that the time and frequency of the region are shifted in units of a resource unit (RU). Fig. 43(a) shows the example in which, in a case in which the BW of a Sounding RS is equal to the entire bandwidth of the base station, the region with which an uplink Sounding RS can be transmitted is allocated in the time-frequency region in such a way that the region differs for each UE group. The figure shows an example in which time sections during each of which a Sounding RS can

be transmitted are allocated to the four UE groups in such a way that each of the time sections has a length of 2 TTIs and the time sections are shifted from one another by 1 TTI. More concretely, among the four UE groups, a UE in the team 1 transmits an uplink Sounding RS during a time section A of TTIs (1) and (2), a UE in the team 2 transmits an uplink Sounding RS during a time section B of TTIs (2) and (3), a UE in the team 3 transmits an uplink Sounding RS during a time section C of TTIs (3) and (4), and a UE in the team 4 transmits an uplink Sounding RS during a time section D of TTIs (4) and (5). The allocation is not limited to this example.

[0184]

Furthermore, as explained in this Embodiment 7, the allocation of an uplink Sounding RS to a region is not limited to allocation to two blocks within 2 TTIs. As an alternative, the allocation can be carried out for each TTI, or the allocation can be carried out in such a way that an uplink Sounding RS is allocated to a predetermined fixed number of blocks over three or more subframes. Furthermore, there is no necessity to configure the time sections during each of which a Sounding RS can be transmitted in such a way that they are shifted from one another by 1 TTI, and what is necessary is just to configure the time sections according to a period which is enough to reduce the network load and to maintain the accuracy of the measurement of the uplink quality. Because using this method, the time sections during which the plurality of UE teams can transmit uplink sounding RSs respectively differ from one another, the number of UEs which the base station receive simultaneously can be reduced.

Furthermore, the distribution of the total transmit power of the base station can be optimized.

[0185]

Fig. 43(b) shows the example in which, in a case in which a plurality of BWs are configured an uplink Sounding RS, the time section during which an uplink Sounding RS can be transmitted is allocated in each of the time-frequency regions of the BWs in such a way that the time section differs for each UE group. Because using this method, the frequency bands with which the plurality of UE teams perform uplink transmissions respectively and the time sections during which the plurality of UE teams can transmit uplink sounding RSs respectively differ from one another, compared with Fig. 43(a), the number of UEs which the base station receive simultaneously with the same band at the time of reception can be reduced and the receiving load of the wireless communication unit of the base station can be reduced. Furthermore, the distribution of the total transmit power of the base station can be optimized.

[0186]

The method of setting up the BW of an uplink Sounding RS, and allocating radio resources, which is explained in this Embodiment 7, can also be applied to a case in which when there exist no transmission of uplink data and a Sounding RS is transmitted for the purpose of transmitting a signal other than an uplink scheduling request signal SR. Furthermore, the method of configuring the BW of an uplink Sounding RS, and allocating radio resources, which is explained in this Embodiment 7, can also be applied to Embodiment 8, Embodiment 9, and Embodiment 10.

[0187]

The transmit power when transmitting a Sounding RS which serves as an uplink scheduling request signal SR has to be set to be equal to or higher than that at the time of transmitting a general uplink Sounding RS in view of the importance of the signal. For example, there is also provided a method of acquiring the transmit power of a Sounding RS which serves as an uplink scheduling request signal SR by using a predetermined equation as follows:

[Equation 1]

$$P_{SR} = P_{Sounding} + \frac{E/N_{SR}}{E/N_{sounding}} \times k$$

k : Constant

P_{SR} : Transmit Power of Sounding RS Serving as Scheduling Request

$P_{Sounding}$: Transmit Power of Uplink Sounding RS

E/N_{SR} : E_b/No of Uplink Sounding RS Serving as Scheduling Request

$E/N_{Sounding}$: E_b/No of Uplink Sounding RS

As mentioned above, by, for example, setting up the transmit powers of mobile terminals according to their respective desired power-to-noise ratios so as to make the transmit power of each mobile terminal at the time of transmitting a Sounding RS which serves as an uplink scheduling request signal SR be equal to or larger than that at the time of transmitting a general uplink Sounding RS, erroneous reception of uplink scheduling request signals by the base station can be reduced. As mentioned above, the method of setting up the transmit power of a Sounding RS which serves as an uplink scheduling request signal SR can also be applied to Embodiment 8, Embodiment 9, and Embodiment 10.

[0188]

As mentioned above, when a transmission request occurs in a case in which a mobile station is synchronized with a base station, and no transmission of uplink data is being carried out and no allocation of an Ack/Nack exclusive channel is made, a frequency band wider than that at the time of using an S-RACH

can be used by transmitting an uplink scheduling request signal SR by using a Sounding RS for measurement of the quality of the uplink. Therefore, transmission further resistant to the frequency selective fading can be implemented. Because by using a "sounding RS which serves as an uplink scheduling request signal SR", an uplink communication path quality measurement in the base station can be carried out while serving as transmission of an uplink scheduling request signal SR. Therefore, the necessity to transmit a sounding RS for measurement of the uplink quality independently from a scheduling request signal SR can be eliminated. Furthermore, because a wide frequency band is used, it is easy to incorporate the communication quality of the uplink into subsequent uplink scheduling. In addition, the radio resources of the S-RACH can be released, and the complexity in the uplink scheduling sequence between the mobile terminal and the base station can be reduced.

[0189]

Embodiment 8.

Even in a case in which a mobile terminal is synchronized with a base station, and is not receiving downlink data (Downlink data, DL data) transmitted from a base station, or allocation of an Ack/Nack exclusive channel for transmitting an Ack/Nack signal or a CQI signal which is the result of reception of downlink data to the base station is not made and the mobile terminal is not carrying out any transmission of uplink data (Uplink data, UL data) such as user data, the mobile terminal may transmit a reference signal for sounding (a reference signal for measurement of the quality of an uplink

communication path) to the base station at certain periodicity in order to maintain uplink synchronization with the base station. A case in which a mobile terminal transmits a reference signal 7901 for sounding at certain periodicity(n×TTI) is shown in Fig. 53. On the other hand, when a necessity to transmit uplink data occurs in the mobile terminal, the mobile terminal has to transmit an uplink scheduling request signal SR to the base station separately.

[0190]

Therefore, there may be a case in which an uplink scheduling request signal SR and a reference signal for sounding are transmitted simultaneously. When transmitted simultaneously, they are not transmitted with single carrier transmission, but are transmitted with multi carrier transmission. In the case in which such signals having no correlation among them are transmitted simultaneously, the PAPR becomes high because the time waveforms of the transmission signals have a high peak. A problem is that as the PAPR becomes high, the power consumption of the mobile terminal increases and therefore the cell coverage becomes narrow. A further problem is that as the PAPR becomes high, those signals become an interference wave to other mobile terminals and the communication system. In order to avoid these problems, there can be considered a measure of shifting the transmission timing of a reference signal for sounding from that of an uplink scheduling request signal SR, or the like, though the scheduling control in the base station and/or the mobile terminal becomes complicated.

In this Embodiment 8, a method of making a reference signal

for sounding serve as an uplink scheduling request signal SR in order to solve the above-mentioned problems will be explained.

[0191]

In above-mentioned Embodiment 7, the transmission method of transmitting a scheduling request in a state in which a mobile terminal does not transmit a reference signal for sounding in a case in which the mobile terminal is not transmitting uplink data is disclosed. In that case, the base station judges that there is a scheduling request when receiving a reference signal for sounding. Therefore, the base station does not have to have a function of judging whether a reference signal for sounding serves as an uplink scheduling request, and/or a function of judging whether or not there occurs scheduling.

However, there arises a new problem that in a case in which a mobile terminal transmits a reference signal for sounding at certain periodicity, in order to make the reference signal for sounding serve as an uplink scheduling request signal SR, the base station has to judge whether the received signal is the one sounding or the one for uplink scheduling, and/or has to judge whether or not there occurs scheduling. In order to solve this problem, in this Embodiment 8, a method of providing two types of pilot patterns for sounding, defining correspondences between these two types of pilot patterns and the presence and absence of an uplink scheduling request, and transmitting one of the two types of pilot patterns according to the presence or absence of an uplink scheduling request is disclosed (refer to Fig. 80).

[0192]

A method of, in a case in which a mobile terminal transmits a reference signal for sounding, allocating a pilot for sounding, and allocating a code specific to each mobile terminal is shown in Fig. 46. Reference numeral 7201 denotes the pilot for sounding, and reference numeral 7202 denotes the code specific to each mobile terminal. When the mobile terminal transmits the reference signal for sounding, the encoder unit or the modulating unit of the mobile terminal multiplies the pilot for sounding by the code specific to each mobile terminal to generate the reference signal for sounding.

After the reference signal for sounding is subjected to a modulation process and is converted into a baseband signal, the reference signal for sounding is converted into a signal having a radio frequency. After that, the reference signal for sounding is transmitted to the base station by way of an antenna. The code specific to each mobile terminal is used by the base station in order for the base station to, when receiving reference signals for sounding from a plurality of mobile terminals, identify which one of the reference signals for sounding is the one from the above-mentioned mobile terminal. It is preferable that the above-mentioned code is the one having orthogonality, or this code yields multiplication of a pilot pattern thereby having orthogonality.

[0193]

As an alternative, the above-mentioned code can be a spread code or a scramble code. A time-frequency region to which the reference signal for sounding is allocated is predetermined or is notified from the base station. A frequency region can have one of various bands. A time region can be

provided once during each TTI or during several TTIs. A correlation operation is performed on the reference signal for sounding which the base station has received by using a code specific to each mobile terminal, and, by using a code which yields a correlation operation result which is equal to or larger than a threshold, the base station can identify the mobile terminal. The base station restarts the synchronization of an uplink channel with the mobile terminal which the base station has identified by using the reference signal for sounding. The base station can also measure the uplink communication path quality by using the above-mentioned signal.

[0194]

One embodiment of making a reference signal for sounding have the functions of an uplink scheduling request signal SR will be disclosed hereafter. A method of generating a reference signal for sounding having the functions of an uplink scheduling request signal SR is shown in Fig. 44. Reference numeral 7001 denotes a pilot pattern 1 for sounding, reference numeral 7002 denotes a pilot pattern 2 for sounding, reference numeral 7003 denotes a switch for switching between the two types of patterns, reference numeral 7004 denotes a control unit for controlling the switch, and reference numeral 7005 denotes a code specific to each mobile terminal. Each of the above-mentioned pilots 1 and 2 for sounding can be a single symbol or can be a plurality of symbols. It is preferable that the above-mentioned code is the one having orthogonality, or this code yields multiplication of a pilot pattern thereby having orthogonality. As an alternative, the above-mentioned code can be a spread code

or a scramble code. However, in a case in which the code is a scramble code, it is preferable that each of the above-mentioned pilots 1 and 2 for sounding is a plurality of symbols.

As the pilot patterns for sounding, there are provided two types of patterns according to the presence and absence of an uplink scheduling request. As shown in a table of the figure, in a case in which there is no uplink scheduling request, the pattern 1 is allocated in advance, whereas in a case in which there is an uplink scheduling request, the pattern 2 is allocated in advance.

[0195]

Fig. 45 shows a diagram of sequences between the mobile terminal and the base station. The mobile terminal transmits a reference signal for sounding at certain periodicity. A time-frequency region to which the reference signal for sounding is allocated is predetermined or is notified from the base station. The mobile terminal, in ST7101, judges whether an uplink data transmission request has occurred. When no uplink data transmission request has occurred, the mobile terminal carries out ST7102 because the mobile terminal does not transmit any scheduling request. The control unit 7004, in ST7102, changes the state of the switch 7003 in such a way as to select the pilot pattern 1 for sounding.

[0196]

In contrast, when an uplink data transmission request has occurred, the mobile terminal carries out ST7103 because the mobile terminal transmits an uplink scheduling request. The control unit 7004, in ST7103, changes the state of the switch

7003 in such a way as to select the pilot pattern 2 for sounding. The mobile terminal, in ST7104, multiplies the pilot pattern for sounding selected in either of the cases by the code 7005 specific to each mobile terminal to generate a reference signal for sounding. The mobile terminal, in ST7105, performs a modulation process, baseband signal conversion, and radio frequency conversion on the reference signal for sounding, and transmits the reference signal for sounding to the base station with the time-frequency region allocated to the reference signal for sounding by way of the antenna. The base station, in ST7106, receives the reference signal for sounding. The base station, in ST7107, performs a correlation operation on this reference signal for sounding with the code specific to each mobile terminal, and identifies the mobile terminal when the result of the operation is equal to or larger than a threshold.

[0197]

Next, the base station, in ST7108, judges whether the pilot for sounding has the pattern 1 or the pattern 2. When judging that the pilot for sounding has the pattern 1, the base station, in ST7109, carries out the processing by judging that there does not occur uplink scheduling. In contrast, when judging that the pilot for sounding has the pattern 2, the base station, in ST7110, carries out a process in the case in which there occurs uplink scheduling.

When, in ST7107, the result of the correlation operation is smaller than the threshold, the base station ends the processing by judging that the reference signal for sounding has been transmitted thereto from another mobile terminal other than the above-mentioned mobile terminal.

In one example of the two types of pilot patterns for sounding which enable the base station to judge whether the pilot for sounding has the pattern 1 or the pattern 2, a code and a reverse code are allocated to the pilot pattern 1 and the pilot pattern 2, respectively (when a certain symbol allocated to one of them is "1", "0" is allocated to the other one). By carrying out the allocation of codes to the two types of pilot patterns in this way, the base station, in ST7108, can judge whether the pilot for sounding is the pilot 1 or the pilot 2 by judging whether the result of the correlation operation is positive or negative.

The base station can also restart the synchronization of the uplink channel with this identified mobile terminal by using the pilot pattern 1 or 2 for sounding.

[0198]

With the above-mentioned structure, the mobile terminal can suppress the increase in the PAPR which appears when transmitting an uplink scheduling request signal SR and a reference signal for sounding simultaneously.

Furthermore, because it becomes unnecessary to ensure the region of an S-RACH for a scheduling request, the waste of the time-frequency resource can be eliminated.

In addition, because the mobile terminal does not have to carry out a process of shifting the transmission timing of a reference signal for sounding and that of an uplink scheduling request signal SR from each other, and so on, the scheduling control in the base station and/or the mobile terminal can be prevented from becoming complicated.

Furthermore, by forming a reference signal for uplink

sounding in such a way that the reference signal for uplink sounding serves as an uplink scheduling request signal SR, as mentioned above, the base station is enabled to, when receiving this signal, judge whether this signal has an uplink scheduling request.

In addition, because only one type of specific code has only to be allocated to each mobile terminal, many code resources can be ensured and the number of mobile terminals from which the base station can receive signals simultaneously can be increased.

Furthermore, because a frequency band wider than that at the time of using an S-RACH or an Ack/Nack exclusive channel can be used, transmission further resistant to the frequency selective fading can be implemented.

[0199]

Hereafter, variants will be explained.

In a first variant, a symbol or two or more symbols of the pilot for sounding are a symbol or two or more symbols for scheduling request. A pilot pattern in which a ~~part~~ symbols or two or more symbols of the pilot for sounding are a symbol or two or more symbols for scheduling request is shown in Fig. 47.

When there is no scheduling request, 1 is allocated to the symbol for scheduling request, whereas when there is a scheduling request, 0 is allocated to the symbol for scheduling request.

[0200]

This variant will be explained with reference to a sequence diagram of Fig. 48. The mobile terminal, in ST7401,

judges whether an uplink data transmission request has occurred. When no uplink data transmission request has occurred, the mobile terminal carries out ST7402 because the mobile terminal does not transmit any scheduling request. The mobile terminal, in ST7402, sets 1 to the symbol for scheduling request. In contrast, when an uplink data transmission request has occurred, the mobile terminal carries out ST7403 because the mobile terminal transmits a scheduling request. The mobile terminal, in ST7403, sets 0 to the symbol for scheduling request. The mobile terminal, in ST7404, multiplies the pilot pattern for sounding selected in either of the cases by a code A specific to each mobile terminal to generate a reference signal for sounding.

[0201]

The mobile terminal, in ST7405, performs a modulation process, baseband signal conversion, and radio frequency conversion on the reference signal for sounding, and transmits the reference signal for sounding to the base station with the time-frequency region allocated to the reference signal for sounding by way of the antenna. The base station, in ST7406, receives the reference signal for sounding. The base station, in ST7407, performs a correlation operation on this reference signal for sounding with the code A specific to each mobile terminal, and identifies the mobile terminal when the result of the operation is equal to or larger than a threshold. Next, the base station, in ST7408, judges whether the symbol for scheduling request is 1 or 0. When judging that the symbol for scheduling request is 1, the base station, in ST7409, carries out the processing by judging that there does not occur uplink

scheduling. In contrast, when judging that the symbol for scheduling request is 0, the base station, in ST7410, carries out a process in the case in which there occurs uplink scheduling.

[0202]

The number of symbols which are used for a scheduling request can be one or can be two or more. By using two or more symbols for a scheduling request, there can be provided an advantage of increasing the composite electric power in the base station and therefore reducing the error rate.

[0203]

Furthermore, the symbols for sounding can be multiplied by a code specific to each mobile terminal according to the number of the symbols for sounding and the one or more symbols for scheduling request can be multiplied by another code specific to the mobile terminal according to the number of the symbols for scheduling request, and the reference signal for sounding and scheduling request can be multiplexed with respect to time. Thereby, a scrambling code can be used as the code specific to each mobile terminal. Furthermore, because the base station can perform the correlation operation by using only the reference signal for sounding, there is provided an advantage of improving the synchronization accuracy and the accuracy of evaluation of channel conditions (the quality of the uplink communication path). In addition, in a case in which the number of the symbols for sounding is the same as the number of the one or more symbols for scheduling request, both of them can be multiplied by an identical code specific to each mobile terminal. Thereby, there is provided an advantage of making

effective use of the code resources.

[0204]

In a second variant, two codes specific to each mobile terminal are prepared, and the pilot for sounding is multiplied by one of the two codes specific to each mobile terminal which is according to the presence or absence of an uplink scheduling request.

An example of generation of a reference signal for sounding is shown in Fig. 49. Reference numeral 7501 denotes a pilot for sounding, reference numeral 7503 denotes a code A specific to each mobile terminal, reference numeral 7504 denotes another code B specific to each mobile terminal, reference numeral 7502 denotes a switch for selecting a code by which the pilot for sounding is multiplied, and reference numeral 7505 denotes a control unit for transmitting a signal for selecting a code (7503 or 7504) according to the presence or absence of a scheduling request by using the switch 7502. As shown in a table of the figure, as the code specific to each mobile terminal, when there is no uplink scheduling request, the code A is allocated, whereas when there is an uplink scheduling request, the code B is allocated.

[0205]

The operation of the variant will be explained with reference to a sequence diagram of Fig. 50. The mobile terminal, in ST7601, judges whether an uplink data transmission request has occurred. When no uplink data transmission request has occurred, the mobile terminal carries out ST7602 because the mobile terminal does not transmit any scheduling request. The mobile terminal, in ST7602, selects the code A by using the

switch 7502 according to a control signal from the control unit 7505 in such a way as to carry out multiplication with the code A. As a result, the pilot for sounding is multiplied by the code A 7503. In contrast, when an uplink data transmission request has occurred, the mobile terminal carries out ST7603 because the mobile terminal transmits a scheduling request. The mobile terminal, in ST7603, selects the code B 7504 by using the switch 7502 according to the control signal from the control unit 7505 in such a way as to carry out multiplication with the code B. As a result, the pilot for sounding is multiplied by the code B.

[0206]

The mobile terminal, in ST7604, performs a modulation process, baseband signal conversion, and radio frequency conversion on the reference signal for sounding, and transmits the reference signal for sounding to the base station with the time-frequency region allocated to the reference signal for sounding by way of the antenna. The base station, in ST7605, receives the reference signal for sounding. The base station, in ST7606, performs a correlation operation on this reference signal for sounding with the code A first, and identifies the mobile terminal when the result of the operation is equal to or larger than a certain threshold, though the base station handles the reference signal for sounding by judging that the reference signal does not include a scheduling request. In contrast, when the result of the operation is smaller than the certain threshold, the base station, in ST7608, performs a correlation operation on the above-mentioned reference signal for sounding with the code B. When the result of the operation

is equal to or larger than a certain threshold, the base station identifies the mobile terminal and then handles the reference signal for sounding by judging that the reference signal includes a scheduling request.

When, in ST7606, the result of the correlation operation with the code A is less than the certain threshold, and when, in ST7608, the result of the correlation operation with the code B is less than the certain threshold, the base station judges that the reference signal for sounding is the one from another mobile terminal other than the mobile terminal, and ends the processing.

[0207]

Because this variant is constructed as mentioned above, there is provided an advantage of eliminating the necessity to provide two types of pilot patterns for sounding, and a further advantage of eliminating the necessity to judge whether the result of each correlation operation is positive or negative because an orthogonal code is also used for judgment of the presence or absence of a scheduling request. Furthermore, because an orthogonal code is also used for judgment of the presence or absence of a scheduling request, there is provided another advantage of improving the judgment precision, the synchronization accuracy, and the accuracy of evaluation of channel conditions.

[0208]

In a third variant, one type of code for judgment of the presence or absence of a scheduling request is prepared, and there is provided a method of controlling whether to carry out multiplication with this code according to the presence or

absence of an uplink scheduling request.

An example of generation of a reference signal for sounding is shown in Fig. 51. Reference numeral 7701 denotes a pilot for sounding, reference numeral 7703 denotes a code a for judgment of the presence or absence of a scheduling request, reference numeral 7702 denotes a switch for selecting whether to multiply the sounding pilot by the code a, reference numeral 7705 denotes a control unit for transmitting a signal indicating whether to multiply the sounding pilot by the code a with the switch 7702, and reference numeral 7704 denotes a code specific to each mobile terminal. As shown in a table of the figure, when there is no uplink scheduling request, the code for judgment of the presence or absence of a scheduling request is not allocated, whereas when there is an uplink scheduling request, the code a is allocated.

[0209]

The operation of this variant will be explained with reference to a sequence diagram of Fig. 52. The mobile terminal, in ST7801, judges whether an uplink data transmission request has occurred. When no uplink data transmission request has occurred, the mobile terminal performs a selection so as not to carry out multiplication by the code a by using the switch 7702 according to the control signal from the control unit 7705 because the mobile terminal does not transmit any scheduling request, and then carries out ST7803. In contrast, when an uplink data transmission request has occurred, the mobile terminal carries out ST7802 because the mobile terminal transmits a scheduling request. The mobile terminal, in ST7802, selects the code a 7703 by using the switch 7702 according to

the control signal from the control unit 7705 in such a way as to carry out multiplication with the code a. As a result, the pilot for sounding is multiplied by the code a for judgment of the presence or absence of a scheduling request. In ST7803, the pilot for sounding is multiplied by the code A specific to each mobile terminal.

[0210]

The mobile terminal, in ST7804, performs a modulation process, baseband signal conversion, and radio frequency conversion on the reference signal for sounding, and transmits the reference signal for sounding to the base station with the time-frequency region allocated to the reference signal for sounding by way of the antenna. The base station, in ST7805, receives the reference signal for sounding. The base station, in ST7806, performs a correlation operation on this reference signal for sounding with the code A specific to each mobile terminal, and identifies the mobile terminal when the result of the operation is equal to or larger than a threshold.

The base station then, in ST7807, performs a correlation operation on the above-mentioned reference signal for sounding with the code a, and, when the result of the operation is equal to or larger than a threshold, handles the reference signal for sounding by judging that the reference signal has a scheduling request. In contrast, when the result of the operation is smaller than the threshold, the base station handles the reference signal for sounding by judging that the reference signal does not include a scheduling request.

The scheduling request presence or absence identification code a and the code A specific to each mobile

terminal can be scramble codes or spread codes.

[0211]

Because this variant is constructed as mentioned above, there is provided an advantage of eliminating the necessity to judge whether the result of each correlation operation is positive or negative because an orthogonal code can also be used for judgment of the presence or absence of a scheduling request. Furthermore, because an orthogonal code is also used for judgment of the presence or absence of a scheduling request, there is provided another advantage of improving the judgment precision. In addition, there is provided a further advantage of eliminating the necessity to double the amount of codes specific to each mobile terminal, unlike the second variant.

[0212]

As mentioned above, with the structure as mentioned in this Embodiment 8, the mobile terminal can suppress the increase in the PAPR which appears when transmitting an uplink scheduling request signal SR and a reference signal for sounding simultaneously.

Furthermore, because it becomes unnecessary to ensure the region of an S-RACH for a scheduling request, the waste of the time-frequency resource can be eliminated.

In addition, because the mobile terminal does not have to carry out a process of shifting the transmission timing of a reference signal for sounding and that of an uplink scheduling request signal SR from each other, and so on, the scheduling control in the base station and/or the mobile terminal can be prevented from becoming complicated.

Furthermore, by forming a reference signal for uplink

sounding in such a way that the reference signal for uplink sounding serves as an uplink scheduling request signal SR, as mentioned above, the base station is enabled to, when receiving this signal, judge whether this signal has an uplink scheduling request.

In addition, because a frequency band wider than that at the time of using an S-RACH or an Ack/Nack exclusive channel can be used, transmission further resistant to the frequency selective fading can be implemented.

[0213]

Embodiment 9.

When a necessity for transmission of uplink data occurs in a mobile terminal in a state in which the mobile terminal is receiving downlink data (Downlink data, DL data) transmitted from a base station or in a state in which allocation of an Ack/Nack exclusive channel for transmitting an Ack/Nack signal, which is the result of reception of downlink data, and/or a CQI signal to the base station is made, the mobile terminal has to transmit an uplink scheduling request signal SR to the base station. In this case, the mobile terminal may transmit the Ack/Nack signal and/or the CQI signal, and the uplink scheduling request signal SR simultaneously. When transmitted simultaneously, they are not transmitted with single carrier transmission, but are transmitted with multi carrier transmission. In the case in which such signals having no correlation among them are transmitted simultaneously, the PAPR becomes high because the time waveforms of the transmission signals have a high peak. A problem is that as the PAPR becomes high, the power consumption of the mobile terminal increases

and therefore the cell coverage becomes narrow.

A further problem is that as the PAPR becomes high, those signals become an interference wave to other mobile terminals and the communication system.

[0214]

In order to avoid these problems, in Embodiments 1 and 2, the method of transmitting an uplink scheduling request signal by using an S-RACH, and DTXing an Ack/Nack and/or a CQI signal at the same timing is disclosed. In Embodiments 3 and 4, the method of incorporating an uplink scheduling request signal into an Ack/Nack exclusive channel to transmit the uplink scheduling request signal is disclosed.

In this Embodiment 9, a method of transmitting an uplink scheduling request signal by using a region for sounding RS will be disclosed. In this Embodiment 9, a case in which there is no sounding RS which is transmitted for uplink timing synchronization at certain periodicity will be disclosed.

[0215]

The region for sounding RS is already explained in Embodiment 7. In Embodiment 7, the case in which no allocation of an Ack/Nack exclusive channel is made is disclosed. In contrast, in this embodiment, a case in which allocation of an Ack/Nack exclusive channel is made will be disclosed.

Fig. 55 shows a figure of a time-frequency resource in a case in which there are regions for an Ack/Nack exclusive channel. Regions A and B are regions for an Ack/Nack exclusive channel. The region for sounding RS is allocated to a region other than channel for Ack/Nack, in this example, the allocation to the first LB is carried out once within 2 TTIs.

Each of a plurality of mobile terminals under the control of the base station transmits a reference signal for sounding using this region for sounding RS. The plurality of mobile terminals can be divided into one or more groups. Furthermore, the region for sounding reference symbols can also be divided into one or more regions. Transmission of an RS for sounding by a mobile terminal included in a certain mobile terminal group can be carried out by using a certain divided region.

[0216]

A transmission signal of a mobile terminal in a case in which a scheduling request occurs is shown in Fig. 60. When a necessity for transmission of uplink data occurs in a mobile terminal in a state in which the mobile terminal is receiving downlink data (Downlink data, DL data) transmitted from a base station, or in a state in which allocation of an Ack/Nack exclusive channel for transmitting an Ack/Nack signal, which is the result of reception of downlink data, and/or a CQI signal to the base station is made, and the mobile terminal then transmits an uplink scheduling request signal SR to the base station, the mobile terminal transmits the uplink scheduling request signal by using a region for sounding RS allocated to this mobile terminal, and transmits an Ack/Nack signal, a CQI signal, or a reference signal for demodulation with other LBs or SBs by using the Ack/Nack exclusive channel. In contrast, when there is no uplink scheduling request, the mobile terminal does not transmit an uplink scheduling request signal, but transmits an Ack/Nack signal and/or a CQI signal by using the Ack/Nack exclusive channel.

[0217]

Fig. 59 shows mapping of transmission symbols in a mobile terminal in the case in which the mobile terminal transmits an uplink scheduling request signal with the region for sounding RS. A pilot symbol for sounding is inserted into a leading LB within 2 TTIs. An Ack/Nack or a CQI symbol is inserted into other LBs. The pilot for sounding is multiplied by a code a specific to each mobile terminal which is used in the region for sounding. This code a is used in order for the base station to identify from which mobile terminal the base station has received the transmission because the region for sounding is shared by a plurality of mobile terminals. The symbol for sounding which is multiplied by the code a specific to each mobile terminal, which is used in the region for sounding, is mapped to the region for sounding RS.

[0218]

An Ack/Nack or a CQI symbol is multiplied by a code A specific to each mobile terminal, and is mapped to the resource for Ack/Nack exclusive channel. This code A is used to identify the mobile terminal in the Ack/Nack exclusive channel, as mentioned in Embodiment 3. These two types of codes specific to each mobile terminal are predetermined, or are notified from the base station.

Fig. 62 is a sequence diagram. The mobile terminal, in ST8901, judges whether an uplink data transmission request has occurred. When no uplink data transmission request has occurred, the mobile terminal carries out ST8904 because the mobile terminal does not transmit any scheduling request. The mobile terminal, in ST8904, inserts an Ack/Nack or a CQI symbol into each of all LBs within 2 TTIs, and multiplies each of them

by the code A. In contrast, when an uplink data transmission request has occurred, the mobile terminal carries out ST8902 and ST8903 because the mobile terminal transmits a scheduling request.

[0219]

The mobile terminal, in ST8902, inserts the pilot for sounding into the first LB within 2 TTIs, and multiplies this LB by the code a. The mobile terminal, in ST8903, inserts an Ack/Nack and/or a CQI into a second or subsequent LBs, and multiplies these LBs by the code A. The mobile terminal, in ST8905, carries out allocation of the pilot for sounding which is multiplied by the code a to the region for sounding RS, and carries out allocation of the Ack/Nack or the CQI which is multiplied by the code A to the resource for Ack/Nack exclusive channel, and then transmits them to the base station. The base station which, in ST8906, received the signals, in ST8907, performs a correlation operation on the signal in the region for sounding by using the code a, and, when the result of the correlation operation is equal to or larger than a certain threshold, can identify the mobile terminal and judge that the base station has received an uplink scheduling request from this identified mobile terminal.

[0220]

The base station which has judged that the base station has received an uplink scheduling request, in ST8910, handles the uplink scheduling request. The base station then, in ST8911, performs a correlation operation on the signal in the second or subsequent LBs or SBs, which is transmitted via the Ack/Nack exclusive channel, by using the code A, and, in ST8912, performs

judgment of the Ack/Nack or the CQI. When, in ST8907, the result of the correlation operation with the code a is smaller than the certain threshold, the base station still cannot identify the mobile terminal and handles the signal by judging that the signal does not have an uplink scheduling request. In that case, the base station, in ST8909, performs a correlation operation on signals in all the LBs and SBs, which are transmitted via the Ack/Nack exclusive channel, by using the code A, and, when the result of the correlation operation is equal to or larger than a certain threshold, identifies the mobile terminal. After identifying the mobile terminal, the base station, in ST8912, performs judgment of the Ack/Nack or the CQI.

[0221]

With the structure as mentioned above, the mobile terminal can suppress the increase in the PAPR which appears when transmitting both an Ack/Nack signal or a CQI signal, and an uplink scheduling request signal SR simultaneously.

Furthermore, because it becomes unnecessary to ensure the region of an S-RACH for a scheduling request in advance, the waste of the time-frequency resource can be eliminated.

In addition, by transmitting an uplink scheduling request signal SR by using a reference signal for sounding, the base station is enabled to, when receiving this signal, judge whether this signal has an uplink scheduling request.

Furthermore, because the mobile terminal transmits an uplink scheduling request signal SR by using a reference signal for sounding, the base station can evaluate the status of the uplink channel used for carrying out uplink scheduling.

[0222]

In addition, because a frequency band wider than that at the time of using an S-RACH or an Ack/Nack exclusive channel can be used, transmission further resistant to the frequency selective fading can be implemented.

Furthermore, the base station can measure the status of the frequency selective fading, and can carry out appropriate uplink scheduling.

In the above-mentioned embodiments, when a mobile terminal does not have an uplink scheduling request, the mobile terminal inserts an Ack/Nack or a CQI symbol into the first LB. As the mapping method, the method disclosed in Embodiment 2 can be applied. By doing in this way, there is provided an advantage of improving the quality of reception of an Ack/Nack or a CQI.

As shown in above-mentioned Embodiment 1, also in the case in which a mobile terminal has an uplink scheduling request, the mobile terminal can insert an Ack/Nack or a CQI symbol into each of all the LBs and SBs, like in the case in which there is no uplink scheduling request, and, only when the mobile terminal has an uplink scheduling request, can DTX only the first LB and transmit a sounding pilot in this LB by using the RS region for sounding. As a result, the complexity of the process of multiplexing symbols can be reduced.

[0223]

In the above-mentioned embodiments, the case in which an Ack/Nack and/or a CQI signal is transmitted by using an Ack/Nack exclusive channel is disclosed. In contrast, the method of this embodiment can also be applied to a case in which an Ack/Nack or a CQI signal is not transmitted by using an Ack/Nack exclusive channel. For example, when a scheduling request occurs in a

mobile terminal, the mobile terminal has only to transmit an RS for sounding by using the first LB in a region for sounding and not to transmit any other signals.

In the above-mentioned embodiments, when a scheduling request occurs in a mobile terminal, the mobile terminal inserts a pilot symbol for sounding into the first LB. The same advantage is acquired even if the mobile terminal changes an LB or SB into which the mobile terminal inserts the pilot symbol according to the region allocated to an RS for sounding.

[0224]

Hereafter, variants will be explained. In a first variant, the region for sounding RS is allocated to all the bands. Fig. 56 is a figure showing a time-frequency resource at the time of allocating the region for sounding RS to all the bands of the system. Regions A and B are regions for an Ack/Nack exclusive channel. In this example, the first LB is allocated, as the region for sounding RS, once within 2 TTIs. Each of a plurality of mobile terminals under the control of the base station transmits a reference signal for sounding by using this region for sounding RS. The plurality of mobile terminals can be divided into one or more groups. Furthermore, the region for a sounding reference signal can also be divided into one or more regions. Transmission of an RS for sounding by a mobile terminal included in a certain mobile terminal group can be carried out by using a certain divided region.

[0225]

A transmission signal of a mobile terminal in a case in which a scheduling request occurs is shown in Fig. 61. When a necessity for transmission of uplink data occurs in a mobile

terminal in a state in which the mobile terminal is receiving downlink data (Downlink data, DL data) transmitted from a base station, or in a state in which allocation of an Ack/Nack exclusive channel for transmitting an Ack/Nack signal, which is the result of reception of downlink data, and/or a CQI signal to the base station is made, and the mobile terminal then transmits an uplink scheduling request signal SR to the base station, the mobile terminal transmits the uplink scheduling request signal by using a region for sounding RS allocated to this mobile terminal, and transmits an Ack/Nack signal, a CQI signal, or a reference signal for demodulation in other LBs or SBs by using the Ack/Nack exclusive channel. In contrast, when there is no uplink scheduling request, the mobile terminal does not transmit any uplink scheduling request signal, and, furthermore, does not transmit any Ack/Nack signal or any CQI signal once with the first LB by using the Ack/Nack exclusive channel within 2 TTIs. This is because since all the bands of the system are allocated to the region for sounding RS and some other mobile terminals under the control of the base station transmit sounding RSs with this LB of the Ack/Nack exclusive channel, if the mobile transmits an Ack/Nack signal or a CQI signal with this LB, the base station cannot discriminate this Ack/Nack or CQI signal from any other signals.

In the mapping of transmission symbols in the mobile terminal, a pilot for sounding is inserted when there is an uplink scheduling request, like in the mapping shown in Fig. 59, whereas when there is no uplink scheduling request, it is preferable to insert either nothing or dummy data into the first LB and not to carry out any transmission with this LB.

[0226]

With the above-mentioned structure, this embodiment offers the same advantages as those provided by Embodiment 9. Furthermore, the base station can make an evaluation of uplink channel conditions with a wider band.

In addition, because the base station can make an evaluation of the channel conditions of an Ack/Nack exclusive channel, there is provided an advantage of performing scheduling of an Ack/Nack signal or a CQI signal of a mobile terminal to an Ack/Nack exclusive channel with a high degree of precision.

Furthermore, by dividing the plurality of mobile terminals into one or more groups, and/or by dividing the region for sounding reference signals into one or more regions, there is provided an advantage of bringing greater efficiency to the use of the code resources allocated to each mobile terminal.

[0227]

In a second variant, the region for sounding RS is divided into parts having the same frequency bandwidth as the Ack/Nack exclusive channel, and a divided part is allocated to a certain mobile terminal group.

Fig. 57 shows a figure of a time-frequency resource. Regions A and B are regions for an Ack/Nack exclusive channel. In this example, the first LB is allocated, as the region for sounding RS, once within 2 TTIs. The region for sounding RS is divided into parts having the same frequency bandwidth as the Ack/Nack exclusive channel, and a divided part is allocated to a certain mobile terminal group. Each of a plurality of mobile terminals in the certain mobile terminal group transmits

a reference signal for sounding by using this divided part of the region for sounding RS.

[0228]

Because the region with which a certain mobile terminal transmits a sounding RS has the same frequency bandwidth as the Ack/Nack exclusive channel, the length of a code for sounding pilot symbols can be made to be equal to that of a code for an Ack/Nack and/or CQI symbols. Therefore, the necessity to separately provide two codes specific to each mobile terminal for sounding pilot symbols and for an Ack/Nack or CQI symbols can be eliminated. In other words, the required number of types of spread codes can be reduced to one.

Therefore, with this structure, there is provided an advantage of being able to reduce the amount of codes specific to each mobile terminal, and hence to increase the number of mobile terminals allocated from the base station.

[0229]

In a third variant, a region for sounding RS is disposed also in an Ack/Nack exclusive channel.

Fig. 58 shows a figure of a time-frequency resource. Regions A and B are regions for the Ack/Nack exclusive channel. In this example, also in the Ack/Nack exclusive channel region, the first LB is allocated, as the region for sounding RS, once within 2 TTIs.

Because the region for sounding RS is disposed in the Ack/Nack exclusive channel, the necessity to separately provide two codes specific to each mobile terminal for sounding pilot symbols and for an Ack/Nack or CQI symbols can be eliminated. That is, the frequency band which is multiplied by the spread

code becomes equal. Therefore, with this structure, there is provided an advantage of being able to reduce the amount of codes specific to each mobile terminal, and hence to increase the number of mobile terminals allocated from the base station.

Furthermore, there is provided an advantage of eliminating the necessity to separately carry out allocation to the time-frequency resources for sounding pilot symbols and for an Ack/Nack and/or CQI symbols at the time of transmission of a signal, thereby being able to simplify the control of each mobile terminal.

[0230]

Since Embodiment 9 uses a sounding reference signal for transmitting a scheduling request signal, when combined with above-mentioned Embodiment 7, Embodiment 9 can be applied to a mobile terminal regardless of whether or not an Ack/Nack exclusive channel is allocated to the mobile terminal. More specifically, what is necessary is just to apply Embodiment 7 in a case in which any Ack/Nack exclusive channel is not allocated to the mobile terminal, and to apply Embodiment 9 in a case in which an Ack/Nack exclusive channel is allocated to the mobile terminal.

[0231]

This Embodiment 9 discloses the case in which a mobile terminal does not transmit any sounding RS for uplink timing synchronization at certain periodicity. Furthermore, when combined with Embodiment 8, Embodiment 9 can also be applied to a case in which a mobile terminal transmits a sounding RS for uplink timing synchronization at certain periodicity. That is, in Embodiment 9, when receiving transmission of a

sounding RS from a mobile terminal, the base station can recognize that the mobile terminal has made a scheduling request, though when the mobile terminal has originally transmitted a sounding RS for uplink timing synchronization, the base station cannot discriminate the sounding RS for uplink timing synchronization which the mobile terminal has originally transmitted from any scheduling request. In order to solve this problem, what is necessary is just to use the method disclosed in Embodiment 8.

Furthermore, also in the case in which a mobile terminal transmits a sounding RS for uplink timing synchronization at certain periodicity, Embodiment 9 can be applied to the mobile terminal regardless of whether or not an Ack/Nack exclusive channel is allocated to the mobile terminal, when combined with the method disclosed in Embodiment 7.

[0232]

Embodiment 10.

A method of enabling a mobile terminal to transmit an uplink scheduling request by using a sounding RS regardless of whether the mobile terminal transmits a sounding RS for uplink timing synchronization at certain periodicity will be disclosed.

A time-frequency region for sounding RS is allocated as shown in Fig. 42 or 55. Fig. 42 shows a case in which no allocation of resources of an Ack/Nack exclusive channel is made, and Fig. 55 shows a case in which allocation of resources of an Ack/Nack exclusive channel is made. In either of the cases, a sounding RS from a mobile terminal is transmitted with an allocated region for sounding RS. It is assumed that the length

of time intervals at which a sounding RS for uplink timing synchronization is transmitted is n×TTI (n>=2).

[0233]

Fig. 63 shows a transmission signal of a mobile terminal when an uplink scheduling request has occurred. Hereafter, it is assumed that the length of time intervals at which a sounding RS for uplink timing synchronization is transmitted is 10TTI. In a case in which a necessity for transmission of uplink data occurs in a mobile terminal, when the timing at which the mobile terminal transmits an uplink scheduling request is the same as that at which the mobile terminal transmits a sounding RS for uplink timing synchronization, the mobile terminal transmits this sounding RS for synchronization while forming the sounding RS in such a way that the sounding RS have the functions of the scheduling request.

As a method of forming a sounding RS for synchronization in such a way that the sounding RS have the functions of a scheduling request, the method disclosed in above-mentioned Embodiment 8 can be used. For example, a method of providing two types of sounding pilot patterns corresponding to the presence and absence of an uplink scheduling request can be used. In a case in which a necessity for transmission of uplink data occurs in a mobile terminal, when the timing at which the mobile terminal transmits an uplink scheduling request differs from that at which the mobile terminal transmits a sounding RS for uplink timing synchronization, the mobile terminal transmits the sounding RS as an uplink scheduling request.

[0234]

Fig. 64 shows a diagram of sequences between the mobile

terminal and the base station. The mobile terminal, in ST9101, judges whether an uplink data transmission request has occurred. When no uplink data transmission request has occurred, the mobile terminal carries out ST9104. In contrast, when an uplink data transmission request has occurred, the mobile terminal, in ST9102, judges whether the transmission timing of an uplink scheduling request is the same as that of a sounding RS for uplink timing synchronization. If those transmission timings are the same as each other, the mobile terminal carries out ST9103. The mobile terminal, in ST9103, selects a pattern 2 as a pilot for sounding. The mobile terminal then carries out ST9105. When, in ST9102, judging that the transmission timing of the uplink scheduling request differs from that of a sounding RS for uplink timing synchronization, the mobile terminal carries out ST9104. The mobile terminal, in ST9104, selects a pattern 1 as a pilot for sounding. The mobile terminal then carries out ST9105. The mobile terminal, in ST9105, multiplies the transmission signal by a code A specific to each mobile terminal. The mobile terminal, in ST9106, transmits the transmission signal to the base station with the region for sounding (RB). The base station which, in ST9107, has received the transmission signal with the region for sounding (RB), in ST9108, judges whether or not the received signal has the timing of a sounding RS for uplink timing synchronization.

[0235]

Because the base station carries out scheduling of the timing of a sounding RS for uplink timing synchronization and notifies the timing to the mobile terminal in advance, or the timing is predetermined, the base station can make the judgment.

When, in ST9108, judging that the received signal has the same timing, the base station carries out ST9110. The base station, in ST9110, performs a correlation operation on the received signal by using the code A. When the result of the correlation operation is equal to or larger than a certain threshold, the base station identifies the mobile terminal. The base station then carries out ST9111. The base station, in ST9111, judges whether the pilot for sounding is the pattern 1 or the pattern 2. As a method of judging whether the pilot for sounding is the pattern 1 or the pattern 2, a method disclosed in Embodiment 8 can be used. When judging that the pilot for sounding is the pattern 1, the base station handles the signal by judging that the signal does not include an uplink scheduling request. When, in ST9111, judging that the pilot for sounding is the pattern 2, the base station carries out ST9112. When, in ST9108, judging that the received signal has a timing different from that of a sounding RS for uplink timing synchronization, the base station carries out ST9109. The base station, in ST9109, performs a correlation operation on the received signal by using the code A, and, when the result of the correlation operation is equal to or larger than a certain threshold, the base station identifies the mobile terminal, and, in ST9112, handles the signal by judging that the signal includes an uplink scheduling request.

[0236]

With the above-mentioned structure, the same advantages as those provided by Embodiment 8 can be offered. Furthermore, there is provided an advantage of enabling a mobile terminal to transmit an uplink scheduling request regardless of whether

the mobile terminal transmits a sounding RS for uplink timing synchronization at certain periodicity.

[0237]

Hereafter, variants will be explained.

In a first variant, when the transmission timing of an uplink scheduling request coincides with that of a sounding RS for uplink timing synchronization, the timing at which an uplink scheduling request is transmitted is delayed by 2 TTIs.

Fig. 65 shows a transmission signal of a mobile terminal when an uplink scheduling request occurs in the mobile terminal. In this case, the transmission time during which a sounding RS for uplink timing synchronization is transmitted is 10TTI. In a case in which a request for transmission of uplink data occurs in a mobile terminal, when the timing at which the mobile terminal transmits an uplink scheduling request is the same as that at which the mobile terminal transmits a sounding RS for uplink timing synchronization, the mobile terminal transmits the scheduling request by delaying its transmission timing by 2TTI. In contrast, when the timing at which the mobile terminal transmits an uplink scheduling request differs from that at which the mobile terminal transmits a sounding RS for uplink timing synchronization, the mobile terminal transmits the scheduling request without delaying its transmission timing by 2TTI.

[0238]

Fig. 66 shows a diagram of sequences between the mobile terminal and the base station. The mobile terminal, in ST9301, judges whether an uplink data transmission request has occurred. When no uplink data transmission request has occurred, the

mobile terminal carries out ST9304. In contrast, when an uplink data transmission request has occurred, the mobile terminal, in ST9302, judges whether the transmission timing of an uplink scheduling request is the same as that of a sounding RS for uplink timing synchronization. If those transmission timings are the same as each other, the mobile terminal carries out ST9303. The mobile terminal, in ST9303, carries out a process of delaying the transmission timing of the scheduling request by 2TTI. In this case, about the sounding RS signal for uplink timing synchronization, the mobile terminal carries out a process of transmitting the sounding RS signal without delaying its transmission timing. The mobile terminal, in ST9304, multiplies the transmission signal by a code A specific to each mobile terminal. The mobile terminal, in ST9305, transmits the transmission signal to the base station with the region for sounding (RB). The base station which, in ST9306, has received the signal with the RB for sounding carries out ST9307.

[0239]

The base station, in ST9307, judges whether or not the received signal has the timing of a sounding RS for uplink timing synchronization. When judging that the received signal has the timing of a sounding RS for uplink timing synchronization, the base station, in ST9308, performs a correlation operation on the received signal by using the code A, and, when the result of the correlation operation is equal to or larger than a certain threshold, identifies the mobile terminal and then carries out ST9309. The base station, in ST9309, handles the signal by judging that the signal does not include an uplink scheduling request. More specifically, in this case, the base station

handles the signal as a normal sounding RS for uplink timing synchronization. When, in ST9307, judging that the received signal has a timing different from that of a sounding RS for uplink timing synchronization, the base station, in ST9310, performs a correlation operation on the received signal by using the code A, and, when the result of the correlation operation is equal to or larger than a certain threshold, the base station identifies the mobile terminal and carries out ST9311. The base station, in ST9311, handles the signal by judging that the signal includes an uplink scheduling request.

[0240]

With the above-mentioned structure, the same advantages as those provided by Embodiment 10 can be offered. Furthermore, there is provided an advantage of reducing the number of types of sounding pilot patterns to only one. Thereby, there is provided another advantage of reducing the processing carried out by the base station and the processing carried out by the mobile terminal. Compared with a case in which in, for example, Embodiment 10, the method of using the two types of codes (the codes A and B), as disclosed in Embodiment 8, is used in order to discriminate a sounding RS for uplink timing synchronization and an uplink scheduling request from each other, there is provided an advantage of reducing the number of codes to one-half that in the above-mentioned case, and increasing the number of mobile terminals to each of which a mobile-terminal-specific code can be allocated.

In the above-mentioned variant, an uplink scheduling request is transmitted with its transmission timing being delayed by 2TTI. As an alternative, an uplink scheduling

request can be transmitted at any timing at which no sounding RS for uplink timing synchronization is transmitted. In this case, a mobile terminal is allowed to transmit a scheduling request with a time delay depending on its processing capability.

[0241]

A combination of Embodiment 10 or the first variant with Embodiment 9 can be applied regardless of whether or not resource allocation of an Ack/Nack exclusive channel is made.

Industrial Applicability

[0242]

As mentioned above, the present invention is suitable for a communication system which needs to prevent the increase in the radio resource load due to temporary increase in the physical channels.

Specification

DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM, AND MOBILE TERMINAL

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. Patent Application Serial No. 12/375,574, filed January 29, 2009, which is a National Stage Application of PCT Application No. PCT/JP2006/326117, filed December 27, 2006, which claims priority to Japanese Patent Application No. 2006-292641, filed October 27, 2006. The entire contents of U.S. Patent Application Serial No. 12/375,574 are incorporated herein by reference in their entirety.

Field of the Invention

[0001]

The present invention relates to a communication system which is called "Long Term Evolution" (LTE), a mobile terminal which constructs this communication system, and a communication method for an uplink control signal which this mobile terminal transmits to a base station.

Background of the Invention

[0002]

Commercial services which employ a W-CDMA (Wideband Code division Multiple Access) method which is included in communication methods called a third generation were started in Japan since 2001. Furthermore, a start of a service with HSDPA (High Speed Down Link Packet Access) which implements a further improvement in the speed of data transmission using

downlinks (an individual data channel and an associated control channel) by adding a channel for packet transmission (HS-DSCH: High Speed-Downlink Shared Channel) to the downlinks has been planned. In addition, an HSUPA (High Speed Up Link Packet Access) method has also been suggested and studied in order to speed up uplink data transmission.

The W-CDMA is a communication method which was determined by the 3GPP (3rd Generation Partnership Project) which is the organization of standardization of mobile communication systems, and the technical specification of the release 6 has been being organized currently.

[0003]

In the 3GPP, as a communication method different from the W-CDMA, a new communication method having a wireless section, which is referred to as "Long Term Evolution" (LTE), and a whole system structure including a core network, which is referred to as "System Architecture Evolution" (SAE), has been studied.

The LTE has an access method, a radio channel configuration, and protocols which are different from those of the current W-CDMA (HSDPA/HSUPA). For example, while the W-CDMA uses, as its access method, code division multiple access (Code Division Multiple Access), the LTE uses, as its access method, OFDM (Orthogonal Frequency Division Multiplexing) for the downlink direction and uses SC-FDMA (Single Career Frequency Division Multiple Access) for the uplink direction. Furthermore, while the W-CDMA has a bandwidth of 5MHz, the LTE can have a bandwidth of 1.25/2.5/5/10/15/20MHz. In addition, the LTE uses only a packet communication method, instead of a circuit switching method which the W-CDMA uses.

[0004]

According to the LTE, because a communication system is constructed using a new core network different from a core network (General Packet Radio System GPRS) which complies with the W-CDMA, the communication system is defined as an independent radio access network which is separate from a W-CDMA network. Therefore, in order to distinguish from a communication system which complies with the W-CDMA, in a communication system which complies with the LTE, a base station (Base station) which communicates with a mobile terminal UE (User Equipment) is called eNB (E-UTRAN NodeB, eNodeB, or eNode-B), a base station control apparatus (Radio Network Controller) which performs exchange of control data and user data with a plurality of base stations and is called an aGW (Access Gateway).

This communication system which complies with the LTE carries out point-to-multipoint (Point to Multipoint) communications, such as a multicast and broadcast type multimedia service called a E-MBMS (Evolved Multimedia Broadcast Multicast Service), and also provides a communication service such as a unicast (Unicast) service for each mobile terminal among a plurality of mobile terminals.

In the case of the LTE, because no individual channels (Dedicated Channel and Dedicated Physical Channel) destined for each mobile terminal exist in transport channels and physical channels, transmission of data to each mobile terminal is carried out by using a common channel (Shared channel), unlike in the case of the W-CDMA.

[0005]

When receiving data, via a downlink, from a base station, a mobile terminal transmits a signal indicating whether the mobile terminal has received the data perfectly, and a signal indicating either the quality of the received data or the quality of the downlink communication path to the base station via an uplink. The response signal indicating whether the mobile terminal could receive the data correctly from the base station is referred to as an Ack/Nack, and the quality information indicating the quality of the received data or the quality of the downlink communication path is referred to as a CQI (Channel Quality Indicator).

An Ack/Nack is a signal with which, when the mobile terminal has received downlink data, the mobile terminal notifies information indicating whether the mobile terminal could receive the downlink data correctly to the base station, and the base station uses the Ack/Nack for retransmission control.

A CQI is a signal with which the mobile terminal notifies the downlink channel's state (the communication path's state) which the mobile terminal has measured to the base station, and the base station uses the CQI for downlink scheduling. Furthermore, when data which the mobile terminal has to transmit to the base station occur, the mobile terminal transmits a signal with which to make a request for allocation of uplink radio resources to the base station. Such a request signal is called a scheduling request, an uplink resource request, or an uplink scheduling request signal (SR: Scheduling Request). The Ack/Nack, the CQI, and the SR as mentioned above are called "uplink L1/L2 control signals" (an L1/L2 control signaling).

[0006]

Fig. 22 is an explanatory drawing for explaining uplink L1/L2 control signals.

As shown in Fig. 22, uplink L1/L2 control signals are roughly divided into two types of L1/L2 control signals. They are uplink-data-associated L1/L2 control signals (a data-associated L1/L2 control signaling), and uplink-data-non-associated L1/L2 control signals (a data-non-associated L1/L2 control signaling).

An uplink-data-associated L1/L2 control signal is information required for uplink data transmission (reception by a base station), such as a transport format, and is transmitted together with uplink data. Uplink-data-non-associated L1/L2 control signals include an Ack/Nack and a CQI which are relevant to a downlink, and random access (Random Access) signals, such as a scheduling request (SR, UL SR) which is transmitted before uplink data transmission is started.

Although an Ack/Nack and a CQI are transmitted regardless of uplink data transmission because they are relevant to a downlink, there is a case in which they are transmitted at the same time when uplink data are transmitted. On the other hand, random access signals include a synchronous random access (Synchronous Random Access which is referred to as SRA from here on) signal and a non-synchronous random access (Non-Synchronous Random Access which is referred to as NSRA from here on) signal.

An SRA is transmitted in a state in which uplink time synchronization is established, whereas an NSRA is transmitted in a state in which uplink time synchronization is not

established.

Not only uplink-data-associated L1/L2 control signals but also an Ack/Nack and a CQI are transmitted in a state in which uplink time synchronization is established. Hereafter, the fact that there is a state in which an Ack/Nack and/or a CQI, and an SRA in a case in which no uplink data transmission is carried out are transmitted simultaneously will be mentioned, and a problem with this state and a solution of this problem will be mentioned.

[0007]

An uplink Ack/Nack and an uplink CQI are relevant to a downlink. For allocation of an Ack/Nack and a CQI to physical resources to in the case in which no uplink data transmission is carried out, a method of monopolistically allocating one certain time-frequency region or a method of monopolistically allocating a plurality of time-frequency regions having separated narrow bands is used (for example, refer to nonpatent reference 1).

Hereafter, these regions are referred to as an Ack/Nack exclusive channel.

That is, in a state in which uplink data transmission is not performed, an Ack/Nack and a CQI are transmitted by using an Ack/Nack exclusive channel.

In further explaining in detail, (1) in a case in which both an Ack/Nack and a CQI have to be transmitted, the Ack/Nack and the CQI are transmitted by using an Ack/Nack exclusive channel, (2) in a case in which an Ack/Nack has to be transmitted, but a CQI does not have to be transmitted, the Ack/Nack is transmitted by using an Ack/Nack exclusive channel, and (3) in

a case in which an Ack/Nack does not have to be transmitted, but a CQI has to be transmitted, the CQI is transmitted by using an Ack/Nack exclusive channel. It can also be considered that, (4) even in a case in which an Ack/Nack does not have to be transmitted, and a CQI does not have to be transmitted, an Ack/Nack exclusive channel is allocated to them. In this case, both no Ack/Nack and no CQI are transmitted by using the above-mentioned channel.

Fig. 23 is an explanatory drawing showing radio resources to which an Ack/Nack and a CQI are allocated in the case in which uplink data transmission is carried out or in the case in which no uplink data transmission is carried out. Fig. 23 shows the method of monopolistically allocating one certain time-frequency region.

An Ack/Nack and a CQI in the case in which no uplink data transmission is carried out are allocated to a region having one or more subframes with respect to time and are allocated to a region having one or more resource units with respect to frequency. In contrast, uplink data, and an Ack/Nack and a CQI in the case in which transmission of either an uplink-data-associated L1/L2 control signal or the uplink data is carried out are allocated to another region.

[0008]

By allocating an Ack/Nack and a CQI in the case in which no uplink data transmission is carried out, i.e., signals associated with only an Ack/Nack and a CQI to a monopolistic region intended only for the signals, a time during which the Ack/Nack and CQI signals are transmitted can be increased, and therefore a large coverage can be acquired.

Fig. 24 is an explanatory drawing showing radio resources in which an Ack/Nack and a CQI are allocated to an Ack/Nack exclusive channel. Fig. 24 shows the method of monopolistically allocating a plurality of time-frequency regions (A and B in Fig. 24) having separated narrow bands for an Ack/Nack and a CQI.

An Ack/Nack and a CQI in the case in which no uplink data transmission is carried out are allocated to some separated regions in units of a subframe with respect to time and are allocated to some separated regions in units of a subcarrier with respect to frequency. By separating the frequency region into some parts (e.g., A and B in Fig. 24), a frequency diversity gain can be acquired.

When using either of the methods, an Ack/Nack and a CQI of one or more mobile terminals can be allocated to one region. It has been studied to, in order to implement a method of multiplexing an Ack/Nack and a CQI of one or more mobile terminals into one region, establish the orthogonality of each mobile terminal by using FDM (Frequency Division Multiplex) / TDM (Time Division Multiplex) / CDM (Code Division Multiplex). In order to ensure the quality of reception of an Ack/Nack and a CQI by a base station, it has been studied to increase the power by carrying out repetition (repetition) transmission of the Ack/Nack and the CQI. More specifically, there are a method of repeatedly transmitting the same subframe twice within one transmission time interval (Transmission Time Interval TTI), a method of repeatedly including a bit of an Ack/Nack and a bit of a CQI to a plurality of LBs (Long Block) in a subframe so as to transmit them, and so on.

[0009]

A synchronous random access (Synchronous Random Access SRA) is a signal used for a scheduling request (SR) which a mobile terminal transmits before starting uplink data transmission, which the mobile terminal transmits when the mobile terminal is placed in a state in which uplink time synchronization is established (in other words, the mobile terminal is placed in an Active mode). As a method of allocating an SRA to physical resources, there is provided a method of monopolistically allocating one certain time-frequency region (Nonpatent reference 3: TR25.814V7.0.0). Fig. 25 is an explanatory drawing showing radio resources in which an uplink scheduling request signal is allocated to an S-RACH. Fig. 25 shows the method of monopolistically allocating one certain time-frequency region.

An SRA is allocated to a region in units of a subframe with respect to time and is allocated to a region in units of one or more resource units with respect to frequency. Hereafter, these regions are referred to as an S-RACH (Synchronous Random Access CHannel). In contrast, uplink data are allocated to other regions. Therefore, an SRA and data are multiplexed with respect to either or both of time and frequency.

With which region a mobile terminal transmits an SRA is predetermined or is notified in advance from a base station. An SRA of one or more mobile terminals is allocated to one region. When transmissions of SRAs of a plurality of mobile terminals occur with an identical region, the signals from the plurality of mobile terminals will collide with one another.

When the SRAs from the plurality of mobile terminals

collide with one another and therefore the base station cannot receive them, each of the plurality of mobile terminals generally repeats transmission of its SRA again with either or both of a different periodicity and a different region. In order to reduce the probability that SRAs from a plurality of mobile terminals collide with one another, a method of establishing the orthogonality of each mobile terminal by using FDM/TDM/CDM has been studied.

[0010]

Use of a scheduled channel has been also studied as allocation of a synchronous random access SRA to physical resources (nonpatent reference 4).

A scheduled channel is scheduled to be allocated to each target mobile terminal, unlike a channel, such as an S-RACH, in which collision (or referred to as competition) of signals from a plurality of mobile terminals is allowed. In this case, because a region which is allocated in advance to each mobile terminal is decided, there is no competition between signals from a plurality of mobile terminals, and therefore there is no necessity ~~to transmit, as an SR signal which each mobile terminal has transmitted, the ID number (the UE-ID) of each mobile terminal which is effective within the cell of the base station~~ <u>for the ID number (the UE-ID) of each mobile terminal which is effective within the cell of the base station to be mapped onto an SR signal which each mobile terminal has transmitted</u>. Therefore, in a case in which an uplink SRA is transmitted by using a scheduled channel, the amount of information of the uplink SR signal can be reduced.

[0011]

A process of transmitting an Ack/Nack and a CQI, and an synchronous random access (an SR or the like) simultaneously in the case in which no uplink data transmission is carried out will be explained.

An uplink Ack/Nack and an uplink CQI are the ones which, when a mobile terminal is receiving downlink data from a base station, the mobile terminal transmits to the base station according to the status of the reception. In contrast, an SRA is the one which the mobile terminal transmits to the base station for an SR or the like before starting transmission of uplink data. Because the descriptions of these signals are independent from one another, there can be a case in which the mobile terminal transmits them simultaneously.

Fig. 26 shows an example in which a mobile terminal transmits an Ack/Nack and an SRA simultaneously in the case in which the mobile terminal is not carrying out any uplink data transmission.

This example is a case in which transmission of uplink data occurs while the mobile terminal carries out continuous reception of downlink data. The mobile terminal is receiving downlink data continuously. The data are demodulated and decoded in units of each TTI. The mobile terminal transmits result information (Ack/Nack) indicating a result of judgment of the reception to the base station according to the status of the reception of the downlink data. When receiving the transmission data normally from the base station, the mobile terminal transmits an Ack signal to the base station. The base station which has received the Ack transmits new data next time. In contrast with this, when not being able to receive the

transmission data transmitted normally from the base station, the mobile terminal transmits a Nack signal to the base station. The base station which has received the Nack retransmits the data which the mobile terminal was not able to receive normally to the mobile terminal.

[0012]

Allocation of the uplink Ack/Nack to physical resources is implemented by monopolistically allocating a plurality of time-frequency regions having separated narrow bands, as previously explained. Therefore, the uplink Ack/Nack is also transmitted continuously. In contrast, when uplink data occurs in the mobile terminal, the mobile terminal transmits a scheduling request SR to the base station before transmitting the uplink data. Allocation of the SR to physical resource is implemented by monopolistically allocating one certain time-frequency region, as previously explained. Therefore, as shown in the figure, when uplink data occur at a certain time, an SR occurs with a short time delay.

When the base station is not able to receive the SR signal which the mobile terminal has transmitted, the mobile terminal transmits the SR signal again. As can be seen from the above explanation, there occurs a status in which, when transmission of uplink data occurs while, for example, a mobile terminal carries out continuous reception of downlink data, the mobile terminal has to transmit an uplink Ack/Nack and an uplink SRA simultaneously. Furthermore, even though the mobile terminal does not receive the downlink data continuously, but receives the downlink data discontinuously, it is apparent that there may be a case in which the mobile terminal carries out the

transmission of the uplink SR signal simultaneously if the mobile terminal transmits the uplink Ack/Nack which is a response to the received data.

[0013]

Similarly, it can be considered that, also when a scheduled channel is allocated as allocation of the scheduling request SR, which the mobile terminal transmits to the base station, to physical resources, there occurs a status in which the mobile terminal have to transmit the uplink Ack/Nack and the uplink SRA simultaneously.

Nonpatent reference 4 describes nothing about what type of channel is used as a scheduled channel and how to allocate a time-frequency region as a physical resource. It is therefore understood that even if there is provided, for example, a channel in which a 1-bit physical resource intended only for a scheduling request SR is allocated, the mobile terminal has to transmit an uplink Ack/Nack continuously when carrying out continuous reception of downlink data, and therefore there occurs a status in which, when transmission of uplink data occurs at that time, the mobile terminal has to transmit an uplink Ack/Nack and an uplink SRA simultaneously.

[0014]

Furthermore, the nonpatent reference 4 suggests nothing about "the problems of the invention" and "the advantages of the invention" which will be shown in the specification of the present invention.

Nonpatent reference 5 discloses transmitting an uplink scheduling request by using an individual uplink control channel, such as an existing channel (CQICH) for CQI

transmission or an existing channel (ACHCH) for Ack/Nack transmission. The reference shows that, as a result, a transmission procedure of transmitting an uplink scheduling request with little delay (Delay) can be established.

However, the nonpatent reference 5 suggests nothing about "the problems of the invention" and "the advantages of the invention" which will be shown in the specification of the present invention.

[0015]

The nonpatent reference 5 discloses only transmitting an uplink scheduling request by using either a channel (CQICH) for CQI transmission or a channel (ACHCH) for Ack/Nack transmission, but discloses nothing about how to allocate the CQICH and the ACHCH, as physical resources, to a time-frequency region. It is therefore understood that even if a case in which an uplink scheduling request is transmitted by using, for example, a channel (CQICH) for CQI transmission, is considered, when a mobile terminal is carrying out continuous reception of downlink data, the mobile terminal has to transmit an uplink Ack/Nack continuously, and therefore there occurs a status in which, when transmission of uplink data occurs at that time, the mobile terminal has to transmit an uplink Ack/Nack (ACHCH) and an uplink scheduling request (CQICH) simultaneously.

It is therefore understood that the nonpatent reference 5 does not solve "the problems of the invention" shown in the specification of the present invention.

[0016]

[Nonpatent reference 1] 3GPP contributions R1-062741

[Nonpatent reference 2] 3GPP contributions R1-062742

[Nonpatent reference 3] 3GPP TR25.814V7.0.0

[Nonpatent reference 4] 3GPP contributions R1-062719

[Nonpatent reference 5] 3GPP contributions R1-062571

[0017]

Because conventional communication systems which comply with the LTE are constructed as mentioned above, an SC-FDMA (Single Career Frequency Division Multiple Access which is also referred to as DFT-spread OFDM) is used as an uplink access method. Because the SC-FDMA is single carrier transmission, compared with multi carrier transmission, such as OFDM, in which symbolic data are transmitted with them being piggybacked onto each subcarrier, the SC-FDMA has a feature of being able to reduce the PAPR (Peak to Average Power Ratio peak to average power ratio). Therefore, because the power consumption of a mobile terminal can be reduced at a time when the mobile terminal carries out transmission and the transmit power which satisfies defined adjacent channel leakage power can be increased, there is provided an advantage of widening the cell coverage. However, there may be a case in which a mobile terminal has to simultaneously carry out a process of transmitting an uplink Ack/Nack and an uplink CQI by using an Ack/Nack exclusive channel and a process of transmitting an uplink scheduling request signal (SR) by using an S-RACH or a scheduled channel, or a CQICH and an ACHCH according on its status. In this case, because those signals have no correlation among them, when transmitted simultaneously, they are not transmitted with single carrier transmission, but are transmitted with multi carrier transmission. In the case in which such signals having no correlation among them are transmitted simultaneously, the

PAPR becomes high because the time waveforms of the transmission signals have a high peak. A problem is that as the PAPR becomes high, the power consumption of the mobile terminal increases and therefore the cell coverage becomes narrow. A further problem is that as the PAPR becomes high, those signals become an interference wave to other mobile terminals and the communication system.

[0018]

The present invention is made in order to solve the above-mentioned problems, and it is therefore an object of the present invention to provide a data communication method, a communication system, and a mobile terminal which can prevent increase in the radio resources load due to temporary increase in the physical channels and can also reduce the PAPR (peak to average power ratio).

Disclosure of the Invention

[0019]

In accordance with the present invention, there is provided a data communication method with which a mobile terminal carries out a response signal transmission process of transmitting a response signal to a base station by using an uplink control channel in an uplink direction from the mobile terminal to the base station, a scheduling request signal transmission process of transmitting a scheduling request signal to the base station by using a physical channel different from the uplink control channel when transmission data to be transmitted to the base station occur, and a control process of, when a processing timing of the response signal transmission process coincides with that of the scheduling request signal

transmission process, stopping the response signal transmission process during a time interval during which the mobile terminal transmits the scheduling request signal.

[0020]

As a result, because it is not necessary to use a multi carrier method of simultaneously transmitting data associated with two physical channels (an Ack/Nack exclusive channel an S-RACH) which are allocated to two types of bands, there is provided an advantage of being able to prevent the increase in the radio resource load of the communication system due to temporary increase in the physical channels, and to reduce the PAPR (peak to average power ratio).

[0021]

In accordance with the present invention, there is provided a communications system in which a mobile terminal includes: a transmitting unit for transmitting a response signal to a base station by using an uplink control channel in an uplink direction from the mobile terminal to the base station, and for transmitting a scheduling request signal to the base station by using a physical channel different from the uplink control channel when transmission data to be transmitted to the base station occur; and a control unit for, when a transmission timing of the response signal coincides with that of the scheduling request signal in the transmitting unit, stopping the transmission process of transmitting the response signal during a time interval during which the transmitting unit transmits the scheduling request signal.

[0022]

As a result, because it is not necessary to use a multi

carrier method of simultaneously transmitting data associated with two physical channels (an Ack/Nack exclusive channel an S-RACH) which are allocated to two types of bands, there is provided an advantage of being able to prevent the increase in the radio resource load of the communication system due to temporary increase in the physical channels, and to reduce the PAPR (peak to average power ratio).

[0023]

In accordance with the present invention, there is provided a data communication method with which a mobile terminal carries out a control signal generation process of generating an uplink control signal including at least a response signal, while, when transmission data to be transmitted to a base station occur, performing time division multiplexing of a scheduling request signal and the response signal to generate the uplink control signal, and a control signal transmission process of transmitting a control signal including the uplink control signal generated through the control signal generation process to the base station by using an uplink control channel in an uplink direction from the mobile terminal to the base station.

[0024]

As a result, because it is not necessary to use a multi carrier method of simultaneously transmitting data associated with two physical channels (an Ack/Nack exclusive channel an S-RACH) which are allocated to two types of bands, there is provided an advantage of being able to prevent the increase in the radio resource load of the communication system due to temporary increase in the physical channels, and to reduce the

PAPR (peak to average power ratio).

[0025]

In accordance with the present invention, there is provided a data communication method with which a mobile terminal selectively carries out either a process of coding individual data by using a first code or a process of coding the individual data including a scheduling request signal by using a second code when transmission data to be transmitted the base station occur, and also carries out a process of transmitting the coded individual data by using an uplink common channel.

[0026]

As a result, because it is not necessary to use a multi carrier method of simultaneously transmitting data associated with two physical channels (an Ack/Nack exclusive channel an S-RACH) which are allocated to two types of bands, there is provided an advantage of being able to prevent the increase in the radio resource load of the communication system due to temporary increase in the physical channels, and to reduce the PAPR (peak to average power ratio).

[0027]

In accordance with the present invention, there is provided a data communication method with which a mobile terminal carries out a control signal generation process of, when transmission data to be transmitted to a base station occur, performing time division multiplexing of at least a scheduling request signal and a response signal to generate an uplink control signal, and a control signal transmission process of transmitting a control signal including the uplink control

signal generated through the control signal generation process to the base station by using a random access channel which is a physical channel.

[0028]

As a result, because it is not necessary to use a multi carrier method of simultaneously transmitting data associated with two physical channels (an Ack/Nack exclusive channel an S-RACH) which are allocated to two types of bands, there is provided an advantage of being able to prevent the increase in the radio resource load of the communication system due to temporary increase in the physical channels, and to reduce the PAPR (peak to average power ratio).

Brief Description of the Figures

[0029]

[Fig. 1] Fig. 1 is an explanatory drawing showing the structure of a mobile communication system mobile communication system which complies with LTE;

[Fig. 2] Fig. 2 is an explanatory drawing showing the structure of channels for use with the communications system which complies with LTE;

[Fig. 3] Fig. 3 is a block diagram showing the structure of a mobile terminal;

[Fig. 4] Fig. 4 is a block diagram showing the structure of a base station;

[Fig. 5] Fig. 5 is an explanatory drawing for explaining radio resources which are allocated to an Ack/Nack exclusive channel and an S-RACH for transmission of an uplink scheduling request signal SR;

[Fig. 6] Fig. 6 is a flow chart explaining processing carried

out by a mobile terminal, including up to a process of transmitting an uplink scheduling request signal;

[Fig. 7] Fig. 7 is a flow chart explaining a series of processes including from the process of transmitting an uplink scheduling request signal up to a process of starting transmission of uplink data;

[Fig. 8] Fig. [[7]] 8 is a flow chart explaining the series of processes including from the process of transmitting an uplink scheduling request signal up to the process of starting transmission of uplink data;

[Fig. 9] Fig. 9 is an explanatory drawing for explaining examples of mapping of Ack/Nack symbols to be transmitted by using an Ack/Nack exclusive channel;

[Fig. 10] Fig. 10 is an explanatory drawing for explaining examples of mapping of Ack/Nack symbols to be transmitted by using an Ack/Nack exclusive channel;

[Fig. 11] Fig. 11 is an explanatory drawing for explaining radio resources which are allocated to an Ack/Nack exclusive channel and an S-RACH for transmission of an uplink scheduling request signal SR;

[Fig. 12] Fig. 12 is an explanatory drawing for explaining examples of mapping of Ack/Nack symbols to be transmitted by using an Ack/Nack exclusive channel;

[Fig. 13] Fig. 13 is a flow chart explaining processing carried out by a mobile terminal, including up to a process of transmitting an uplink scheduling request signal;

[Fig. 14] Fig. 14 is an explanatory drawing for explaining an example of mapping of an uplink scheduling request signal which is transmitted by using an Ack/Nack exclusive channel;

[Fig. 15] Fig. 15 is a flow chart for explaining processing carried out by a mobile terminal which transmits an uplink scheduling request signal, and processing carried out by a base station which receives the uplink scheduling request signal;

[Fig. 16] Fig. 16 is a flow chart for explaining processing carried out by a mobile terminal which transmits an uplink scheduling request signal, and processing carried out by a base station which receives the uplink scheduling request signal;

[Fig. 17] Fig. 17 is an explanatory drawing showing allocation of radio resources of a UL-SCH and an RACH;

[Fig. 18] Fig. 18 is a flow chart explaining processing carried out by a mobile terminal, including up to a process of transmitting an uplink scheduling request signal;

[Fig. 19] Fig. 19 is an explanatory drawing showing radio resources in which a preamble and a message, an Ack/Nack, a CQI, and an SR are mapped onto an S-RACH;

[Fig. 20] Fig. 20 is an explanatory drawing showing radio resources in which a preamble and a message, an Ack/Nack, a CQI, and an SR are mapped onto an S-RACH;

[Fig. 21] Fig. 21 is an explanatory drawing showing radio resources in which a preamble and a message, an Ack/Nack, a CQI, and an SR are mapped onto an S-RACH;

[Fig. 22] Fig. 22 is an explanatory drawing for explaining an uplink L1/L2 control signal;

[Fig. 23] Fig. 23 is an explanatory drawing showing radio resources to which an Ack/Nack and a CQI are allocated in the case in which uplink data transmission is carried out or in the case in which no uplink data transmission is carried out;

[Fig. 24] Fig. 24 is an explanatory drawing showing radio

resources in which an Ack/Nack and a CQI are allocated to an Ack/Nack exclusive channel;

[Fig. 25] Fig. 25 is an explanatory drawing showing radio resources in which an uplink scheduling request signal is allocated to an S-RACH;

[Fig. 26] Fig. 26 is an explanatory drawing showing an example in which a mobile terminal transmits an Ack/Nack and an SRA simultaneously in a case in which the mobile terminal is not carrying out any uplink data transmission;

[Fig. 27] Fig. 27 is an explanatory drawing for explaining an example of mapping of an uplink scheduling request signal which is transmitted by using an Ack/Nack exclusive channel;

[Fig. 28] Fig. 28 is a sequence diagram in a case of a first example of a setting;

[Fig. 29] Fig. 29 is a flow diagram of processing carried out by a mobile terminal in the case of the first example of the setting;

[Fig. 30] Fig. 30 is a flow diagram of processing carried out by a base station in the case of the first example of the setting;

[Fig. 31] Fig. 31 is a sequence diagram in a case of a second example of the setting;

[Fig. 32] Fig. 32 is a flow diagram of processing carried out by a mobile terminal in the case of the second example of the setting;

[Fig. 33] Fig. 33 is a flow diagram of processing carried out by a base station in the case of the second example of the setting;

[Fig. 34] Fig. 34 is a detailed block diagram of a mobile terminal which transmits an uplink scheduling request signal;

[Fig. 35] Fig. 35 is an explanatory drawing of allocation of radio resources for a Sounding RS during transmission of uplink data in Embodiment 7;

[Fig. 36] Fig. 36 is a concrete sequence diagram in a case in which an uplink transmission request occurs in a state where no data communications are carried out via both an uplink and a downlink;

[Fig. 37] Fig. 37 is a flow chart showing a flow in a case in which a transmission request occurs in a state in which a mobile station is synchronized with a base station and is not carrying out transmission of uplink data;

[Fig. 38] Fig. 38 is an explanatory drawing showing a method of allocating radio resources in a case in which a base station sets up a plurality of BWs for a usual Sounding RS, and the circumstances of allocation of radio resources to a mobile terminal UE1;

[Fig. 39] Fig. 39 is a flow chart showing a setting of the BW of a Sounding RS by a base station eNodeB;

[Fig. 40] Fig. 40 is a flow chart showing a judging method in a case in which the base station eNodeB selects the BW;

[Fig. 41] Fig. 41 is a flow chart showing a judging method in a case in which a mobile terminal selects the BW;

[Fig. 42] Fig. 42 is an explanatory drawing of allocation of radio resources in a plurality of UEs in one UE group;

[Fig. 43] Fig. 43 is an explanatory drawing in a case of ~~setting up~~ a Sounding RS region for each UE group;

[Fig. 44] Fig. 44 is an explanatory drawing of a generation method of generating a reference signal for sounding having the functions of an uplink scheduling request signal;

[Fig. 45] Fig. 45 is a diagram of sequences between a mobile terminal and a base station;

[Fig. 46] Fig. 46 is an explanatory drawing of an allocation method of allocating a pilot for sounding and a mobile-terminal-specific code in a case in which a mobile terminal transmits a reference signal for sounding;

[Fig. 47] Fig. 47 is an explanatory drawing showing a pilot pattern in which a part of a sounding pilot is symbols for scheduling request;

[Fig. 48] Fig. 48 is a diagram of sequences between a mobile terminal and a base station;

[Fig. 49] Fig. 49 is an explanatory drawing of an example of generation of a reference signal for sounding;

[Fig. 50] Fig. 50 is a diagram of sequences between a mobile terminal and a base station;

[Fig. 51] Fig. 51 is an explanatory drawing of an example of generation of a reference signal for sounding;

[Fig. 52] Fig. 52 is a diagram of sequences between a mobile terminal and a base station;

[Fig. 53] Fig. 53 is an explanatory drawing in a case in which a reference signal for sounding is transmitted at certain time intervals;

[Fig. 54] Fig. 54 is an explanatory drawing in a case in which a reference signal for sounding which is transmitted at certain time intervals serves as an uplink scheduling request signal;

[Fig. 55] Fig. 55 is an explanatory drawing of a time-frequency resource in a case in which there is an Ack/Nack exclusive channel region;

[Fig. 56] Fig. 56 is an explanatory drawing of a time-frequency

resource in a case of allocating a region of RS for sounding to all of the entire band of the system;

[Fig. 57] Fig. 57 is an explanatory drawing of a time-frequency resource;

[Fig. 58] Fig. 58 is an explanatory drawing of a time-frequency resource;

[Fig. 59] Fig. 59 is an explanatory drawing of transmission symbol mapping in a mobile terminal in a case of transmitting an uplink scheduling request signal with a region for sounding RS;

[Fig. 60] Fig. 60 is an explanatory drawing of a transmission signal of a mobile terminal when a scheduling request occurs;

[Fig. 61] Fig. 61 is an explanatory drawing of a transmission signal of a mobile terminal when a scheduling request occurs;

[Fig. 62] Fig. 62 is a diagram of sequences between a mobile terminal and a base station;

[Fig. 63] Fig. 63 is an explanatory drawing of a transmission signal of a mobile terminal when an uplink scheduling request occurs;

[Fig. 64] Fig. 64 is a diagram of sequences between a mobile terminal and a base station;

[Fig. 65] Fig. 65 is an explanatory drawing of a transmission signal of a mobile terminal when an uplink scheduling request occurs; and

[Fig. 66] Fig. 66 is a diagram of sequences between a mobile terminal and a base station.

Preferred Embodiments of the Invention

[0030]

Hereafter, in order to explain this invention in greater

detail, the preferred embodiments of the present invention will be described with reference to the accompanying drawings.

Embodiment 1.

Fig. 1 is an explanatory drawing showing the structure of a mobile communication system which complies with LTE. In Fig. 1, an aGW 1 performs transmission and reception of control data and user data with a plurality of base stations (eNodeB) 2, and a base station 2 transmits and receives data to and from a plurality of mobile terminals 3. Between a base station 2 and a mobile terminal 3, broadcast information, information used for processing a call, individual control data, individual user data, control data for E-MBMS, user data, and so on are transmitted. It has also been studied that base stations 2 communicate with each other.

A base station 2 has uplink and downlink schedulers. These schedulers of a base station 2 enable transmission and reception of data between the base station 2 and each mobile terminal 3, and carry out scheduling for improvements in the throughput of each mobile terminal 3 and that of the whole mobile communication system.

[0031]

A E-MBMS provides a broadcast type point-to-multipoint (Point to Multipoint PtoM) communication service with which data are transmitted at a time from a certain base station toward a plurality of mobile terminals. Concretely, an information service, such as news or weather forecast, and a large-volume broadcast service, such as mobile TV, have been studied.

The aGW 1 communicates with a service center 5 via a PDN 4 (Packet Data Network).

The service center 5 stores and distributes a content used for providing a service for users. A content provider transmits E-MBMS data, such as mobile TV broadcast data, to the service center 5. The service center 5 stores the E-MBMS data therein and also transmits the E-MBMS data to base stations 2 via the PDN 4 and the aGW 1.

[0032]

Fig. 2 is an explanatory drawing showing the structure of channels. Mapping of logical channels (Logical channels) and transport channels (Transport channels) is shown in Fig. 2.

The logical channels are classified according to the functions and logical characteristics of transmission signals. The transport channels are classified according to transmission forms. Broadcast information is piggybacked onto a BCCH (Broadcast Control Channel). A BCCH is mapped to a BCH (Broadcast Channel) and is transmitted from a base station to mobile terminals.

Information used for processing a call is piggybacked onto a PCCH (Paging Control Channel). A PCCH is mapped to a PCH (Paging Channel) and is transmitted from a base station to mobile terminals in the cell of the base station. Individual control data destined for each mobile terminal are piggybacked onto a DCCH (Dedicated Control Channel).

[0033]

Individual user data destined for each mobile terminal are piggybacked onto a DTCH (Dedicated Traffic Channel). A DCCH and a DTCH are mapped to a DL-SCH (Downlink Shared Channel), and are transmitted individually from a base station to each

mobile terminal. In contrast with this, it is individually transmitted from each mobile terminal to a base station by using a UL-SCH (Uplink Shared Channel).

A DL-SCH and a UL-SCH are shared channels (Shared Channels).

Control data for E-MBMS and user data are piggybacked onto an MCCH (Multicast Control Channel) and an MTCH (Multicast Traffic Channel), respectively, and are mapped to a DL-SCH or an MCH (Multicast Channel) and are transmitted from a base station to a mobile terminal.

A connection request signal from a mobile terminal, e.g., a scheduling request signal SR is transmitted from each mobile terminal to a base station by using a random access channel (Random Access Channel RACH). An S-RACH is one of RACHs.

[0034]

Fig. 3 is a block diagram showing the structure of a mobile terminal. A transmitting process of the mobile terminal 3 is carried out as follows.

First, control data from a protocol processing unit 6 and user data from an application unit 7 are stored in a transmission data buffer unit 8.

The data stored in the transmission data buffer unit 8 are delivered to an encoder unit 9, and the encoder unit performs an encoding process, such as an error correction, on the data. There can exist data on which no encoding process is performed and which are directly outputted from the transmission data buffer unit 8 to a modulating unit 10.

The modulating unit 10 performs a modulation process on the data on which the encoding process has been performed by

the encoder unit 9. After the modulated data are converted into a baseband signal, this baseband signal is outputted to a frequency converting unit 11 and is then converted into a signal having a radio transmit frequency. After that, the transmission signal is transmitted to a base station 2 from an antenna 12.

[0035]

A receiving process of the mobile terminal 3 is carried out as follows. A radio signal from the base station 2 is received by the antenna 12. The received signal having a radio receive frequency is converted into a baseband signal by the frequency converting unit 11, and a demodulating unit 13 performs a demodulation process on the baseband signal. Data which the demodulating unit obtains after demodulating the baseband signal are delivered to a decoder unit 14, and the decoder unit performs a decoding process, such as an error correction, on the data. Control data among the decoded data are delivered to the protocol processing unit 6, while user data among the decoded data are delivered to the application unit 7. The series of transmission and reception processes of the mobile terminal is controlled by a control unit 15.

[0036]

Fig. 4 is a block diagram showing the structure of a base station. A transmitting process of the base station 2 is carried out as follows.

An aGW communication unit 16 transmits and receives data between the base station 2 and an aGW 1. An other base station communication unit 17 transmits and receives data to and from another base station.

Each of the aGW communication unit 16 and the other base station communication unit 17 receives and sends information from and to a protocol processing unit 18. Control data from the protocol processing unit 18 and user data from the aGW communication unit 16 and the other base station communication unit 17 are stored in a transmission data buffer unit 19.

The data stored in the transmission data buffer unit 19 are delivered to an encoder unit 20, and the encoder unit performs an encoding process, such as an error correction, on the data. There can exist data on which no encoding process is performed and which are directly outputted from the transmission data buffer unit 19 to a modulating unit 21. The modulating unit 21 performs a modulation process on the data on which the encoding process has been performed by the encoder unit.

[0037]

After the modulated data are converted into a baseband signal, this baseband signal is outputted to a frequency converting unit 22 and is then converted into a signal having a radio transmit frequency. After that, the transmission signal is transmitted from an antenna 23 to one or more mobile terminals 1.

A receiving process of the base station 2 is carried out as follows.

A radio signal from one or more mobile terminals 3 is received by the antenna 23. The received signal having a radio receive frequency is converted into a baseband signal by the frequency converting unit 22, and a demodulating unit 24 performs a demodulation process on the baseband signal. Data

which the demodulating unit obtains after demodulating the baseband signal are delivered to a decoder unit 25, and the decoder unit performs a decoding process, such as an error correction, on the data. Control data among the decoded data are delivered to the protocol processing unit 18, and user data among the decoded data are delivered to the aGW communication unit 16 and the other base station communication unit 17. The series of transmission and reception processes of the base station 2 is controlled by a control unit 26.

[0038]

Hereafter, the operation of a mobile terminal in accordance with the present invention will be explained.

When a mobile terminal is not performing uplink data transmission and is receiving downlink data, the mobile terminal transmits an Ack/Nack signal indicating the result of the reception of the downlink data (whether the mobile terminal has received the data properly) to the base station by using an Ack/Nack exclusive channel.

The mobile terminal also transmits a downlink communication path quality (CQI) signal for the downlink scheduling by the base station, as well as the Ack/Nack signal indicating the result of the reception of the downlink data, to the base station by using the Ack/Nack exclusive channel.

Furthermore, regardless of whether the mobile terminal has received the downlink data, in order to enable the downlink scheduling by the base station or maintain the synchronization between the base station and the mobile terminal, the mobile terminal transmits a CQI signal to the base station by using the Ack/Nack exclusive channel.

[0039]

When the mobile terminal starts transmission of uplink data in a state in which the mobile terminal transmits an Ack/Nack signal and/or a CQI signal to the base station, as mentioned, the mobile terminal has to transmit an uplink scheduling request signal SR independently from the above-mentioned Ack/Nack and/or the above-mentioned CQI to the base station. In this embodiment, a method of, when transmitting an uplink scheduling request signal SR to the base station by using a physical channel (S-RACH) different from the Ack/Nack exclusive channel, transmitting the uplink scheduling request signal by using an SC-FDMA method which implements a wider coverage and a lower PAPR will be explained.

[0040]

In this Embodiment 1, in a case in which a mobile terminal desires to start transmission of uplink data in a state in which the mobile terminal transmits an Ack/Nack signal and/or a CQI signal by using an uplink Ack/Nack exclusive channel while receiving downlink data without performing transmission of uplink data, the mobile terminal transmits an uplink scheduling request signal SR for setting up a channel for uplink data transmission by using a physical channel (in this Embodiment 1, by using an S-RACH) to which a frequency band different from that of the Ack/Nack exclusive channel is allocated.

At that time, the mobile terminal does not use a multi carrier method of simultaneously transmitting data associated with two physical channels which are allocated to two types of bands, respectively, the mobile terminal does not transmit an Ack/Nack signal and/or a CQI signal by using the Ack/Nack

exclusive channel (DTX Discontinuous Transmission) while transmitting an SR (preamble/message) which the mobile terminal temporarily transmits to the base station when starting transmission of uplink data.

As a result, increase in the radio resource load on the system due to temporary increase in the physical channels of one mobile terminal can be prevented, while transmission with a single carrier method which guarantees a low PAPR can be implemented.

[0041]

Fig. 5 is an explanatory drawing for explaining radio resources which are allocated to an Ack/Nack exclusive channel and an S-RACH for transmission of an uplink scheduling request signal SR. Fig. 6 is a flow chart explaining processing carried out by a mobile terminal, including up to a process of transmitting an uplink scheduling request signal.

Figs. 7 and 8 are flow charts explaining a series of processes including from the process of transmitting an uplink scheduling request signal up to a process of starting transmission of uplink data. In Fig. 5, it is assumed that at the same time when the mobile terminal UE1 is not carrying out transmission of uplink data, such as user data, but is receiving only downlink data, the mobile terminal is transmitting an Ack/Nack and/or a CQI to these received data by using an Ack/Nack exclusive channel.

The modulating unit 10 of the mobile terminal shown in Fig. 3 performs a CDM multiplexing process (can alternatively perform an FDM multiplexing process or a TDM multiplexing process), which is specific to the mobile terminal, on the

Ack/Nack signal, and transmits the Ack/Nack signal by using the Ack/Nack exclusive channel. Therefore, there can be a case in which the mobile terminal UE1 transmits the Ack/Nack signal continuously with respect to time by using the Ack/Nack exclusive channel.

[0042]

In this case, when an uplink data transmission request in ST601 of Fig. 6 occurs (if Yes in ST601), the mobile terminal, in ST602, checks the receiving state of the downlink data (DL data).

In this Embodiment 1, because the mobile terminal is receiving the downlink data, the mobile terminal advances to ST604 in which the mobile terminal determines the timing at which the mobile terminal transmits an uplink scheduling request signal SR (preamble or/and message) by using an S-RACH. If the mobile terminal is not receiving any downlink data and the synchronization with the base station is not established (if No in ST602), the mobile terminal, in ST603, carries out an algorithm of transmitting an uplink scheduling request signal SR by using a physical channel called a Non-S-RACH.

After, in ST604, determining the transmission timing of the uplink scheduling request signal SR, at the same time when the mobile terminal UE1 transmits the uplink scheduling request signal SR by using the S-RACH, the mobile terminal, in ST605, stops the transmission of a predetermined Ack/Nack symbol (or LB) of the uplink Ack/Nack exclusive channel or a CQI symbol (or LB), which the mobile terminal was originally scheduled to transmit at the same timing, and suspends the transmission while the mobile terminal transmits the uplink scheduling request

signal SR (symbol DTX or DTX of LB). This stop (DTX) of the transmission of the Ack/Nack symbol is performed by the modulating unit 10 under the control of the control unit 15.

[0043]

Fig. 5 shows an example of the allocation of radio resources to an S-RACH which is a physical channel via which an uplink scheduling request signal SR is transmitted, and an Ack/Nack exclusive channel.

In Fig. 5, the radio resources are divided into a plurality of time-frequency regions. In each time-frequency region, the time axis is divided into units of each subframe (=0.5ms), and the frequency axis is divided into units having different bands according to the amount of transmission data associated with the physical channel.

[0044]

In the allocation of the radio resources according to this Embodiment 1, the S-RACH and the channel for uplink data transmission use time-frequency unit regions having the same size, respectively, whereas the Ack/Nack exclusive channel uses a frequency band unit region narrower than the time-frequency unit regions (the same time division). A subframe 1 of one subcarrier in the Ack/Nack exclusive channel is comprised of six long blocks (Long Blocks LB1 to LB6) and two short blocks (Short Blocks SB, small blocks).

A symbol for physical channel synchronization (a symbol for demodulation) is included in a short block SB. While the mobile terminal UE1 transmits the uplink scheduling request signal SR with the length of one subframe by using the time-frequency region of the S-RACH which is allocated as shown

in Fig. 5, the mobile terminal stops the modulation and transmission of the symbol data of the long blocks LB1 to LB6 and the two short blocks SB which are currently allocated to the Ack/Nack exclusive channel (the mobile terminal carries out DTX).

[0045]

However, because, in the next subframe 2, there is no transmission of the uplink scheduling request signal SR using the S-RACH and there is also no transmission of uplink data such as user data, the mobile terminal transmits symbol data (LB2-1 to LB2-6) for the subframe 2 by using the Ack/Nack exclusive channel. Furthermore, in the next subframe (a subframe 1 during TTI No.2), an uplink scheduling request signal SR from another mobile terminal UE occurs, an S-RACH for this SR is allocated to a time-frequency region which exists in a frequency band different from that of the mobile terminal UE1.

In this case, the S-RACH of the other mobile terminal UE is transmitted, and Ack/Nack symbol data and/or CQI symbol data from the mobile terminal UE1 during this subframe interval are transmitted by using the Ack/Nack exclusive channel. The sequence including from the transmission of an uplink scheduling request signal SR by using the S-RACH up to the uplink data transmission is shown in Figs. 7 and 8.

[0046]

Fig. 7 shows a flow chart in a case (ST701) in which the mobile terminal transmits an uplink scheduling request signal SR (preamble and message) in only one step.

Fig. 8 shows a flow chart in a case (ST801 and ST803) in which the mobile terminal transmits an uplink scheduling

request signal SR by sequentially transmitting its preamble (preamble) and its message (message) in two steps.

In Fig. 7, after the mobile terminal notifies the uplink scheduling request to the base station with the preamble and the message, the mobile terminal receives information "uplink data resource allocation (Uplink Data Resource Allocation)" about allocation of radio resources for uplink data transmission and timing by using a downlink L1/L2 control signal from the base station.

In Fig. 8, the mobile terminal receives "scheduling request resource allocation (SR Resourece Allocation)" after transmitting the preamble, and, after notifying a message part of the scheduling request to the base station by using a resource which is allocated thereto with the scheduling request resource allocation, receives information (Uplink Data Resource Allocation) about radio resources allocation for uplink data transmission and timing by using a downlink L1/L2 control signal from the base station.

[0047]

The mobile terminal then starts transmission of uplink data by using a UL-SCH (Uplink Shared channel). In this Embodiment 1, the example in which one subframe is allocated to transmission of an uplink scheduling request signal SR is explained. However, because there is a case in which a preamble and a message are sent at a time during a long transmission time, as shown in Fig. 7, and a case in which ~~they are sent at two times during short transmission time~~ <u>a preamble is sent at a time during short transmission time and a message is sent at a time during another short transmission time</u>, as shown in Fig.

8, the length of a transmission time during which an Ack/Nack cannot be transmitted, and the occurrence frequency can be changed according to the length and frequency of the transmission time of the uplink scheduling request signal SR.

The structure of long blocks and short blocks in a subframe shown in Fig. 5 is only an example, and, even if the structure of the subframe changes, the concept of the present invention can be applied.

[0048]

Hereafter, the preamble and message of an uplink scheduling request signal SR will be explained. It is considered that, for example, a "random ID (random ID (UE ID))" which is specific identifying information for identifying the terminal is allocated to the preamble. As the message, the amount of uplink transmission data (a buffer state in the UE), the QoS of the uplink transmission data, or a transmission power margin of the terminal, in addition to the "UE ID" previously shown, can be considered.

[0049]

In conventional communication methods (FDMA, TDMA, and CDMA), a stop (DTX) of transmission of symbols via an uplink provides an advantage of reducing the power consumption of a mobile terminal, reducing the highest transmit power of the mobile terminal to within a power range indicated by a base station, and also reducing the transmit power of the whole system to within a fixed range. In contrast, by using the method of stopping transmission of symbols (DTX) in accordance with the present invention, because, for an uplink, not only the PAPR in the mobile terminal can be reduced, but single carrier

transmission can be carried out, unlike in the case of using DTX of a conventional communication method, the scale of the implementation of the modulation and demodulation processes can be reduced in both the mobile terminal and the base station, and the processing load on the whole system can be reduced compared with the case of using a multi carrier transmission method.

[0050]

As mentioned above, by using Embodiment 1, there can be provided an advantage of, in a case in which a mobile terminal is not carrying out transmission of uplink data, but is receiving downlink data, enabling the mobile terminal which has to transmit an uplink scheduling request signal SR together with an Ack/Nack to perform the transmission of these signals simultaneously without increasing the PAPR in the mobile terminal.

[0051]

In contrast, there can be a case in which in the mobile communication system, even when a mobile terminal does not receive downlink data, an Ack/Nack exclusive channel is allocated to the mobile terminal.

More specifically, there can be considered a case in which even when there exist no downlink data in a base station, in order to prepare future downlink scheduling or maintain the synchronization between the base station and a mobile terminal, the result (CQI) of measurement of the quality of a downlink communication path is notified from the mobile terminal to the base station. Also in such a case, there can be considered a case in which the transmission of the CQI using an Ack/Nack

exclusive channel and an uplink scheduling request signal SR occur simultaneously. In such a mobile communication system, it is preferable that when performing judgment as shown in ST602, a mobile terminal judges whether or not an Ack/Nack exclusive channel is allocated thereto. In addition, even a mobile communication system in which when a mobile terminal does not receive downlink data no Ack/Nack exclusive channel is allocated to the mobile terminal can adopt this judgment.

[0052]

Embodiment 2.

In above-mentioned Embodiment 1, in a case in which a mobile terminal transmits an uplink scheduling request signal SR by using an S-RACH while transmitting an Ack/Nack signal and/or a CQI signal by using an Ack/Nack exclusive channel, the mobile terminal stops the transmission of the Ack/Nack signal and/or the CQI signal while transmitting the uplink scheduling request signal SR.

By stopping the transmission of the Ack/Nack signal and/or the CQI signal while transmitting the uplink scheduling request signal SR, the mobile terminal does not have to use a multi carrier method with which to simultaneously transmit data associated with the two physical channels (the Ack/Nack exclusive channel and the S-RACH) which are allocated to two types of bands, respectively. Therefore, increase in the radio resources load on the communication system due to temporary increase in the physical channels can be prevented, and transmission with a single carrier method which guarantees a low PAPR can be implemented.

In contrast, in Embodiment 2 which will be explained

hereafter, a mapping method for an Ack/Nack exclusive channel of, when performing a stop (DTX) of transmission of an Ack/Nack symbol, preventing a bad influence from being exerted upon the performance of communications of symbols on the Ack/Nack exclusive channel will be explained.

[0053]

In Embodiment 1, the processing including from the process of transmitting an uplink scheduling request signal SR by using an S-RACH up to a process of transmitting uplink data is explained with reference to Fig. 52. More specifically, the transmission of an uplink scheduling request signal SR (a preamble or/and a message) includes a case, as shown in Fig. 7, in which a long transmission time is needed in order to send the preamble and the message at a time and a case, as shown in Fig. 8, in which the preamble is transmitted at a time and the message is transmitted at another time and therefore their respective transmission time become short.

In the case in which the transmission time of an uplink scheduling request signal SR is long, the time during which an Ack/Nack and/or a CQI cannot be transmitted (the DTX of the Ack/Nack symbol and/or the CQI symbol) becomes long, whereas in the case in which the transmission time of an uplink scheduling request signal SR are short, the time interval during which an Ack/Nack and/or a CQI cannot be transmitted becomes short. For each of the cases, a method of preventing the degradation of the communication quality ~~due to occurrence of errors in the~~ because no transmission of the Ack/Nack symbol information and/or the CQI symbol information is carried out during the time during which the uplink scheduling request

signal SR is transmitted will be explained hereafter.

[0054]

First, the process in the case of Fig. 7 will be explained. Because the preamble and the message are collectively transmitted at a time in the transmission of the uplink scheduling request signal SR shown in Fig. 7, the time interval during which the Ack/Nack and/or the CQI cannot be transmitted becomes long, and can have a length of about one subframe as shown in Fig. 5. In order to prevent the degradation in the communication quality due to errors in the transmission of the Ack/Nack symbol information and/or the CQI symbol information which can occur during this time interval, in accordance with this Embodiment 2, a pattern of symbols to be sent by using the Ack/Nack exclusive channel is mapped in such a way that a pattern having a length of one subframe is repeated twice and is updated during each transmission time interval (TTI).

Furthermore, in order to ensure communication quality, a symbol pattern having a length of one subframe is formed to be a combination of symbols in which important information (higher-order bits) are given a higher priority and the number of repetitions of the important information is increased. Concrete examples of the mapping of symbol information which is to be transmitted by using an Ack/Nack exclusive channel are shown in Figs. 9 and 10.

[0055]

Fig. 9 is an explanatory drawing explaining examples of the mapping of Ack/Nack symbols to be transmitted by using an Ack/Nack exclusive channel. Fig. 9 shows an example of the mapping of symbols to the Ack/Nack exclusive channel, which has

been proposed by the 3GPP (3rd Generation Partnership Project) until now (refer to the nonpatent reference 2).

For each of a case in which only Ack/Nack symbols are mapped to long blocks LB (Fig. 9(a)), a case in which only CQI symbols are mapped to long blocks (Fig. 9(b)), and a case in which CQI symbols and Ack/Nack symbols are multiplexed and are mapped to long blocks LB (Fig. 9(c)), a symbol mapping structure with a transmission time interval length (TTI) is shown.

[0056]

A symbol pattern which is proposed in this Embodiment 2 is formed in such a way that even in a case in which an Ack/Nack and/or a CQI cannot be transmitted for a long period of time (= 1 subframe), a symbol pattern having a length of one subframe is repeated twice within 1 TTI for the purpose of preventing occurrence of errors in the transmission of the Ack/Nack and/or the CQI, thereby improving the communication quality.

In the symbol pattern shown in Fig. 9 in the case of CQI symbols, for one subframe A, CQI1, CQI2, CQI3, CQI4, CQI5, and CQI1 are mapped to long blocks, whereas for one subframe B, CQI2, CQI3, CQI4, CQI1, CQI2, and CQI1 are mapped to long blocks, and the CQI symbols are not arranged with the same symbol pattern in the subframes.

Therefore, when, for example, the one subframe A is DTXed, CQI5 is not transmitted once (one LB) during 1 TTI. Also in the symbol pattern in which CQIs and Acks/Nacks are multiplexed with respect to time, they are not arranged with the same symbol pattern in both the one subframe A and the one subframe B.

[0057]

A mapping example of mapping the CQI symbols and a mapping example of multiplexing and mapping the CQI and the Ack/Nack, which are proposed by the present invention, are shown in Fig. 10.

First, in the mapping example of mapping the CQI symbols of Fig. 10(a), the same symbol mapping pattern is repeated in both a first subframe (single sub-frame A) and a second subframe (single sub-frame B) within 1 TTI. Furthermore, in the mapping of the symbols to each subframe length, symbols with a higher priority (i.e., symbols showing a higher-order digit of the CQI: in this example, CQI1) are repeated a larger number of times.

Furthermore, also in the mapping example of multiplexing and mapping the CQI symbols and the Ack/Nack symbol of Fig. 10(b), the same symbol mapping pattern is repeated in both a first subframe (single sub-frame A) and a second subframe (single sub-frame B) within 1 TTI, and, in the mapping of the symbols to each subframe length, symbols with a higher priority (the Ack/Nack and so on) are placed in a vicinity of a short block SB.

[0058]

In this Embodiment 2, an Ack/Nack and the higher-order bits of a CQI (CQI1 is the most significant bit) are considered as symbols having a higher priority. An Ack/Nack indicates the result of reception of downlink data, and therefore there arises a problem that retransmission of corresponding packet data occurs when this bit cannot be received properly by the base station. It is therefore necessary to increase the priority of the Ack/Nack in the symbol arrangement. It is further necessary to place the higher-order ones of the CQI bits

indicating the reception state of the downlink data on a priority basis so as to enable the base station to cope with transmission errors and so on.

[0059]

Thus, it is not necessary to limit the mapping pattern in the symbol mapping method of taking into consideration a risk of the Ack/Nack information not being transmitted while the uplink scheduling request signal SR is transmitted and the importance of the symbols to the pattern of Fig. 10 which is explained in this Embodiment 2.

Even though the symbol mapping is not performed as shown in Fig. 10, this Embodiment 2 can be implemented. Therefore, the concept about the symbol mapping will be mentioned hereafter.

(1) Repeat symbols having a higher priority a larger number of times. (2) Place symbols having a higher priority in a vicinity of a short block SB.

In general, an Ack/Nack and the higher-order bits of a CQI (CQI1 is the most significant bit) are symbols having a higher priority.

[0060]

An Ack/Nack indicates the result of reception of downlink data, and therefore there arises a problem that, when this symbol cannot be received properly by the base station, retransmission of the corresponding packet data occurs and the throughput of the downlink data falls as a result. It is therefore necessary to increase the priority of the Ack/Nack in the symbol arrangement.

Also in the case of the higher-order ones of the CQI bits

indicating the state of the reception of the downlink data, when a transmission error occurs, the erroneous difference between the downlink communication path quality which is measured by the mobile terminal and the downlink communication path quality which the base station has received becomes large, and therefore appropriate scheduling cannot be carried out by the base station and this results in reduction in the downlink throughput of the whole mobile communications system. It is therefore necessary to increase the priority of the higher-order ones of the CQI bits indicating the state of the reception of the downlink data in the symbol arrangement.

[0061]

The priority of the Ack/Nack and that of the CQI depend on the desired error rates of their respective signals.

Because increase in the number of repetitions (repetition) can increase the receive power of the base station, the larger number of repetitions (repetition) a symbol has the more rarely an error occurs in the symbol.

Because it can be considered that a short block is used for phase compensation when receiving the short block and then demodulating the short block, the phase compensation is carried out more correctly as the difference between the transmission timing of the short block and that of the corresponding symbol decreases. Therefore, an error occurs more rarely in a symbol which is placed nearer to a short block. Some predetermined patterns exist in the mapping of the symbols of Ack/Nack information (an Ack/Nack and/or a CQI), and the mobile station can select one pattern from among the predetermined patterns, one pattern can be selected and notified by the base station,

or one pattern can be dynamically allocated to the mobile station. As previously explained, when transmission of an Ack/Nack symbol and/or CQI symbols using an Ack/Nack exclusive channel cannot be carried out temporarily for a long period of time (= during one subframe) because of transmission of an uplink scheduling request signal SR by using an S-RACH, an transmission error can be preventing from occurring in the information symbols of the Ack/Nack exclusive channel and therefore high communication quality can be maintained.

[0062]

Next, a case in which the transmission time during which an uplink scheduling request signal SR is transmitted once is sufficiently short, like the sequence of Fig. 8, will be explained.

In a case in which a mobile terminal, in ST605 of Fig. 6, transmits an uplink scheduling request signal SR, as shown in the flow chart of Fig. 8, by dividing it into a preamble and a message or sending the preamble and the message of a small size together, the time interval during which the mobile terminal transmits the uplink scheduling request signal SR becomes short. Therefore, the transmission stop time interval during which transmission of an Ack/Nack symbol and/or a CQI symbol in the Ack/Nack exclusive channel is stopped during the transmission of the uplink scheduling request signal SR also becomes short.

An example of how, in such a case, the S-RACH used for the transmission of the uplink scheduling request signal SR and the Ack/Nack exclusive channel are allocated in time-frequency is shown in Fig. 11.

[0063]

Because the amount of information of the uplink scheduling request signal SR in the sequence diagram of Fig. 8 is sufficiently small, in Fig. 11, a region to which the S-RACH of the mobile terminal UE1 is allocated in time-frequency is only one leading data symbol block included in one time-frequency unit region. An Ack/Nack symbol or a CQI symbol which is transmitted at the same timing as this block is a symbol in a long block LB1 of the Ack/Nack exclusive channel. While the uplink scheduling request signal SR using the S-RACH of the mobile terminal UE1 is transmitted, the Ack/Nack information symbol or the CQI symbol in the block which is the long block LB1 is not transmitted.

[0064]

Fig. 12 is an explanatory drawing for explaining examples of the mapping of an Ack/Nack symbol and CQI symbols which are transmitted by using the Ack/Nack exclusive channel.

Unlike Fig. 10, Fig. 12 shows cases in each of which different symbols are mapped in a first subframe (one sub-frame A) and a second subframe (one sub-frame B) within 1 TTI, respectively, and either the Ack/Nack or higher-order CQI bits having a higher priority are placed a larger number of repetitions within the TTI.

As shown in Fig. 12(a), in a case in which only CQI symbols are transmitted, when transmission of an uplink scheduling request signal SR occurs, a symbol CQI1 having a higher priority is allocated to the position of a long block LB (e.g., LB1) having a possibility of not being transmitted and the same symbol CQI1 is also allocated to the next long block LB2.

As a result, even in a case in which transmission of an uplink scheduling request signal SR occurs, the most important symbol CQI1 can be transmitted with the second long block LB2, and, even in a case in which no transmission of an uplink scheduling request signal SR occurs, the degradation in the quality at the time of occurrence of a communication error can be prevented by transmitting the most important symbol CQI1 four times.

[0065]

Furthermore, in a case in which the CQI symbols and the Ack/Nack symbol are multiplexed and mapped, as shown in Fig. 12(b), even when transmission of an uplink scheduling request signal SR occurs through allocation of a low-priority symbol CQI5 to the position of an LB (LB1) having a possibility of not being transmitted, and the CQI5 symbol cannot be transmitted, other symbols having a higher priority can be sent without their repetition numbers being reduced, and therefore the communication quality can be maintained.

[0066]

It is not necessary to limit the mapping pattern in the symbol mapping method according to the importance of the symbols to the pattern which is explained in this Embodiment 2. Because the concept of the symbol mapping is already explained, the explanation of this concept will be omitted hereafter. Either the mobile terminal or the base station can select one pattern from among some predetermined patterns of the mapping of the symbols of Ack/Nack information (an Ack/Nack and/or a CQI), or one of them can be dynamically selected and allocated to the mobile terminal.

[0067]

As a case in which a region to which the S-RACH of the mobile terminal UE1 is allocated in time-frequency is only a part of data symbol blocks with respect to time, as shown in Fig. 11, there can be not only a case in which the information which is to be transmitted by using the S-RACH as shown in the flow chart of Fig. 8, but also a case in which the amount of information of the uplink scheduling request signal SR is large as shown in the flow chart of Fig. 7.

In this case, the uplink scheduling request signal can be sent in a small amount of time by allocating the S-RACH to the time-frequency region whose band is extended in the frequency direction, and transmitting the uplink scheduling request signal by using the S-RACH. More specifically, compared with the case of allocation of Fig. 11, either a wider time-frequency region in the frequency direction or a plurality of time-frequency unit regions which are continuous in the frequency direction are allocated to the transmission of the uplink scheduling request signal SR.

[0068]

Embodiment 1 and Embodiment 2 are based on the CDM multiplexing of the Ack/Nack information which is carried out for each mobile terminal in the Ack/Nack exclusive channel. As an alternative, there can be another method of carrying out TDM multiplexing or FDM multiplexing of the pieces of Ack/Nack information about a plurality of mobile terminals. Also in such a case, the invention explained in above-mentioned Embodiment 1 can be applied.

By doing in the above-mentioned way, also in a case in

which an uplink Ack/Nack symbol and/or CQI symbols which are allocated to the same timing as the time-frequency region to which the symbols of the uplink transmission request signal SR are allocated with the S-RACH cannot be modulated and transmitted (DTX) during the transmission time of the uplink scheduling request signal SR, there can be provided an advantage of being able to use the radio resources effectively and to maintain the communication quality of the uplink or reduce the degradation in the communication quality of the uplink to a minimum.

[0069]

Embodiment 3.

In above-mentioned Embodiment 1, by stopping transmission of an Ack/Nack signal and/or a CQI signal while transmitting an uplink scheduling request signal SR by using an S-RACH, and by no using a multi carrier method with which to simultaneously transmit data associated with the two physical channels (the Ack/Nack exclusive channel and the S-RACH) which are allocated to two types of bands, respectively, increase in the radio resources load on the communication system due to temporary increase in the physical channels can be prevented, and transmission with a single carrier method which guarantees a low PAPR can be implemented.

In this Embodiment 3, a method of implementing transmission using an SC-FDMA method which implements a wider coverage and a lower PAPR (peak to average power ratio) by transmitting an Ack/Nack and/or a CQI and an uplink scheduling request signal SR by using an identical physical channel will be explained hereafter.

[0070]

In accordance with this Embodiment 3, a mobile terminal transmits an uplink scheduling request signal SR by mapping the uplink scheduling request signal SR to an Ack/Nack exclusive channel instead of an S-RACH. By transmitting an uplink scheduling request signal SR by using an Ack/Nack exclusive channel, increase in the radio resources load on the communication system due to temporary increase in the physical channels can be prevented, and transmission with a single carrier method which guarantees a low PAPR can be implemented. As a result, even when the number of control signals (L1/L2 control signalings) which have to be temporarily transmitted increases in a certain mobile terminal, increase in the radio resources load on the communication system can be prevented, and transmission with a single carrier method which guarantees a low PAPR and high communication quality can be implemented.

[0071]

In this case, the Ack/Nack exclusive channel is a scheduled channel for which radio resources are scheduled in advance. As mentioned above, in the nonpatent reference 4, allocation of an synchronous random access SRA to a scheduled channel is studied. However, because the nonpatent reference 4 describes nothing about what type of channel is used as the scheduled channel and how a time-frequency region is allocated as a physical resource, in a case in which there is disposed a channel to which a 1-bit physical resource used for a scheduling request SR is allocated to a time-frequency region different from the Ack/Nack exclusive channel, a status in which an uplink Ack/Nack and/or a CQI and an uplink SR have to be

transmitted simultaneously occurs, and these signals are transmitted simultaneously with respect to time. In this case, because they are not transmitted with single carrier transmission, but are transmitted with multi carrier transmission, there arises a problem that the PAPR increases.

[0072]

In order to solve this problem, in accordance with this Embodiment 3, a mobile terminal transmits an uplink scheduling request signal SR by mapping an Ack/Nack and a CQI with the uplink scheduling request signal SR, to an Ack/Nack exclusive channel.

An important thing to satisfy request for a single carrier transmission from a mobile terminal is that the mobile terminal transmits all of an "Ack/Nack", a "CQI", and an "uplink scheduling request signal SR", which are signals having a possibility of having to be transmitted simultaneously, by using an Ack/Nack exclusive channel in a state in which uplink time synchronization is established and the mobile terminal is not transmitting uplink data. By transmitting an Ack/Nack and a CQI with an uplink scheduling request signal SR, by using an Ack/Nack exclusive channel, increase in the radio resources load on the communication system due to temporary increase in the physical channels can be prevented, and transmission with a single carrier method which guarantees a low PAPR can be implemented.

As a result, even when the number of control signals (L1/L2 control signalings) which has to be temporarily transmitted increases in a certain mobile terminal, increase in the radio resources load on the communication system can be prevented, and transmission with a single carrier method which guarantees

a low PAPR and high communication quality can be implemented.

[0073]

Fig. 13 is a flow chart for explaining processing carried out by a mobile terminal, the processing including up to a process of transmitting an uplink scheduling request signal. Fig. 14 is an explanatory drawing for explaining an example of mapping of an uplink scheduling request signal which is transmitted by using an Ack/Nack exclusive channel.

Hereafter, the operation of a mobile terminal in accordance with Embodiment 3 of the present invention will be explained with reference to Fig. 13. In Fig. 13, because the same reference numerals as those shown in Fig. 6 denote the same components or like components, the explanation of the components will be omitted hereafter.

[0074]

A mobile terminal is not carrying out uplink user data transmission, and, at the same time when receiving downlink data, is transmitting, via an uplink, an Ack/Nack and/or a CQI to the received data by using a physical channel for an Ack/Nack and /or a CQI.

For the Ack/Nack exclusive channel, multiplexing of signals from mobile terminals is carried out by using either one of a CDM method, an FDM method, and a TDM method. When a request for transmission of uplink data occurs in the mobile terminal (ST601), the state of the reception of the downlink data is checked in ST602.

In this Embodiment 3, because the mobile terminal is receiving the downlink data, the mobile terminal advances to ST1301 in which the mobile terminal transmits Ack/Nack

information with an uplink scheduling request signal SR (only a part corresponding to a preamble or a part corresponding to the preamble and a message), by using the Ack/Nack exclusive channel.

[0075]

The sequence including from the transmission in ST1301 of the uplink scheduling request signal SR up to the transmission of the uplink data is shown in Fig. 8. In a case in which the information size of the uplink scheduling request signal SR is small and the transmission time is short, transmitting the uplink scheduling request signal SR by using the Ack/Nack exclusive channel is very effective from the viewpoint of the two following aspects: the efficiency of use of radio resources; and the attainment of the communication quality of transmission (an L1/L2 control signaling) of an L1/L2 control signal having a small size, like an Ack/Nack or an uplink scheduling request signal SR.

[0076]

A time-frequency region having a length of one subframe in the Ack/Nack exclusive channel is comprised of six data symbol blocks which are called long blocks LB and symbol blocks for physical channel synchronization which are called short blocks SB.

In this Embodiment 3, an example of the mapping of symbols at the time of carrying out multiplexing of an uplink scheduling request signal SR, Ack/Nack information and/or CQI information within a time-frequency region of 1 TTI (= two subframes) with a predetermined positional relationship will be shown.

[0077]

Fig. 14 is an example of the symbol mapping in a case in which CQI information and Ack/Nack information are multiplexed, and an uplink scheduling request signal SR is further allocated to these pieces of multiplexed information. In this case, it is assumed that the Ack/Nack, the CQI, and the uplink scheduling request signal SR are multiplexed, and are mapped and updated in units of 1 TTI.

[0078]

First, the uplink scheduling request (UL scheduling request) is mapped to a leading symbol block (LB1) within the time-frequency region having a length of a transmission time interval (TTI) (= a length of two subframes). The number of times that the uplink scheduling request signal SR is mapped and transmitted is one time/two subframes at the fastest rate. The description of the SR symbol is 1 bit long, and is information indicating either with request or without request.

Even though the symbol mapping is not carried out as shown in Fig. 14, this Embodiment 3 can be implemented. Therefore, the concept about the symbol mapping will be mentioned hereafter.

[0079]

(1) Repeat symbols having a higher priority a larger number of times. (2) Place symbols having a higher priority in a vicinity of a short block SB.

In general, an Ack/Nack, the higher-order bits of a CQI (CQI1 is the most significant bit), and an uplink scheduling request signal SR are symbols having a higher priority.

An Ack/Nack indicates the result of reception of downlink data, and therefore there arises a problem that, when this

symbol cannot be received properly by the base station, retransmission of the corresponding packet data occurs and the throughput of the downlink data falls as a result. It is therefore necessary to increase the priority of the Ack/Nack in the symbol arrangement.

Also in the case of the higher-order ones of the CQI bits indicating the state of the reception of the downlink data, when a transmission error occurs, the erroneous difference between the downlink communication path quality which is measured by the mobile terminal and the downlink communication path quality which the base station has received becomes large, and therefore appropriate scheduling cannot be carried out by the base station and this results in reduction in the downlink throughput of the whole mobile communications system. It is therefore necessary to increase the priority of the higher-order ones of the CQI bits indicating the reception state of the downlink data in the symbol arrangement.

[0080]

Furthermore, a case in which an uplink scheduling request signal SR is accidentally received by the base station will be considered. When the base station erroneously receives "presence" of an uplink scheduling request SR from a mobile terminal even though the mobile terminal shows "absence" of the uplink scheduling request SR, an unnecessary uplink resource is allocated to the mobile terminal and hence the radio resource goes to waste.

In contrast, when the base station erroneously receives "absence" of an uplink scheduling request SR from a mobile terminal even though the mobile terminal shows "presence" of

the uplink scheduling request SR, there arises a problem that the mobile terminal has to retransmit the uplink scheduling request SR and the uplink throughput decreases as a result.

The priorities of the Ack/Nack, the CQI, and the uplink scheduling request SR depend on their error rates.

[0081]

Because increase in the number of repetitions (repetition) can increase the receive power of the base station, the larger number of repetitions (repetition) a symbol has the more rarely an error occurs in the symbol.

Because it can be considered that a short block is used for phase compensation when receiving data and then performing demodulation of the data, the phase compensation is carried out more correctly as the difference between the transmission timing of the short block and that of the corresponding symbol decreases. Therefore, an error occurs more rarely in a symbol which is placed nearer to a short block.

[0082]

In the explanation of the concept of the symbol mapping, which is made until now, the case in which the multiplexing of a CQI and an Ack/Nack in an Ack/Nack exclusive channel is carried out by using the TDM method is shown. Even in a case in which the multiplexing is carried out by using another method, the concept of the above-mentioned symbol mapping can be applied as the method of mapping an uplink scheduling request signal SR.

Furthermore, an uplink scheduling request signal SR has a value which is defined as follows: "with request = ('1')" and "without request = ('0')", as mentioned above. However, the

definition is not limited to this example, and, for example, an uplink scheduling request signal SR can alternatively have a value which is defined as follows: "with request = ('0')" and "without request = ('1')". Further speaking, an uplink scheduling request signal SR has only to show the presence or absence of an uplink scheduling request.

There can be considered the two following examples of the setting of the value of this bit.

[0083]

In the first example of the setting, when there is no uplink scheduling request signal SR, 0 is always transmitted. In contrast, in a case in which the mobile terminal transmits an uplink scheduling request signal SR, as shown in the flow chart of Fig. 8, the mobile terminal transmits "with request (= '1')", and then transmits 0 during the next transmission time interval (TTI).

If there does not occur any receiving error, when "uplink data resource allocation (Uplink Data Resource Allocation)" which the base station ought to have transmitted to the mobile station does not arrive thereat, the mobile terminal judges that an receiving error has occurred in the base station, and then transmits the uplink scheduling request signal SR indicating "with request ('1')" again.

[0084]

The first example of the setting will be explained in greater detail with reference to Figs. 28, 29, and 30.

Fig. 28 is a sequence diagram, and Fig. 29 is a flow diagram of processing carried out by the mobile terminal. Fig. 30 is a flow diagram of processing carried out by the base station.

In Fig. 28, a time T shows a time limit (an upper limit) by which the mobile terminal has to receive uplink resource allocation made by the base station, and the mobile terminal uses a timer or the like in order to implement the time T.

The operation of the first example of the setting will be explained by mainly referring to Fig. 29.

[0085]

First, a case in which no receiving error occurs when the base station receives an uplink scheduling request signal SR will be explained. As a sequence diagram, Fig. 28(i) shows the case in which no receiving error occurs.

The mobile terminal, in ST2901, judges whether a request for transmission of uplink data has occurred. When a request for transmission of uplink data has occurred, the mobile terminal advances to ST2902. In contrast, when no request for transmission of uplink data has occurred, the mobile terminal returns to the judgment of ST2901.

The mobile terminal, in ST2902, sets up information indicating the presence of an uplink scheduling request (UL Scheduling request= "1" currently allocated to LB1 in Fig. 14) in the Ack/Nack exclusive channel.

The mobile terminal then, in ST2903, transmits the information indicating the "presence" of uplink scheduling by using the Ack/Nack exclusive channel. This step corresponds to ST2801 in Fig. 28.

[0086]

After transmitting the information indicating the "presence" of uplink scheduling by using the Ack/Nack exclusive channel, the mobile terminal, in ST2904, sets up information

indicating the absence of an uplink scheduling request (UL Scheduling request= "0" currently allocated to LB1 in Fig. 14) in the Ack/Nack exclusive channel.

The mobile terminal, in ST2905, judges whether the mobile terminal has received uplink data resource allocation "Uplink Data Resource Allocation" from the base station. That is, the mobile terminal judges whether the mobile terminal has received uplink transmission allocation from the base station.

When, in ST2905, has received uplink data resource allocation, the mobile terminal advances to ST2906. This step corresponds to ST2804 in Fig. 28. The mobile terminal, in ST2906, transmits uplink data according to the allocation from the base station.

In contrast, when, in ST2905, has not received uplink data resource allocation, the mobile terminal advances to ST2907. The mobile terminal, in ST2907, judges whether the current time exceeds the time limit by which the mobile terminal has to receive "Uplink Data Resource Allocation" from the base station. More specifically, the mobile terminal judges whether the time which has elapsed since the mobile terminal transmitted the information indicating the "presence of an uplink scheduling request signal SR exceeds the time T as shown in Fig. 28.

[0087]

When, in ST2905, the elapsed time does not exceed the time T, the mobile terminal advances to ST2908. The mobile terminal, in ST2908, transmits the information indicating the "absence" of uplink scheduling by using the Ack/Nack exclusive channel (UL Scheduling request = "0" currently allocated to LB1 in Fig. 14).

After, in ST2908, transmitting the information indicating the "absence" of uplink scheduling by using the Ack/Nack exclusive channel, the mobile terminal returns to the judgment of ST2905. This step corresponds to ST2802 and ST2803 in Fig. 28.

[0088]

Next, a case in which an receiving error occurs when the base station receives an uplink scheduling request signal SR will be explained. As a sequence diagram, Fig. 28(ii) shows the case in which a receiving error occurs.

Because the explanation of the steps of ST2901 to ST2906 is the same as that in the above-mentioned case in which no receiving error occurs, the explanation will be omitted.

The mobile terminal, in ST2907, judges whether the current time exceeds the time limit by which the mobile terminal has to receive "Uplink Data Resource Allocation" from the base station, like in the above-mentioned case in which no receiving error occurs. More specifically, the mobile terminal judges whether the time which has elapsed since the mobile terminal transmitted the information indicating the "presence" of an uplink scheduling request signal SR exceeds the time T as shown in Fig. 28.

[0089]

In this case, as shown in Fig. 28(ii), an receiving error has occurred in the information indicating the presence or absence of an uplink scheduling request currently allocated, in ST2807, to the Ack/Nack exclusive channel. Therefore, at the timing (time '"t"' of (ii) of Fig. 28) at which the mobile terminal should have originally received "Uplink Data Resource

Allocation" from the base station, the mobile terminal does not accept any uplink transmission allocation from the base station. As a result, the mobile terminal, in ST2907, judges that the time which has elapsed since the mobile terminal, in ST2811 of Fig. 28, transmitted the information indicating the "presence" of an uplink scheduling request signal SR exceeds the time T.

In this case, the mobile terminal returns to ST2902, sets up information indicating the presence of an uplink scheduling request (UL Scheduling request= "1" currently allocated to LB1 in Fig. 14) in the Ack/Nack exclusive channel, and then retransmits the uplink scheduling request signal SR (ST2903). This step corresponds to ST2811 in Fig. 28.

[0090]

Next, a flow of processing performed by the base station in the first example of the setting will be explained with reference to Fig. 30.

The base station, in step ST3001, judges whether the information indicating the presence or absence of an uplink scheduling request currently allocated to the Ack/Nack exclusive channel in ST3001 shows the "presence." When the information indicates the "absence," the base station returns to the judgment of ST3001.

When the base station, in step ST3001, judges that the information indicates the "presence", the base station performs an uplink scheduling process for the mobile terminal which, in step ST3002, has transmitted the uplink scheduling request thereto by using the Ack/Nack exclusive channel. This step corresponds to ST2801 or ST2811 in Fig. 28.

In order to perform uplink transmission allocation for

the mobile terminal, the base station, in ST3003, transmits the result as "Uplink Data Resource Allocation." This step corresponds to ST2804 or ST2814 in Fig. 28.

[0091]

In the second example of the setting, when not receiving any uplink scheduling request signal SR, the base station always transmits 0, like in the case of the first example of the setting. In contrast, in the flow chart of Fig. 8, when the mobile terminal transmits an uplink scheduling request signal SR, the mobile terminal continues transmitting the information indicating "the presence of a request (= '1')" until "Uplink Data Resource Allocation" is transmitted thereto from the base station, and, after receiving "Uplink Data Resource Allocation", the mobile terminal transmits the information indicating "the absence of a request (= '0')".

[0092]

The second example of the setting will be explained in greater detail with reference to Figs. 31, 32, and 33.

Fig. 31 is a sequence diagram, and Fig. 32 is a flow diagram showing processing carried out by the mobile terminal. Fig. 33 is a flow diagram showing processing carried out by the base station.

The operation of the second example of the setting will be explained by mainly referring to Fig. 32.

First, a case in which no receiving error occurs when the base station receives an uplink scheduling request signal SR will be explained. As a sequence diagram, Fig. 31(i) shows the case in which no receiving error occurs.

[0093]

The mobile terminal, in ST3201, judges whether a request for transmission of uplink data has occurred. When a request for transmission of uplink data has occurred, the mobile terminal advances to ST3202. In contrast, when no request for transmission of uplink data has occurred, the mobile terminal returns to the judgment of ST3201.

The mobile terminal, in ST3202, sets up information indicating the presence of an uplink scheduling request (UL Scheduling request= "1" currently allocated to LB1 in Fig. 14) in the Ack/Nack exclusive channel.

The mobile terminal then, in ST3203, transmits an uplink scheduling request by using the Ack/Nack exclusive channel. This step corresponds to ST3101 in Fig. 31.

[0094]

The mobile terminal, in ST3204, judges whether the mobile terminal has received "uplink data resource allocation (Uplink Data Resource Allocation)" from the base station. That is, the mobile terminal judges whether the mobile terminal has received uplink transmission allocation from the base station.

When, in ST3204, has received uplink transmission allocation, the mobile terminal advances to ST3205. In contrast, when has not received uplink transmission allocation, the mobile terminal returns to ST3202. This step corresponds to ST3104 in Fig. 31.

The mobile terminal, in ST3205, sets up information indicating the absence of an uplink scheduling request (UL Scheduling request= "0" currently allocated to LB1 in Fig. 14) in the Ack/Nack exclusive channel. This step corresponds to ST3105 in Fig. 31.

The mobile terminal, in ST3206, transmits uplink data according to the allocation from the base station.

[0095]

Next, a case in which a receiving error occurs when the base station receives an uplink scheduling request signal SR will be explained. As a sequence diagram, Fig. 31(ii) shows the case in which a receiving error occurs.

Because the flow of the processing carried out by the mobile terminal in this case is the same as that in the above-mentioned case in which no receiving error occurs, the flow will be omitted.

The case (ii) shown in Fig. 31 will be explained.

A receiving error occurs in the information indicating the presence or absence of an uplink scheduling request currently allocated, in ST3107, to the Ack/Nack exclusive channel. Therefore, at the timing (time '"t"' in the case (ii) of Fig. 31) at which the mobile terminal should have originally received "Uplink Data Resource Allocation" from the base station, the mobile terminal does not accept any uplink transmission allocation from the base station.

[0096]

However, in the second example of the setting, following the step of ST3107, the mobile terminal, also in ST3108, transmits the information indicating the presence of an uplink scheduling request (UL Scheduling request= "1" currently allocated to LB1 in Fig. 14) by using the Ack/Nack exclusive channel. Therefore, when normally receiving the information indicating the presence or absence of an uplink scheduling request currently allocated to the Ack/Nack exclusive channel

transmitted in ST3108, the base station, in ST3111, transmits "Uplink Data Resource Allocation." That is, the mobile terminal receives the uplink transmission allocation from the base station.

[0097]

Next, a flow of processing carried out by the base station in the second example of the setting will be explained with reference to Fig. 33.

The base station, in step ST3301, judges whether the information indicating the presence or absence of an uplink scheduling request currently allocated to the Ack/Nack exclusive channel shows the "presence". When the information indicates the "absence," the base station returns to the judgment of ST3301.

When the base station, in step ST3301, judges that the information indicates the "presence," the base station, in ST3302, judges whether or not the base station is performing an uplink scheduling process for the mobile terminal.

When, in ST3302, judging that the base station is performing an uplink scheduling process for the mobile terminal (corresponding to ST3102, ST3103, ST3109, and ST3110 in Fig. 31), the base station advances to ST3303. The base station, in ST3303, continues performing the uplink scheduling process which the base station has been performing.

[0098]

In contrast, when, in ST3302, judging that the base station is not performing any uplink scheduling process for the mobile terminal (corresponding to ST3101 and ST3108 in Fig. 31), the base station advances to ST3304. The base station, in

ST3304, starts performing an uplink scheduling process for the mobile terminal.

When, in ST3303 or ST3304, completing the uplink scheduling process for the mobile terminal, the base station, in ST3305, transmits the result of the process as "Uplink Data Resource Allocation" in order to perform uplink transmission allocation for the mobile terminal. This step corresponds to ST3104 or ST3111 in Fig. 31.

[0099]

The advantages of the first example of the setting and the second example of the setting will be explained.

Compared with the second example of the setting, the merits of the first example of the setting can be provided as follows:

(1) Because, when receiving an uplink scheduling request by using the Ack/Nack exclusive channel, the base station does not have to judge whether or not the base station is performing an uplink scheduling process for the mobile terminal (ST3302 in Fig. 33), the processing carried out by the base station can be simplified.

[0100]

Compared with the first example of the setting, the merits of the second example of the setting can be provided as follows:

(1) When a receiving error occurs in the information indicating the presence or absence of an uplink scheduling request currently allocated to the Ack/Nack exclusive channel, the time which has elapsed until the mobile terminal actually receives "Uplink Data Resource Allocation" from the timing at which the mobile terminal was expected to receive "Uplink Data

Resource Allocation" from the base station becomes short. In the first example of the setting, the time is equal to "a", as shown in Fig. 28. In contrast, in the second example of the setting, the time is equal to "b," as shown in Fig. 31.

(2) Because the mobile terminal does not have to judge whether the current time exceeds the time limit by which the mobile terminal has to receive "Uplink Data Resource Allocation" from the base station (ST2907 in Fig. 29) in its internal processing, the processing carried out by the mobile terminal can be simplified.

[0101]

Each of the first and second examples of the setting of a scheduling request signal SR which are explained above can also be used in any one of Embodiment 1, Embodiment 6, Embodiment 7, Embodiment 8, Embodiment 9, and Embodiment 10.

Furthermore, in a case in which the mobile terminal does not have to transmit an Ack/Nack and/or a CQI, but has to transmit only a scheduling request signal, the mobile terminal does not transmit any information about the Ack/Nack and the CQI by using the Ack/Nack exclusive channel, but can transmit only the scheduling request by using the Ack/Nack exclusive channel.

[0102]

An Ack/Nack symbol and CQI symbols are mapped to long blocks (LB2 to LB6) other than the leading LB (LB1), to which an uplink scheduling request signal SR is mapped, during a transmission time interval (TTI). In this mapping, the Ack/Nack symbol and CQI symbols at higher-order digits with a higher priority among all the CQI symbols are given a higher priority so that they are repeatedly mapped. In Fig. 14, during

1 TTI (=2 subframes), the Ack/Nack symbol is repeatedly mapped three times, and CQI1 and CQI2 with a higher priority are repeatedly mapped twice.

[0103]

As previously explained, in a case in which the transmission time of an uplink scheduling request signal SR is sufficiently small as shown in the sequence of Fig. 8, the uplink scheduling request signal SR, and Ack/Nack information symbols (an Ack/Nack and/or a CQI), is mapped to the Ack/Nack exclusive channel. As a result, even when a plurality of "data-non-associated L1/L2 control signals" which have to be transmitted occur simultaneously in a mobile terminal, while the communication quality of these important control signals is attained, increase in the radio resources load on the communication system can be prevented, and transmission with a single carrier method which guarantees a low PAPR and high communication quality can be implemented.

[0104]

Furthermore, because the Ack/Nack exclusive channel is not a channel (contention based channel), such as an S-RACH, which allows communications competition among a plurality of mobile terminals, compared with the case of using an S-RACH, the use of this method can also provide an advantage of eliminating the necessity to transmit the identification number (UE-ID) of the mobile terminal through transmission of an uplink scheduling request signal SR.

Therefore, in a case in which the frequency of the transmission of an SR is high, it can be said that it is an effective means because the required number of bits for

transmitting an SR is small. In addition, a plurality of time-frequency regions (A and B in Fig. 24) having narrow bands which are separated as shown in Fig. 24 are allocated to the Ack/Nack exclusive channel. As a result, a scheduling request signal SR which is transmitted by using the Ack/Nack exclusive channel has high resistance to the frequency selective fading. In other words, a scheduling request signal SR can have a frequency diversity gain.

Furthermore, in a case in which a scheduling request signal SR is transmitted from the mobile terminal to the base station by not using an S-RACH, but using the Ack/Nack exclusive channel when the mobile terminal is not performing any transmission of uplink data, but is receiving downlink data, the radio resources (the frequency-time regions) which are beforehand allocated for the S-RACH can be released for a UL-SCH or the like, and the method is effective from the viewpoint of effective use of the radio resources.

[0105]

The Ack/Nack exclusive channel is a channel which the mobile terminal has been using in the state in which the mobile terminal is not performing any transmission of uplink data, but is receiving downlink data. Therefore, by mapping an Ack/Nack and a CQI with an uplink scheduling request signal SR, to the Ack/Nack exclusive channel, there is provided an advantage of being able to use the radio resources currently being used effectively, in addition to an advantage of being able to implement transmission by using a single carrier method which guarantees both a low PAPR and high communication quality.

Furthermore, as mentioned above, by using a scheduled

channel like the Ack/Nack exclusive channel, there can be provided a further advantage of eliminating the necessity to transmit the identification number (UE-ID) of the mobile terminal through transmission of an uplink scheduling request signal SR. Therefore, the processing load on the base station when receiving an uplink scheduling request signal can be reduced.

In addition, because the Ack/Nack exclusive channel is used with a frequency band narrower than usually being allocated thereto, the Ack/Nack exclusive channel has a small amount of information to be processed per a unit time. Therefore, because the processing time in each of the transmission and the reception also becomes short, the process delay (Latency) of the sequence (ST701 to ST703 of Fig. 7 and ST801 to ST804 of Fig. 8) including from the transmission of an uplink scheduling request signal SR up to a start of the transmission becomes short, and this can contribute to greater efficiency and a speedup of the processing of the whole communication system.

[0106]

On the other hand, there can be considered a mobile communication system in which even when a mobile terminal is not receiving any downlink data, an Ack/Nack exclusive channel is allocated to the mobile terminal. More specifically, there can be considered a case in which, in order to prepare for future downlink scheduling even when there exist no downlink data, or maintain synchronization between a base station and a mobile terminal, the mobile terminal notifies the result (CQI) of measurement of the quality of a downlink communication path. Also in such a case, there may be a case in which transmission

of a CQI using an Ack/Nack exclusive channel and that of an uplink scheduling request signal SR occur simultaneously. In such a mobile communication system, in the judgment of ST602, the mobile terminal had better to makes the judgment by judging whether the mobile terminal has received allocation of an Ack/Nack exclusive channel. In addition, even a mobile communication system in which when a mobile terminal is not receiving any downlink data no Ack/Nack exclusive channel is allocated to the mobile terminal can use this judgment.

In this Embodiment 3, an Ack/Nack exclusive channel to which a plurality of time-frequency regions having narrow bands which are separated as shown in Fig. 24 are allocated monopolistically is explained. However, this Embodiment 3 can also be adapted to an Ack/Nack exclusive channel not having a narrow band, as shown in Fig. 23.

[0107]

Embodiment 4.

In a case in which a mobile terminal is not transmitting any uplink data (Uplink data, UL data) such as user data, but is receiving downlink data (Downlink data, DL data) transmitted from a base station, the mobile terminal has to transmit an Ack/Nack signal, which is the result of the reception of the downlink data, and a CQI indicating the quality of a downlink communication path to the base station.

Furthermore, when a necessity for transmission of uplink data occurs in a mobile terminal, the mobile terminal has to transmit an uplink scheduling request signal SR to the base station.

Hereafter, a method of making a mobile terminal which has

to transmit an Ack/Nack and an uplink scheduling request signal SR simultaneously perform these transmissions simultaneously without increasing the PAPR will be explained.

[0108]

In accordance with above-mentioned Embodiment 3, by transmitting an Ack/Nack and a CQI with a scheduling request signal SR, by using an Ack/Nack exclusive channel, transmission through use of a single carrier method which guarantees both a low PAPR and high communication quality can be implemented. However, in a case of an example shown in Fig. 14, in the transmission, it is necessary to map a symbol indicating the presence or absence of a scheduling request signal SR to the Ack/Nack exclusive channel. Therefore, in the case of using above-mentioned Embodiment 3 to multiplex an Ack/Nack, a CQI and an uplink scheduling request signal SR (SR) to the Ack/Nack exclusive channel by using a TDM method, the following two problems newly arise.

[0109]

The first problem will be explained hereafter.

Even in a case in which an SR does not have to be transmitted, an LB to which an SR is mapped has to be allocated in advance. Therefore, a radio resource must always be allocated to the information which does not have to be transmitted. The problem is therefore that there cannot be provided an advantage of making effective use of the radio resources.

The second problem will be explained hereafter.

Compared with a case in which an SR is not multiplexed to an Ack/Nack exclusive channel by using a TDM method, there

is a disadvantage of reducing the number of repetitions that an Ack/Nack or a CQI is transmitted. In most cases, an encoding process with high error correction capability is not performed on an Ack/Nack and a CQI, unlike in the case of data. Therefore, in order to prevent a receiving error from occurring in a base station, repeating the same information to increase the receive power of the base station is important to improve the reception quality (repetition). The problem is therefore that from the viewpoint of maintaining the reception quality of the base station, reduction in the number of LBs which can be used for the repetition has to be avoided as much as possible.

[0110]

A method of solving the first and second problems arising newly will be explained hereafter.

Fig. 15 is a flow chart for explaining processing carried out by a mobile terminal which transmits an uplink scheduling request signal, and processing carried out by a base station which receives the uplink scheduling request signal. Fig. 15 shows processing in a case in which the mobile terminal is not performing transmission of uplink data, but is receiving downlink data.

The mobile terminal, in ST1500, judges whether a request for transmission of uplink data has occurred. When no request for transmission of uplink data has occurred (if No in ST1500), the mobile terminal advances to ST1501. The mobile terminal, in ST1501, maps either or both of an Ack/Nack and a CQI to an Ack/Nack exclusive channel.

As an example of the mapping, the example shown in Fig. 9 can be used. The mobile terminal, in ST1503, multiplies the

Ack/Nack exclusive channel by a code (code a) indicating that either or both of the Ack/Nack and CQI are mapped to the Ack/Nack exclusive channel.

[0111]

This multiplication by code is carried out by the modulating unit 10 or the encoder unit 9. After the multiplication by code is carried out, a process of ST1505 is carried out.

In contrast, when, in ST1500, a request for transmission of uplink data has occurred, a process of ST1502 is carried out. The mobile terminal, in ST1502, maps either or both of the Ack/Nack and the CQI to the Ack/Nack exclusive channel, and also maps an uplink scheduling request signal SR to the Ack/Nack exclusive channel.

As an example of the mapping, the example shown in Fig. 14 can be used. The mobile terminal, in ST1504, multiplies the Ack/Nack exclusive channel by a code (code b) indicating that either or both of the Ack/Nack and the CQI, and the uplink scheduling request signal SR are mapped to the Ack/Nack exclusive channel, the code being different from the code a. This multiplication by code is carried out by the modulating unit 10 or the encoder unit 9. After the multiplication by code is carried out, the process of ST1505 is carried out. As the codes a and b, codes which are perpendicular to each other can be used in order to reduce occurrence of an error in the judgment by the base station.

[0112]

In the mobile communication system, in a case in which code division multiplexing is used as multiplexing of signals

from a plurality of mobile terminals in the Ack/Nack exclusive channel, the Ack/Nack exclusive channel is, in ST1505, multiplied by a code (a code A) for identifying the plurality of mobile terminals. This multiplication by code is carried out by the modulating unit 10. After the multiplication by code is carried out, ST1506 is carried out.

Since the Ack/Nack exclusive channel is, in ST1505, multiplied by the code (the code A) for identifying the plurality of mobile terminals, the codes (the codes a and b) by which the Ack/Nack exclusive channel is multiplied in steps ST1503 and ST1504 can be used in common by the plurality of mobile terminals whose signals are multiplexed into the Ack/Nack exclusive channel. The order in which the Ack/Nack exclusive channel is multiplied by the codes a and A, and the order in which the Ack/Nack exclusive channel is multiplied by the codes b and A can be reverse. The mobile terminal, in ST1506, transmits the Ack/Nack exclusive channel to the base station.

[0113]

The base station, in ST1507, receives the signal transmitted thereto by using the Ack/Nack exclusive channel. The base station then performs a process of multiplying the signal by the codes which are used for the multiplexing of the signals from the plurality of mobile terminals in the Ack/Nack exclusive channel in order to demultiplex the signal transmitted thereto by using the Ack/Nack exclusive channel into the signals from the plurality of mobile terminals.

The base station, in ST1508, performs a correlation operation by using the code (code A) indicating the mobile terminal. When the result of the correlation operation is equal

to or larger than a predetermined threshold (if Yes in ST1508), the base station judges that the reception is the one of the Ack/Nack exclusive channel from the mobile terminal, and carries out a process of ST1509.

[0114]

When the result of the correlation operation which the base station performed in step ST1508 is smaller than the predetermined threshold (if No in ST1508), the base station judges that the reception is not the one of Ack/Nack exclusive channel from the mobile terminal, and ends the processing. The correlation operation using the code A is carried out by the demodulating unit 24. The base station, in ST1509, performs a correlation operation by using the code a in order to judge whether or not only the Ack/Nack and the CQI are mapped to the Ack/Nack exclusive channel from the mobile terminal. When the result of the correlation operation is equal to or larger than the predetermined threshold (if Yes in ST1509), the base station judges that only the Ack/Nack and the CQI are mapped to the Ack/Nack exclusive channel from the mobile terminal (judges that any scheduling request signal SR is not mapped to the Ack/Nack exclusive channel), and carries out a process of ST1510.

The correlation operation using the code a is carried out by the demodulating unit 24 or the decoder unit 25. The base station, in ST1510, carries out the process by judging that only the Ack/Nack and the CQI are mapped to the received Ack/Nack exclusive channel from the mobile terminal.

[0115]

In contrast, when the result of the correlation operation

which the base station, in ST1509, performed by using the code a is less than the predetermined threshold (if No in ST1509), the base station carries out ST1511. The base station, in ST1511, performs a correlation operation by using the code b in order to judge whether or not the scheduling request signal SR, in addition to the Ack/Nack and the CQI, is mapped to the Ack/Nack exclusive channel from the mobile terminal. When the result of the correlation operation is equal to or larger than a predetermined threshold (if Yes in ST1511), the base station judges that the scheduling request signal SR, in addition to the Ack/Nack and the CQI, is mapped to the Ack/Nack exclusive channel from the mobile terminal, the base station carries out a process of ST1512.

The correlation operation using the code b is carried out by the demodulating unit 24 or the decoder unit 25. The base station, in ST1512, carries out the processing by judging that the scheduling request signal SR, in addition to the Ack/Nack and the CQI, is mapped to the received Ack/Nack exclusive channel from the mobile terminal. In contrast, when the result of the correlation operation which the base station, in ST1511, performed by using the code b is less than the predetermined threshold (if No in ST1511), the base station judges that a receiving error has occurred and ends the processing.

[0116]

As mentioned above, in Fig. 15, ST1503 in which the multiplication by the code a is performed, ST1504 in which the multiplication by the code b is performed, and ST1505 in which the multiplication by the code A is performed are carried out by the encoder unit 9 and the modulating unit 10 in the mobile

terminal. A detailed block diagram showing the multiplication by the code a, the multiplication by the code b, and the multiplication by the code A is shown in Fig. 34.

A symbol pattern 3401 for the Ack/Nack exclusive channel in the transmission buffer 8 or the encoder unit 9 is multiplied by either the code a 3402 indicating that either or both of the Ack/Nack and the CQI are mapped to the Ack/Nack exclusive channel, or the code b 3403 indicating that either or both of the Ack/Nack and the CQI and the scheduling request signal SR are mapped to the Ack/Nack exclusive channel.

[0117]

The multiplication by the code a 3402 and the multiplication by the code b 3403 are switched by a switch 3404. The switching condition of the switch 3404 is as shown in Fig. 34.

When a request for transmission of uplink data has occurred, i.e., when there is an uplink scheduling request, the switch operates in such a way that the symbol pattern 3401 for the Ack/Nack exclusive channel is multiplied by the code b. In contrast, when no request for transmission of uplink data has occurred, i.e., when there is no uplink scheduling request, the switch operates in such a way that the symbol pattern 3401 for the Ack/Nack exclusive channel is multiplied by the code a.

After multiplying the symbol pattern by the code a or b, the mobile terminal multiplies the symbol pattern by the code A 3405 for identifying the mobile terminal. After that, a modulation process is performed on the symbol pattern by the modulating unit 10.

[0118]

As previously explained, because the mobile terminal multiplies the Ack/Nack exclusive channel by a code which differs according to whether or not a scheduling request signal SR, in addition to an Ack/Nack and a CQI, is mapped to the Ack/Nack exclusive channel, the mobile terminal does not have to reserve a symbol for the scheduling request signal SR in the Ack/Nack exclusive channel. For example, the scheduling request signal SR is mapped to the first long block LB1 shown in Fig. 14, though, when no scheduling request signal SR is transmitted, the Ack/Nack, the CQI, and so on can be mapped to the LB1. Furthermore, because the base station can identify easily whether a signal from a certain mobile terminal includes a scheduling request signal SR by using the code by which the signal is multiplied, the base station can perform an appropriate process on the signal according to whether or not the scheduling request signal SR is mapped.

[0119]

In accordance with the W-CDMA method which is a conventional technology, in order to enable a base station to demultiplex a received signal into signals associated with a plurality of channels transmitted simultaneously from a mobile terminal, a signal associated with each channel is multiplied by a different code (a channelization code) and the signals associated with the plurality of channels are simultaneously transmitted from the mobile terminal to the base station.

In contrast, in accordance with this Embodiment 4, in order to demultiplex the received signal into the several types of information: "Ack/Nack and CQI" or "Ack/Nack, CQI, and SR"), which are transmitted with the codes, the codes are used.

In this Embodiment 4, either "Ack/Nack and CQI" or "Ack/Nack, CQI, and SR" are transmitted from the mobile terminal to the base station, and both "Ack/Nack and CQI" and "Ack/Nack, CQI, and SR" which are demultiplexed with the codes are not transmitted simultaneously. In the above-mentioned point, this Embodiment 4 differs from the conventional technology (W-CDMA) which uses codes in order to demultiplex a received signal into a plurality of channels transmitted simultaneously.

[0120]

By using this Embodiment 4, the following advantages can be provided, like in the case of using above-mentioned Embodiment 3.

There can be provided an advantage of enabling a mobile terminal which has to transmit, an uplink scheduling request signal SR and an Ack/Nack in a case in which the mobile terminal is not performing any transmission of uplink data, but is receiving downlink data to simultaneously transmit them without increasing the PAPR of the mobile terminal.

[0121]

There can be provided another advantage of eliminating the necessity to add a UE-ID to an uplink scheduling request signal SR through transmission of the uplink scheduling request signal SR by using an Ack/Nack exclusive channel. Therefore, in a case in which the frequency of the transmission of an SR is high, it can be said that it is an effective means because the required number of bits for transmitting an SR is small. In addition, a plurality of time-frequency regions (A and B in Fig. 24) having narrow bands which are separated as shown in Fig. 24 are allocated to the Ack/Nack exclusive channel.

As a result, a scheduling request signal SR which is transmitted by using the Ack/Nack exclusive channel has high resistance to the frequency selective fading.

In other words, a scheduling request signal SR can have a frequency diversity gain. Furthermore, in a case in which a scheduling request signal SR is transmitted from a mobile terminal to a base station by not using an S-RACH, but using an Ack/Nack exclusive channel when the mobile terminal is not performing any transmission of uplink data, but is receiving downlink data, the radio resources (the frequency-time regions) which are beforehand allocated for the S-RACH can be released for a UL-SCH or the like, and the method is effective from the viewpoint of effective use of the radio resources.

[0122]

By using this Embodiment 4, the following advantages can be provided in addition to the advantages offered in the case of using above-mentioned Embodiment 3.

In a case in which no SR has occurred in a mobile terminal, an LB which is beforehand allocated for transmitting an SR in an Ack/Nack exclusive channel can be eliminated, and therefore the radio resources can be used more effectively. Furthermore, because the allocation for mapping an SR can be eliminated, in the case in which no SR has occurred in the mobile terminal, it becomes unnecessary to reduce the number of repetitions of an Ack/Nack or a CQI in the conventional Ack/Nack exclusive channel. Therefore, there can be provided an advantage of improving the quality of reception of the Ack/Nack or the CQI by a base station.

There can be considered a case in which in the mobile

communication system, even when a mobile terminal is not receiving any downlink data, an Ack/Nack exclusive channel is allocated to the mobile terminal. More specifically, there can be considered a case in which, in order to prepare for future downlink scheduling even when there exist no downlink data, or maintain synchronization between a base station and a mobile terminal, the mobile terminal notifies the result (CQI) of measurement of the quality of a downlink communication path. Also in such a case, there may be a case in which transmission of a CQI using an Ack/Nack exclusive channel and that of an uplink scheduling request signal SR occur simultaneously. This Embodiment 4 can also be used for such a mobile communication system.

[0123]

Hereafter, variants will be explained.

As a first variant, there can be considered a case in which in order to judge whether only an Ack/Nack and a CQI are mapped to an Ack/Nack exclusive channel, only one of the code a or the code b indicating that an uplink scheduling request signal SR is furthermore mapped to the Ack/Nack exclusive channel is used.

As a concrete example, the mobile terminal multiplies the Ack/Nack exclusive channel by the code a when only an Ack/Nack and a CQI are mapped to the Ack/Nack exclusive channel, whereas when an uplink scheduling request signal SR, in addition to an Ack/Nack and a CQI, is mapped to the Ack/Nack exclusive channel, the mobile terminal carries out the process of ST1505 without multiplying the Ack/Nack exclusive channel by the code b (ST1504 is omitted).

[0124]

The base station, in ST1509, performs a correlation operation by using the code a. When the result of the correlation operation is equal to or larger than a predetermined threshold, the base station judges that only an Ack/Nack and a CQI are mapped to the Ack/Nack exclusive channel and advances to ST1510.

In contrast, when the result of the correlation operation which the base station, in ST1509, performed is smaller than the predetermined threshold, the base station judges that a scheduling request signal SR, in addition to an Ack/Nack and a CQI, is mapped to the Ack/Nack exclusive channel and then carries out ST1512.

By using this first variant, the number of the codes can be reduced, and the process of multiplying the Ack/Nack exclusive channel by the codes in the mobile terminal, and the process of performing correlation operations using the codes in the base station can be reduced. Furthermore, because the number of the codes is reduced, there is provided an advantage of increasing the number of mobile terminals which can be allocated to the Ack/Nack exclusive channel.

[0125]

As a second variant, there can be considered a case in which for each mobile terminal whose signals are multiplexed into the Ack/Nack exclusive channel, two codes (a code A and a code B) indicating that only an Ack/Nack and a CQI is mapped to the Ack/Nack exclusive channel or an uplink scheduling request signal SR, in addition to the Ack/Nack and the CQI, is mapped to the Ack/Nack exclusive channel are allocated.

As a concrete example, the mobile terminal multiplies the

Ack/Nack exclusive channel by the code A when only an Ack/Nack and a CQI are mapped to the Ack/Nack exclusive channel (ST1503), whereas when an uplink scheduling request signal SR, in addition to the Ack/Nack and the CQI, are mapped to the Ack/Nack exclusive channel, the mobile terminal multiplies the Ack/Nack exclusive channel by the code B (ST1504) and advances to ST1506. That is, because the codes allocated for each mobile terminal are used, the mobile terminal, in ST1505, does not have to further multiply the Ack/Nack exclusive channel by a code indicating the mobile terminal.

[0126]

The base station, in ST1508, performs a correlation operation by using the code (the code A) indicating the mobile terminal. When the result of the correlation operation is equal to or larger than a predetermined threshold, the base station judges that only an Ack/Nack and a CQI are mapped to the Ack/Nack exclusive channel from the mobile terminal, and then advances to ST1510.

In contrast, when the result of the correlation operation is smaller than the predetermined threshold, the base station further, in ST1508, performs a correlation operation by using the code (the code B) indicating the mobile terminal. When the result of the correlation operation is equal to or larger than a predetermined threshold, the base station judges that an uplink scheduling request signal SR, in addition to the Ack/Nack and the CQI, are mapped to the Ack/Nack exclusive channel, and then advances to ST1512. That is, the steps ST1509 and ST1511 among the steps of Fig. 15 can be omitted.

[0127]

Furthermore, in this Embodiment 4, the entire Ack/Nack exclusive channel is multiplied by either of the code a indicating that only an Ack/Nack and a CQI are mapped to the Ack/Nack exclusive channel and the code b indicating that an uplink scheduling request signal SR, in addition to the Ack/Nack and the CQI, is mapped to the Ack/Nack exclusive channel.

In a third variant, a long block on the Ack/Nack exclusive channel to which an Ack/Nack and a CQI are mapped is multiplied by the code a indicating that effect and a long block on the Ack/Nack exclusive channel to which an uplink scheduling request signal SR is mapped is multiplied by the code b indicating that effect.

[0128]

Concretely, the steps ST1503 and ST1504 among the steps shown in Fig. 15 are omitted, and, instead, a step of multiplying a long block on the Ack/Nack exclusive channel to which an Ack/Nack and a CQI are mapped by the code a indicating that effect, and multiplying a long block on the Ack/Nack exclusive channel to which an uplink scheduling request signal SR is mapped by the code b indicating that effect is added.

Furthermore, the steps of ST1509, ST1510, ST1511, and ST1512 among the steps carried out by the base station are omitted, and, instead, a process of performing a correlation operation by using the code a in order to judge whether or not a long block is the one to which an Ack/Nack and a CQI are mapped is added.

[0129]

When the result of the correlation operation is equal to or larger than a predetermined threshold, the base station

judges that the long block is the one to which an Ack/Nack and a CQI are mapped, and then performs a subsequent process. In contrast, when the result of the correlation operation is smaller than the threshold, the base station performs a correlation operation by using the code b in order to judge whether or not the long block is the one to which an uplink scheduling request signal SR is mapped.

When the result of the correlation operation is equal to or larger than a predetermined threshold, the base station judges that the long block is the one to which an uplink scheduling request signal SR is mapped, and then performs a subsequent process. In this case, in addition to the advantages provided by Embodiment 4, there can be provided an advantage of being able to freely choose the location of a long block on the Ack/Nack exclusive channel to which an uplink scheduling request signal SR is mapped.

[0130]

Hereafter, a fourth variant will be explained.

One type of mapping to the Ack/Nack exclusive channel is provided regardless of whether or not an SR is included in the mapping. The mapping can use the example of Fig. 9. Therefore, information which is, in ST1501 and ST1502, actually mapped to the Ack/Nack exclusive channel is only an Ack/Nack or/and a CQI.

Because subsequent processing carried out by the mobile terminal is the same as that of Fig. 15, the explanation of the subsequent processing will be omitted hereafter.

[0131]

The base station which has received the Ack/Nack exclusive channel, in ST1510, judges that the base station has

not received an SR from the mobile terminal, and then performs a process on the Ack/Nack exclusive channel after judging that only an Ack/Nack or/and a CQI are mapped to the Ack/Nack exclusive channel.

The base station, in ST1512, judges that the base station has received an SR from the mobile terminal, and then performs the processing on the Ack/Nack exclusive channel by judging that only an Ack/Nack or/and a CQI are mapped to the Ack/Nack exclusive channel.

[0132]

Fig. 27 is an explanatory drawing for explaining an example of the mapping of information to the Ack/Nack exclusive channel according to the fourth variant of Embodiment 4. In accordance with the fourth variant of this Embodiment 4, it becomes unnecessary to map an SR to the Ack/Nack exclusive channel, and it becomes possible to make further effective use of the radio resources. Furthermore, even in a case in which an uplink scheduling request signal SR is transmitted from the mobile terminal, the number of repetitions of an Ack/Nack or/and a CQI can be maintained. Therefore, there can be provided an advantage of being able to maintain the quality of reception of an Ack/Nack or/and a CQI by the base station even in a case in which an uplink scheduling request signal SR is transmitted to the base station, like in a case in which no SR is transmitted to the base station. That is, the use of this method can offer an advantage of, when desiring to transmit an uplink scheduling request signal SR, being able to not only use physical channels and radio resources which have already been used, but also hardly affect the amount of information and the quality of other

data which are being transmitted by using the radio resources. Therefore, when, for example, allocating an uplink Ack/Nack exclusive channel to a radio resource, the base station does not have to take into consideration the influence of transmission of an uplink scheduling request signal SR upon selection of a condition of the radio resource (a frequency bandwidth or the like).

[0133]

In this Embodiment 4 and its variants, the case in which the multiplexing of a plurality of mobile terminals into an Ack/Nack exclusive channel is carried out by using a CDM method is explained. As an alternative, Embodiment 4 and the variants can also be applied to a case in which an FDM method or a TDM method is used as the multiplexing method. In this Embodiment 4 and its variants, an Ack/Nack exclusive channel to which a plurality of time-frequency regions having narrow bands separated as shown in Fig. 24 are allocated monopolistically is explained. However, this Embodiment 4 and its variants can also be applied to an Ack/Nack exclusive channel not having a narrow band, as shown in Fig. 23.

[0134]

Embodiment 5.

Fig. 16 is a flow chart for explaining processing carried out by a mobile terminal which transmits an uplink scheduling request signal, and processing carried out by a base station which receives the uplink scheduling request signal.

The mobile terminal, in ST1601, judges whether or not the mobile terminal is transmitting uplink data. When the mobile terminal is transmitting uplink data, the mobile terminal

advances to ST1602. The mobile terminal which is transmitting uplink data, i.e., which is scheduled to have an uplink resource from the base station does not have to transmit an uplink scheduling request signal SR, and therefore, when the mobile terminal is, in ST1601, transmitting uplink data, the mobile terminal can carry out a process of advancing to ST1602 without going via judgment of ST1604. In other words, it can be considered that in one mobile terminal, uplink data and an uplink scheduling request signal SR do not coexist in a UL-SCH, and the relation of SC-FDMA is not satisfied and hence no increase is produced in the PAPR in the mobile terminal.

[0135]

The mobile terminal, in ST1602, multiplies the UL-SCH by a code (a code c) indicating that a symbol mapped to the UL-SCH is uplink data. This multiplication by code is carried out by the modulating unit 10 or the encoder unit 9. After performing the multiplication by the code c, the mobile terminal advances to ST1603.

The mobile terminal, in ST1603, maps the uplink data to a resource included in the UL-SCH on which scheduling has been performed by the base station, and advances to ST1607. In contrast, when, in ST1601, the mobile terminal is not transmitting any uplink data, the mobile terminal advances to ST1604.

The mobile terminal, in ST1604, judges whether a request for transmission of uplink data has occurred. When no request for transmission of uplink data has occurred, the mobile terminal returns to ST1601. In contrast, when a request for transmission of uplink data has occurred, the mobile terminal

advances to ST1605.

[0136]

The mobile terminal, in ST1605, multiplies the UL-SCH by a code (a code d) indicating that the symbol mapped to the UL-SCH is an uplink scheduling request signal SR. This multiplication by code is carried out by the modulating unit 10 or the encoder unit 9. After performing the multiplication by the code d, the mobile terminal advances to ST1613. The mobile terminal, in ST1613, multiplies the UL-SCH by a code (a code A) for identifying the mobile terminal. This multiplication by code is carried out by the modulating unit 10. After performing the multiplication by the code, the mobile terminal carries out ST1606. The mobile terminal, in ST1606, maps an uplink scheduling request signal SR (a resource request, a preamble, a message, and so on) to a resource included in the UL-SCH, and advances to ST1607. The order in which the processes of ST1613 and ST1606 are carried out can be reverse. As the codes c and d, codes which are perpendicular to each other can be used in order to reduce occurrence of errors in the judgment by the base station.

[0137]

The mobile terminal, in ST1607, transmits the UL-SCH to the base station. The base station, in ST1608, receives the UL-SCH transmitted thereto from the mobile terminal. The base station, in ST1609, performs a correlation operation by using the code c in order to judge whether or not uplink data are mapped to the UL-SCH.

When the result of the correlation operation is equal to or larger than a predetermined threshold, the base station

judges that uplink data are mapped to the UL-SCH, and then advances to ST1610. The correlation operation using the code c is implemented by the demodulating unit or the decoder unit. The base station, in ST1610, carries out the processing by judging that uplink data are mapped to the UL-SCH.

[0138]

Because the mobile terminal transmits the uplink data by using a predetermined radio resource for the UL-SCH which the base station has allocated and notified, the base station can distinguish the reception of the UL-SCH channel from the mobile terminal from those from other mobile terminals. In contrast, when, in ST1609, the result of the correlation operation which the base station has carried out by using the code c is smaller than the predetermined threshold, the base station advances to ST1614.

The base station, in ST1614, performs a correlation operation by using the code (the code A) which is used for multiplexing of signals from mobile terminals into the UL-SCH. When the result of the correlation operation is equal to or larger than a predetermined threshold (if Yes in ST1614), the base station judges that the base station has received the UL-SCH from the mobile terminal, and then carries out a process of ST1611. In contrast, when the result of the correlation operation which the base station, in ST1614, carried out is smaller than the predetermined threshold (if No in ST1614), the base station judges that the base station has not received the UL-SCH from the mobile terminal, and ends the processing. The correlation operation using the code A is carried out by the demodulating unit 24.

[0139]

The base station, in ST1611, performs a correlation operation by using the code d in order to judge whether or not an uplink scheduling request signal SR is mapped to the UL-SCH. When the result of the correlation operation is equal to or larger than a predetermined threshold, the base station judges that an uplink scheduling request signal SR is mapped to the UL-SCH, and then advances to ST1612. The correlation operation using the code d is implemented by the demodulating unit 24 or the decoder unit 25. The base station, in ST1612, carries out the processing by judging that an uplink scheduling request signal SR is mapped to the UL-SCH.

[0140]

As previously explained, because the base station can judge whether or not uplink data are mapped to the UL-SCH and whether or not an uplink scheduling request signal SR is mapped to the UL-SCH by using the codes c and d, there is provided an advantage of eliminating the necessity to reserve radio resources for the RACH (Non-S-RACH and S-RACH) transmission (Fig. 17). Therefore, there is provided an advantage of being able to use the uplink radio resources efficiently. Furthermore, when a request for transmission of an uplink scheduling request signal SR occurs in a mobile terminal, the use of a conventional method does not make it possible for the mobile terminal to transmit the SR to the base station until an uplink resource timing reserved for the RACH (Non-S-RACH and S-RACH). In contrast, according to the present invention, the mobile terminal can transmit an uplink scheduling request signal SR to the base station at all times.

Therefore, there is provided an advantage of being able to reduce the control delay in the mobile communication system. Furthermore, because in a case in which a mobile terminal maps an uplink scheduling request signal to a UL-SCH, multiplexing is carried out by using a code (a code A) for identification of the mobile terminal, also when scheduling request signals SRs are simultaneously transmitted to the base station from a plurality of mobile terminals, the base station can receive the scheduling request signals from those terminals while discriminating them from one another. Therefore, collision among the scheduling request signals from the plurality of mobile terminals which can happen in the case of using an S-RACH can be prevented.

[0141]

In addition, this Embodiment 5 can also be applied to a multiplexing method of multiplexing transmission, via an uplink, of an Ack/Nack and a CQI for downlink data and uplink data (a UL-SCH) in a case in which a mobile terminal is receiving downlink data without performing any transmission of uplink data. Because the operation of the mobile communication system is the same as the processing shown in the flow chart of Fig. 16, the explanation of the operation will be omitted.

Like in the case of Embodiment 5, it can be considered that in one mobile terminal, transmission of an Ack/Nack and transmission of a CQI do not coexist in a case in which no uplink data exist in the UL-SCH and the mobile terminal is not performing any transmission of uplink data via the UL-SCH, but is receiving downlink data, and the relation of SC-FDMA is not satisfied and hence no increase is produced in the PAPR in the

mobile terminal.

Therefore there is provided an advantage of, in a case in which a mobile terminal is receiving downlink data without performing any transmission of uplink data, eliminating the necessity to dispose an Ack/Nack exclusive channel (Figs. 23 and 24) for transmission of an Ack/Nack for downlink data via an uplink. Furthermore, the radio resources which are allocated for the Ack/Nack exclusive channel can be released for the UL-SCH or the like. Therefore, there can be provided another advantage of being able to use the uplink radio resources efficiently.

[0142]

Embodiment 6.

In a case in which a mobile terminal is not transmitting any uplink data (Uplink data, UL data) such as user data, but is receiving downlink data (Downlink data, DL data) transmitted from a base station, the mobile terminal has to transmit an Ack/Nack, which is the result of the reception of the downlink data, and a CQI signal to the base station.

Furthermore, when a necessity for transmission of uplink data occurs in a mobile terminal, the mobile terminal has to transmit an uplink scheduling request signal SR to a base station. Hereafter, a method of making a mobile terminal which has to transmit an Ack/Nack and an uplink scheduling request signal SR simultaneously perform these transmissions simultaneously without increasing the PAPR in the mobile terminal will be explained.

[0143]

The nonpatent reference 1 discloses that in a case in which

a mobile terminal is receiving downlink data without performing transmission of uplink data, an Ack/Nack or/and a CQI are transmitted by suing an Ack/Nack exclusive channel having a broad band as shown in Fig. 23.

The nonpatent reference 4 discloses that in the case in which a mobile terminal is receiving downlink data without performing transmission of uplink data, an SR is transmitted by using an S-RACH.

However, the above-mentioned two nonpatent references 1 and 4 suggest nothing about the problems of the present invention. The problems of the present invention will be explained hereafter, though they are already mentioned.

[0144]

There may be a case in which a mobile terminal has to simultaneously carry out a process of transmitting an uplink Ack/Nack and a CQI by using an Ack/Nack exclusive channel and a process of transmitting an SR by using an S-RACH. In this case, because those signals have no correlation among them, when transmitted simultaneously, they are not transmitted with single carrier transmission, but are transmitted with multi carrier transmission. In the case in which such signals having no correlation among them are transmitted simultaneously, the PAPR becomes high because the time waveforms of the transmission signals have a high peak. A problem is that as the PAPR becomes high, the power consumption of the mobile terminal increases and therefore the cell coverage becomes narrow. A further problem is that as the PAPR becomes high, those signals become an interference wave to other mobile terminals and the communication system.

[0145]

In a case in which a mobile terminal has to transmit an uplink Ack/Nack, a CQI, and an SR simultaneously, the mobile terminal should use single carrier transmission in order to reduce the increase in the PAPR in the mobile terminal.

There can be considered a case in which, when a mobile terminal uses an Ack/Nack or/and a CQI which are transmitted by using an Ack/Nack exclusive channel having a broad band, which is disclosed by the conventional technology, and an SR which is transmitted by using an S-RACH, just as they are, a necessity for the mobile terminal to transmit those pieces of information simultaneously occurs.

Therefore, this Embodiment 6 presents multiplexing of an Ack/Nack or/and a CQI, and an SR into either one of an Ack/Nack exclusive channel to which one certain time-frequency region is allocated monopolistically, and an S-RACH.

[0146]

The multiplexing method will be explained hereafter. A method of transmitting an uplink scheduling request signal SR, an Ack/Nack, and a CQI together by using either an Ack/Nack exclusive channel to which one certain time-frequency region as shown in Fig. 23 is allocated monopolistically, or an S-RACH as shown in Fig. 25 will be explained.

Because a region in units of a subframe with respect to time and in units of one or more resource units with respect to frequency is allocated to each of the Ack/Nack exclusive channel and the S-RACH, the present invention can be applied to each of the channels.

[0147]

In this Embodiment 6, a case in which when a necessity to simultaneously transmit an Ack/Nack or/and a CQI, and an uplink scheduling request signal SR occurs in a mobile terminal, the mobile terminal transmits the Ack/Nack and/or the CQI, with the uplink scheduling request signal SR together by using an S-RACH will be shown. In other words, it means that even a mobile terminal which receives downlink data and therefore has to transmit an Ack/Nack or/and a CQI does not use an Ack/Nack exclusive channel during a time interval during which the mobile terminal is performing transmission of an uplink scheduling request signal SR. Furthermore, during the time interval during which the mobile terminal is transmitting an uplink scheduling request signal SR, the mobile terminal can perform transmission of a CQI or transmission of an Ack/Nack and a CQI by using an S-RACH, and is therefore allowed not to use an Ack/Nack exclusive channel at that time.

[0148]

Fig. 18 is a flow chart for explaining processing carried out by a mobile terminal, the processing including up to a process of transmitting an uplink scheduling request signal. Hereafter, the operation of the mobile terminal will be explained with reference to Fig. 18. In Fig. 18, because each of the same steps as those shown in Fig. 6 denote the same step or a like step, the explanation of the steps will be omitted hereafter.

Steps ST601 to ST603 are the same as those shown in Fig. 6. When, in ST602, is receiving downlink data, the mobile terminal carries out ST1801. In ST1801, the mobile terminal, maps an Ack/Nack, and/or a CQI with an uplink scheduling request

signal SR onto an S-RACH, and transmits them to the base station. Because the processing of the mobile communication system is the same as that shown in Fig. 52, the explanation of the processing will be omitted hereafter.

[0149]

Next, methods of mapping those pieces of information onto the S-RACH will be explained hereafter.

According to a first mapping method, a preamble and a message, an Ack/Nack, and a CQI are mapped onto the S-RACH. Fig. 19 is an explanatory drawing showing radio resources in which a preamble and a message, an Ack/Nack, and a CQI are mapped onto the S-RACH.

According to a second mapping method, a preamble, an Ack/Nack, and a CQI are mapped onto the S-RACH. Message information required for an uplink scheduling request signal SR is transmitted at the timing of the next S-RACH transmission or by using the uplink resources which are allocated to the mobile terminal by the base station.

[0150]

Fig. 20 is an explanatory drawing showing radio resources in which a preamble and a message, an Ack/Nack, and a CQI are mapped onto the S-RACH.

According to a third mapping method, a preamble and a message are mapped onto the S-RACH as usual. An Ack/Nack and a CQI are newly added into a message on the S-RACH which is transmitted in a state in which uplink time synchronization is established. Fig. 21 is an explanatory drawing showing radio resources in which a preamble and a message, an Ack/Nack, and a CQI are mapped onto the S-RACH.

[0151]

As previously explained, by mapping both an uplink scheduling request signal SR and Ack/Nack information symbols (an Ack/Nack and/or a CQI) not to an Ack/Nack exclusive channel, but to an S-RACH with the uplink scheduling request signal SR and the Ack/Nack information symbols being separated with respect to time, they are not transmitted simultaneously because they are transmitted with them being separated with respect to time. As a result, even when a plurality of "data-non-associated L1/L2 control signals" which have to be transmitted occur simultaneously in one mobile terminal, while the communication quality of these important control signals is attained, increase in the radio resources load on the communication system can be prevented, and transmission with a single carrier method which guarantees a low PAPR and high communication quality can be implemented.

[0152]

Furthermore, compared with the case in which an Ack/Nack and a CQI are transmitted with a plurality of time-frequency regions having narrow bands which are separate from one another, in the case of using the method according to this embodiment of transmitting an Ack/Nack and a CQI by using either an Ack/Nack exclusive channel to which one certain time-frequency region as shown in Fig. 23 is allocated monopolistically, or an S-RACH as shown in Fig. 25, the bandwidth becomes large. Therefore, the amount of information which can be transmitted with the radio resources allocated monopolistically increases.

As a result, there can be provided an advantage of being able to change the repetition pattern of an Ack/Nack and a CQI

(e.g., the number of repetitions) according to the environment of the communication path. By changing the repetition pattern under an instruction from the base station according to the environment of the communication path, the quality of reception of an Ack/Nack and a CQI can be maintained constant regardless of the environment of the communication path.

[0153]

Embodiment 7.

In a case in which a mobile terminal is synchronized with a base station, and is carrying out neither transmission of uplink data (Uplink data, UL data) nor reception of downlink data (Downlink data, DL data), there exists no Ack/Nack exclusive channel because the mobile terminal does not have to transmit an Ack/Nack to downlink data via an uplink. A method of, when an uplink transmission request occurs in such a case, transmitting an uplink scheduling request signal SR by using a signal for uplink communication quality measurement, which is called "sounding reference signal" (sounding reference signal, Sounding Reference Signal (RS)) without using radio resources for an S-RACH will be disclosed.

The use of this method makes it possible to not only release the radio resources reserved for an S-RACH, but also make effective use of the resources because a radio resource region which is shared with other mobile terminals is used for transmission of a Sounding RS. Furthermore, one sounding reference signal (Sounding RS) can be made to have the two following functions: measurement of the communication quality of a channel via which transmission is started; and the functions of an uplink schedule request signal SR.

[0154]

A Sounding RS is transmitted from a mobile terminal UE to a base station eNB in order to enable the base station to measure the communication quality of the uplink. In the 3GPP, the specifications of two types of reference signals: a reference signal for demodulation (a Demoduration RS); and a reference signal for uplink channel quality measurement (a Sounding RS) are currently under debate as uplink reference signals (Reference signals).

A plurality of suggestions are currently written together in the nonpatent reference 3, and the specifications have not been determined yet.

In this Embodiment 7, a case in which a sounding reference signal (a Sounding RS) is transmitted only during transmission of uplink data will be considered.

[0155]

A part of allocation of radio resources for a Sounding RS during transmission of uplink data in this Embodiment 7 is shown in Figs. 35(a) and 35(b).

First, Fig. 35(a) shows an example in which a sounding RS is allocated to two short blocks (SB) within 2 TTIs with the total bandwidth of one time-frequency region. A radio resource allocation method in a case in which two mobile terminals (UE1 and UE2) use a part of one time-frequency region is shown in Fig. 35(a).

In the figure, reference numeral 501 denotes a data symbol of the mobile terminal UE1, reference numeral 502 denotes a Sounding RS which the mobile terminals UE1 and UE2, and which all mobile terminals using this time-frequency region use in

common, reference numeral 503 denotes a reference signal for demodulation (Demoduration) of the mobile terminal UE1, reference numeral 504 denotes a data symbol of the mobile terminal UE2, and reference numeral 505 denotes a reference signal for demodulation (Demoduration) of the mobile terminal UE2. Among these, two SBs with the total bandwidth of one time-frequency region is allocated within two 2 TTIs as the region of the Sounding RS 502.

[0156]

Similarly, an example in which a Sounding RS is allocated to two long blocks (LB) within 2 TTIs with the total bandwidth of one time-frequency region is shown in Fig. 35(b). A radio resource allocation method in a case in which three mobile terminals (UE1, UE2, and UE3) use a part of one time-frequency region is shown in Fig. 35(b). In the figure, reference numeral 506 denotes a data symbol of the mobile terminal UE1, reference numeral 507 denotes a reference signal for demodulation of the mobile terminal UE1, reference numeral 508 denotes a data symbol of the UE2, reference numeral 509 denotes a reference signal for demodulation of the mobile terminal UE2, reference numeral 511 denotes a data symbol of the mobile terminal UE3, reference numeral 512 denotes a reference signal for demodulation of the mobile terminal UE3, and reference numeral 510 denotes a Sounding RS which the mobile terminals UE1, UE2, and UE3, and all other mobile terminals using this time-frequency region use in common.

As mentioned above, two LBs with the total bandwidth of one time-frequency region is made available for the radio resources for a Sounding RS.

[0157]

In either of the cases of Fig. 35(a) and 35(b), a Sounding RS is code-multiplexed for each UE. Because radio resources having a wide band can be shared and used for a Sounding RS by a plurality of terminals, the base station can measure the status of the frequency selective fading and can therefore carry out appropriate uplink scheduling. Furthermore, because a signal of each of the plurality of mobile terminals is code-multiplexed, the base station can carry out high-accuracy quality measurement for each of the plurality of mobile terminals.

[0158]

As a case in which a mobile station is synchronized with a base station and a transmission request occurs in a state in which no transmission of uplink data is carried out, there can be considered a case in which the mobile terminal receives downlink data, and, in order for the mobile terminal to transmit an Ack/Nack and a CQI to the downlink received data via the uplink, an ACK/Nack exclusive channel is allocated to the mobile terminal, and a case in which the mobile terminal receives downlink data, but no ACK/Nack exclusive channel is allocated to the mobile terminal, as described in Embodiment 3. In a flow chart of Fig. 37, a method of transmitting an uplink scheduling request signal SR in each of the cases is shown.

[0159]

First, when recognizing occurrence of an uplink data transmission request (ST5201), the mobile terminal checks to see whether or not an Ack/Nack exclusive channel via which the mobile terminal transmits an Ack/Nack to downlink received data

is allocated in the uplink (ST5202). When an Ack/Nack exclusive channel is allocated in the uplink, the mobile terminal transmits an uplink scheduling request signal SR, as well as an Ack/Nack and a CQI, by using the Ack/Nack exclusive channel (ST5204). Processing in this case is the same as that explained in Embodiment 3. In contrast, when, in ST5202, no Ack/Nack exclusive channel is allocated in the uplink, the mobile terminal transmits a Sounding RS for uplink quality measurement (a Sounding Reference signal) which serves as an uplink scheduling request signal SR to the base station (ST5203).

[0160]

There can be considered a case in which in the mobile communication system, even when a mobile terminal is not receiving any downlink data, an Ack/Nack exclusive channel is allocated to the mobile terminal. More specifically, there can be considered a case in which, in order to prepare for future downlink scheduling even when there exist no downlink data, or maintain synchronization between a base station and a mobile terminal, the mobile terminal notifies the result (CQI) of measurement of the quality of the downlink communication path. In such a case, it can be considered that the judgment of ST5202 is suitable as mentioned above.

In contrast, there can be considered a case in which in the mobile communication system, only when there exist downlink data destined for a mobile terminal, an Ack/Nack exclusive channel is allocated to the mobile terminal. In such a case, in the judgment of ST5202, the mobile terminal can judge whether or not the mobile terminal is receiving downlink data.

[0161]

A concrete example of a sequence when an uplink transmission request occurs under a condition resulting in a "No" in a branch of ST5202 of Fig. 37, i.e., in a state in which there is no allocation of an ACK/Nack exclusive channel will be explained in Fig. 36.

This embodiment is based on that synchronization is established between a mobile terminal and a base station. Therefore, synchronization has to be established between the mobile terminal and the base station by using a certain method before this embodiment is applied. As an example of the method, Fig. 36 shows a case in which a non-synchronous random access signal (Non-Synchronous Rrandom Access) is transmitted from the mobile terminal to the base station.

[0162]

The base station eNodeB, in ST5101, receives a synchronous request from the mobile terminal UE, specifies the mobile terminal which has made the request, and also establishes synchronization with this mobile terminal and then recognizes that the mobile terminal has changed to an Active state. Furthermore, the base station, in next ST5102, notifies the mobile terminal that synchronization with this mobile terminal is established, and also notifies the mobile station of L1/L2 control information which is required for settings of uplink and downlink communication paths and whose setting value is nearly fixed (semi-static) for the reason of being set to other UEs in common with the mobile terminal.

When transmitting an uplink scheduling request signal SR by using a sounding RS for measurement of the communication quality of the uplink, the base station notifies

Sounding-RS-related control information as well as the notification of the synchronization establishment because the base station has to transmit a "Sounding RS which serves as an uplink scheduling request" if there is no transmission of uplink data. Because the Sounding RS for measurement of the communication quality of the uplink also uses the radio resources which the mobile terminal shares with the other UEs, the base station eNodeB, in ST5102, notifies the mobile terminal UE of mobile terminal identifying information (a sequence number or a UE-ID) which is allocated to this mobile terminal and is used for the code division multiplexing, the mobile terminal identifying information being included in the L1/L2 control information for controlling the Sounding RS, the frequency bandwidth (BW) of a radio resource which is scheduled to be allocated to the transmission of the Sounding RS, and so on, thereby enabling the transmission of the Sounding RS also when any uplink data are not transmitted.

In a case in which the Sounding RS is not used for notification of an uplink scheduling request signal SR, but is transmitted only during transmission of uplink data, what is necessary is just not to carry out the transmission along with the notification of the synchronization establishment, but to notify the Sounding RS-related control information (the sequence number, the BW, etc.) at, for example, the time (ST5104) of resource allocation for uplink data, unlike in the above case. Furthermore, the above-mentioned transmission along with the notification of the synchronization establishment means that they do not have to be carried out at the same time.

[0163]

When an uplink transmission data request occurs in the mobile terminal, the mobile terminal UE transmits a Sounding RS according to the sequence number of the UE for the uplink Sounding RS, which the mobile terminal, in ST5102, received from the base station, and/or the control information, such as the frequency band which is scheduled to be allocated to the Sounding RS transmission, so as to notify the base station that the specific mobile terminal UE has an uplink scheduling request (ST5103). Such a Sounding RS is called a "Sounding RS which serves as an uplink scheduling request."

A Sounding RS of each mobile terminal is multiplexed with a CAZAC sequence code which has occurred with the sequence number for the mobile terminal UE which the mobile terminal, in ST5102, received, and is transmitted with the frequency band and at the timing which are notified from the base station.

[0164]

By receiving the Sounding RS in the time-frequency region of the radio resources, which this mobile terminal uses, to correlate the reception, the base station can detect the reception of the Sounding RS of the mobile terminal. When detecting a Sounding RS from a mobile terminal which has not transmitted any uplink data through the reception detection, the base station can judge this Sounding RS to be an uplink scheduling request signal SR (ST5103). This is because this Embodiment 7 is based on that only during transmission of uplink data, a Sounding RS is transmitted.

In the above-mentioned example, the use of a CAZAC sequence code for the method of identifying a mobile terminal

in a Sounding RS is shown. As an alternative, another method can be used.

[0165]

When judging that the sounding RS which the base station has received from the mobile terminal is a scheduling request signal SR, the base station notifies the control information, such as radio resource allocation required for transmission of uplink data, by using an "Uplink Data Resource Allocation" message (ST5104). The mobile terminal then starts transmission of uplink data by using the radio resources received from the base station (ST5105).

A flow chart in the base station at the time when the base station eNodeB, in ST5102, notifies the BW is shown in Fig. 39.

First, a flow of instructions at the time when the base station eNodeB notifies the BW will be explained with reference to Fig. 39.

[0166]

The base station, in ST5401, checks whether or not synchronization is established with the mobile terminal UE, and, when synchronization is not established, waits until the base station receives a synchronous request via a Non-Sync RACH (ST5402). When receiving a synchronous request, the base station establishes synchronization with the mobile terminal, as shown in the explanation of ST5102 of Fig. 36 (ST5403), and then transmits L1/L2 control information for Sounding RS to the mobile terminal UE in semi-static mode (ST5404). The identification information (the sequence number or the UE-ID) of the UE for uplink Sounding RS, and the BW of uplink Sounding RS are included in this L1/L2 control information.

When judging that synchronization is established as a result of, in ST5401, checking synchronization with the UE, the base station, in ST5405, checks to see whether or not the mobile terminal is receiving downlink data. While receiving downlink data, the base station notifies L1/L2 control information for Sounding RS to the mobile terminal UE in dynamic mode, and changes the frequency bandwidth (BW) dynamically (ST5406).

[0167]

In the flow chart of Fig. 39, the base station notifies the BW of uplink Sounding RS by using both the L1/L2 control information in semi-static mode and the one in dynamic mode. In practice, the base station can notify the BW of uplink Sounding RS by using either one of the two types of L1/L2 control information: the semi-static L1/L2 control information and the dynamic L1/L2 control information.

[0168]

As a method of retransmitting an uplink Sounding RS which serves as an uplink scheduling request signal SR in a mobile terminal, in accordance with this Embodiment 7, there are provided the following two methods: a method of setting up a timer which times a predetermined time interval in the mobile terminal, and, when an "Uplink Data Resource Allocation" message cannot be received in ST5104 from the base station by the time the timer times out, retransmitting an uplink Sounding RS, and a method of continuing transmitting an uplink Sounding RS continuously until, in ST5104, receiving an "Uplink Data Resource Allocation" message. Because these methods are already explained in detail with reference to the explanatory figures 28 to 30 of Embodiment 3, and Figs. 31 to 33, the

explanation of the methods will be omitted hereafter.

[0169]

When, in ST5103, transmitting a Sounding RS which serves as an uplink scheduling request signal SR, the mobile terminal naturally uses an SB or LB which the mobile terminal ought to use for Sounding RS for (usually) measurement of the communication quality of the uplink, and has to make the frequency band and bandwidth (BW: BandWidth) of the SB or LB be equal to those of a general Sounding RS. This is because since for a Sounding RS, a plurality of mobile terminals to which an identical time-frequency region is allocated in such a way as to use the identical time-frequency region carries out code division multiplexing of the same SB (or LB) region to use this, if one mobile terminal changes the ends of the frequency band which the mobile terminal uses for Sounding RS in common with other mobile terminals or uses another block (LB or SB), data and reference signals of other mobile terminals are crushed. Therefore, in a case in which, for example, a Sounding RS for measurement (usually) of the communication quality of the uplink has a bandwidth equal to the entire bandwidth of the base station, a Sounding RS which serves as an uplink scheduling request SR also has the same bandwidth, and, when the base station sets up a plurality of BWs (frequency bands) for a Sounding RS for measurement (usually) of the communication quality of the uplink, the mobile terminal uses the same BW as that of another mobile terminal to which the same time-frequency region as that of the mobile terminal itself is allocated as a radio resource.

[0170]

There can be a case in which the base station eNodeB judges and selects the BW for a Sounding RS which serves as an uplink scheduling request SR, the BW being used for the mobile terminal, and a case in which the mobile terminal UE can judge and select the BW by itself.

A flow chart showing a judging method in the case in which the base station eNodeB selects the BW is shown in Fig. 40, and a flow of a judging method in the case in which the mobile terminal selects the BW is shown in Fig. 41.

[0171]

Next, a process flow in the case in which the base station eNodeB selects the BW of an uplink Sounding RS will be explained. This selection flow shows a method of determining the BW included in either the semi-static (semi-static) L1/L2 control information which is, in ST5404 of the flow chart shown in Fig. 39, notified to the UE, or the dynamic (dynamic) L1/L2 control information which is, in ST5406, notified to the UE.

Fig. 40 shows a process flow in the case in which the base station eNodeB selects the frequency bandwidth (Band Width: BW) of an uplink Sounding RS.

[0172]

First, the base station, in ST5501 of the figure, checks to see whether there exist two or more BWs with which an uplink Sounding RS is transmitted, and, if there exists only one BW, the base station sets the BW to be equal to the BWs of uplink Sounding RSs of all other mobile terminals UE (ST5502). In contrast, when there exist two or more BWs with which an uplink Sounding RS is transmitted, the base station checks whether or not the number of UEs each of which transmits a Sounding RS which

serves as an uplink scheduling request signal SR with the same BW is appropriate (ST5504), checks whether or not one of the two or more BWs includes frequencies which can be allocated to the UE at the cell edge (ST5505), checks whether one of the two or more BWs shows a good result of reporting the downlink CQI (the channel quality or the downlink communication path quality) (ST5506), and then searches through the two or more BWs for one BW which satisfies these conditions (ST5507). The base station then determines one BW which satisfies the conditions of ST5504 to ST5506 as the BW for uplink Sounding RS (ST5508).

[0173]

A process flow in the case in which the UE carries out the above-mentioned selection of one BW is shown in Fig. 41. The result of the selection of one BW for uplink Sounding RS which is carried out by the UE is reflected, referring to the flow chart of Fig. 39, in the BW notified by using the dynamic L1/L2 down control information when the mobile terminal is, in ST5405, receiving downlink data. First, the mobile terminal receives the number of BWs for uplink Sounding RS from the base station via a channel such as a BCH (ST5601). The mobile terminal checks to see whether there exist two or more BWs for uplink Sounding RS (ST5602), and, when there exist only one BW, selects the same BW as the BWs for uplink Sounding RSs of all other UEs (ST5603). In contrast, when there exist two or more BWs, the mobile terminal selects one BW from among them in order, and searches for one BW which satisfies the conditions "the quality of the downlink CQI is good" of ST5605 to determine one BW (ST5607). The mobile terminal then notifies the result of

the determination to the base station.

[0174]

By using one of methods, such as the above-mentioned, the number of UEs which transmit with the same BW can be controlled, and the increase in the total receive power of the base station can be prevented. Furthermore, a frequency which a UE at the cell edge can allocate as an uplink frequency can be set up beforehand, and the uplink communication path quality at a frequency band to actually know can be acquired. Furthermore, by expecting and selecting a good BW of the uplink from the downlink CQI, the uplink communication path quality can be acquired with radio resources which are most stabilized for the mobile terminal UE.

The above-mentioned determining method of determining one BW for a Sounding RS which serves as an uplink scheduling request SR which the mobile terminal uses (the method of determining one BW for Sounding RS in the case of notifying an uplink scheduling request SR by using a Sounding RS) can also be applied to Embodiment 8, Embodiment 9, and Embodiment 10.

[0175]

A concrete method of allocating radio resources for use in a base station and a mobile terminal, in ST5103 of the sequence of Fig. 36, will be explained.

Fig. 38 is a figure showing a method of allocating radio resources in a case in which the base station sets up a plurality of BWs for a Sounding RS for measurement (usually) of the communication quality of the uplink, and the circumstances of allocation of radio resources to the mobile terminal UE1 after a transmission request occurs. In Fig. 38, the radio resources

which the base station manages are divided into three time-frequency regions whose bandwidths are expressed as BW#1, BW#2, and BW#3, respectively. A UE group A including a mobile terminal UE1 is allocated to the time-frequency region of BW#1, a UE group B is similarly allocated to the time-frequency region of BW#2, and a UE group C is similarly allocated to the time-frequency region of BW#3. In the figure, reference numeral 531 denotes a data region of the UE group A, reference numeral 532 denotes a sounding (Sounding RS) region of the UE group A, reference numeral 533 denotes an RS region for demodulation (Demoduration) of the UE group A, reference numeral 534 denotes a data region of the UE group B, reference numeral 535 denotes a sounding (Sounding) RS region of the UE group B, and reference numeral 536 denotes an RS region for demodulation (Demoduration) of the UE group B. In this figure, the Sounding RS region is placed in two SBs within 2 TTIs, like in the example of Fig. 35(a), and its bandwidth is the same as the bandwidths (BW#1, BW#2, and BW#3) of the plurality of time-frequency regions respectively set for the plurality of UE groups. Each of the data region and the RS region for Demoduration in each UE group region is divided into a plurality of parts for the respective UEs in each UE group.

[0176]

A case in which, for example, the UE 1 included in the UE group A desires to transmit an uplink scheduling request signal SR in a subframe (1) of TTI #1 under the radio resources allocation conditions of Fig. 38 is shown in Fig. 38(b). Reference numeral 537 denotes a sounding (Sounding) RS region which serves as a scheduling request signal SR of the UE1,

reference numeral 538 denotes a transmission data region after the UE1 starts data transmission, reference numeral 539 denotes an RS region for demodulation (Demoduration) of the UE1, and reference numeral 540 denotes a sounding (Sounding) RS region for measurement (usually) of the uplink communication quality of the UE1. The UE1 transmits a Sounding RS which serves as a scheduling request SR with an SB1 (537) which is allocated as a Sounding RS of the UE group A. The BW of the SB 537 which is used for a Sounding RS which serves as a scheduling request signal SR of the UE1 is the same as the BW#1 of Sounding RS of the UE group A. Because the UE1 is not performing any transmission of uplink data in the subframe (1), the region which the UE1 uses at that time is only the SB1. That is, there is no transmission from the UE1 with LBs (LB1, LB2, LB3, LB4, and LB5) and SBs (SB2) other than the SB1 of the subframe (1). After that, the base station carries out an uplink scheduling process.

[0177]

In this case, while 3 TTIs elapse, allocation of radio resources for transmission of uplink data is notified from the base station to the UE1, and the UE1 starts transmission of uplink data from the subframe (7). After that, the data 538 for the UE1 are allocated to the LBs 1 to 6, the uplink Sounding RS 540 for measurement (usually) of the uplink communication quality of the UE1 is allocated to the SB1 in TTI#4 and the SB2 in TTI#5, and the RS for demodulation is allocated to the remaining SBs. As shown in the figure, the BW of the region of the uplink Sounding RS which serves as a scheduling request SR of the UE1, and the BW of the region of the uplink Sounding

RS for measurement (usually) of the communication quality of the uplink are the same as the bandwidth BW#1 of the UE group A, and all mobile terminals UE of the UE group A in a data transmission state allocate the same region having the completely same timing as this region for transmission of an uplink Sounding RS. In contrast, the bandwidth of the data region of the UE1 and that of the region allocated to a Demoduration RS are smaller than BW#1, and, as these regions, regions distinguished from those of other UEs are used.

[0178]

Thus, the timing of transmission of an uplink Sounding RS which serves as an uplink scheduling request signal SR has to be synchronized with that of transmission of an uplink Sounding RS of another UE (there can be two or more other UEs) under transmission to which the same BW is allocated.

[0179]

Fig. 42 shows in greater detail how each of a plurality of UEs is using radio resources allocated thereto at the same timing in the time-frequency region allocated to the UE group A. Unlike in the case of Fig. 38, in the case of Fig. 42, the region for uplink Sounding RS is placed in two LBs (LB1 in a first subframe, and LB6 in a second subframe) within 2 TTIs, like in the case of Fig. 35(b). In the figure, reference numeral 571 denotes a Sounding RS region of the UE group A, reference numeral 572 denotes an RS region for Demoduration of the UE group A, reference numeral 573 denotes a data region of the UE group A, reference numeral 574 denotes a Sounding RS region of the UE group B, reference numeral 575 denotes an RS region for Demoduration of the UE group B, reference numeral 576 denotes

a data region of the UE group B, reference numeral 577 denotes a region of a Sounding RS which serves as an scheduling request signal SR of the UE1 for a start of transmission of uplink data, and a region of a Sounding RS of the UE2 under transmission, reference numeral 578 denotes a Demoduration RS region of the UE2, reference numeral 579 denotes a data region of the UE2, reference numeral 580 denotes a general Sounding RS region of the UE1 and the UE2, reference numeral 581 denotes an RS region for Demoduration of the UE1, and reference numeral 582 denotes a data region of the UE1 under transmission.

[0180]

Hereafter, it is assumed that in the two mobile terminals UE1 and UE2 in the same UE group A, at a time, the UE1 tries to start uplink transmission and the UE2 has been transmitting uplink data. The LB1 577 which is allocated to the uplink Sounding RS region which all the mobile terminals of the UE group A use at the time of uplink transmission is used, in the UE1, for transmission of an uplink Sounding RS which serves as an uplink scheduling request signal SR notified from the mobile terminal to a base station for a start of uplink transmission, and is, in the UE2, used for transmission of an uplink Sounding RS used for usual measurement of the quality in a base station. As shown in the figure, these two UEs transmit uplink Sounding RSs having different meanings with the same block (LB) of the completely same bandwidth (=BW#1) at the completely same timing.

[0181]

When receiving this LB1, the base station demodulates the block with codes which are respectively generated from the

sequence numbers of the UEs to receive the uplink Sounding RSs from the UE1 and the UE2. The base station then uses the Sounding RS signal from the UE1 from which the base station has not received any uplink data signal until now for measurement of the uplink quality of the UE1, and judges that this Sounding RS signal is a notification (an uplink scheduling request signal SR) of a start of transmission by the UE1. In contrast, the base station uses the Sounding RS signal from the UE2 from which the base station has so far received an uplink data signal at regular intervals for measurement of the uplink quality of the UE2.

[0182]

The region for data and the region for a Demoduration RS which are allocated while each of the UE1 and the UE2 carries out transmission are allocated to regions which are separated from each other, respectively, as shown in Fig. 42, unlike that for an uplink Sounding RS.

[0183]

Furthermore, a time-frequency region via which an uplink Sounding RS can be transmitted is not configured similarly for any UE group, as explained with reference to Figs. 38 and 42, and therefore there is also provided a method of configuring a different time-frequency region for each UE group. Figs. 43(a) and 43(b) show examples in each of which the region to which an uplink Sounding RS is allocated is configured for each UE group in such a way that the time and frequency of the region are shifted in units of a resource unit (RU). Fig. 43(a) shows the example in which, in a case in which the BW of a Sounding RS is equal to the entire bandwidth of the base station, the

region with which an uplink Sounding RS can be transmitted is allocated in the time-frequency region in such a way that the region differs for each UE group. The figure shows an example in which time sections during each of which a Sounding RS can be transmitted are allocated to the four UE groups in such a way that each of the time sections has a length of 2 TTIs and the time sections are shifted from one another by 1 TTI. More concretely, among the four UE groups, a UE in the team 1 transmits an uplink Sounding RS during a time section A of TTIs (1) and (2), a UE in the team 2 transmits an uplink Sounding RS during a time section B of TTIs (2) and (3), a UE in the team 3 transmits an uplink Sounding RS during a time section C of TTIs (3) and (4), and a UE in the team 4 transmits an uplink Sounding RS during a time section D of TTIs (4) and (5). The allocation is not limited to this example.

[0184]

Furthermore, as explained in this Embodiment 7, the allocation of an uplink Sounding RS to a region is not limited to allocation to two blocks within 2 TTIs. As an alternative, the allocation can be carried out for each TTI, or the allocation can be carried out in such a way that an uplink Sounding RS is allocated to a predetermined fixed number of blocks over three or more subframes. Furthermore, there is no necessity to configure the time sections during each of which a Sounding RS can be transmitted in such a way that they are shifted from one another by 1 TTI, and what is necessary is just to configure the time sections according to a period which is enough to reduce the network load and to maintain the accuracy of the measurement of the uplink quality. Because using this method, the time

sections during which the plurality of UE teams can transmit uplink sounding RSs respectively differ from one another, the number of UEs which the base station receive simultaneously can be reduced.

Furthermore, the distribution of the total transmit power of the base station can be optimized.

[0185]

Fig. 43(b) shows the example in which, in a case in which a plurality of BWs are configured an uplink Sounding RS, the time section during which an uplink Sounding RS can be transmitted is allocated in each of the time-frequency regions of the BWs in such a way that the time section differs for each UE group. Because using this method, the frequency bands with which the plurality of UE teams perform uplink transmissions respectively and the time sections during which the plurality of UE teams can transmit uplink sounding RSs respectively differ from one another, compared with Fig. 43(a), the number of UEs which the base station receive simultaneously with the same band at the time of reception can be reduced and the receiving load of the wireless communication unit of the base station can be reduced. Furthermore, the distribution of the total transmit power of the base station can be optimized.

[0186]

The method of setting up the BW of an uplink Sounding RS, and allocating radio resources, which is explained in this Embodiment 7, can also be applied to a case in which when there exist no transmission of uplink data and a Sounding RS is transmitted for the purpose of transmitting a signal other than an uplink scheduling request signal SR. Furthermore, the

method of configuring the BW of an uplink Sounding RS, and allocating radio resources, which is explained in this Embodiment 7, can also be applied to Embodiment 8, Embodiment 9, and Embodiment 10.

[0187]

The transmit power when transmitting a Sounding RS which serves as an uplink scheduling request signal SR has to be set to be equal to or higher than that at the time of transmitting a general uplink Sounding RS in view of the importance of the signal. For example, there is also provided a method of acquiring the transmit power of a Sounding RS which serves as an uplink scheduling request signal SR by using a predetermined equation as follows:

[Equation 1]

$$P_{SR} = P_{Sounding} + \frac{E/N_{SR}}{E/N_{sounding}} \times k$$

k : Constant

P_{SR} : Transmit Power of Sounding RS Serving as Scheduling Request

$P_{Sounding}$: Transmit Power of Uplink Sounding RS

E/N_{SR} : E_b/No of Uplink Sounding RS Serving as Scheduling Request

$E/N_{Sounding}$: E_b/No of Uplink Sounding RS

As mentioned above, by, for example, setting up the transmit powers of mobile terminals according to their respective desired power-to-noise ratios so as to make the transmit power of each mobile terminal at the time of transmitting a Sounding RS which serves as an uplink scheduling request signal SR be equal to or larger than that at the time of transmitting a general uplink Sounding RS, erroneous reception of uplink scheduling request signals by the base station can be reduced. As mentioned above, the method of setting up the transmit power of a Sounding RS which serves as an uplink scheduling request signal SR can also be applied to Embodiment 8, Embodiment 9, and Embodiment 10.

[0188]

As mentioned above, when a transmission request occurs in a case in which a mobile station is synchronized with a base station, and no transmission of uplink data is being carried out and no allocation of an Ack/Nack exclusive channel is made, a frequency band wider than that at the time of using an S-RACH

can be used by transmitting an uplink scheduling request signal SR by using a Sounding RS for measurement of the quality of the uplink. Therefore, transmission further resistant to the frequency selective fading can be implemented. Because by using a "sounding RS which serves as an uplink scheduling request signal SR", an uplink communication path quality measurement in the base station can be carried out while serving as transmission of an uplink scheduling request signal SR. Therefore, the necessity to transmit a sounding RS for measurement of the uplink quality independently from a scheduling request signal SR can be eliminated. Furthermore, because a wide frequency band is used, it is easy to incorporate the communication quality of the uplink into subsequent uplink scheduling. In addition, the radio resources of the S-RACH can be released, and the complexity in the uplink scheduling sequence between the mobile terminal and the base station can be reduced.

[0189]

Embodiment 8.

Even in a case in which a mobile terminal is synchronized with a base station, and is not receiving downlink data (Downlink data, DL data) transmitted from a base station, or allocation of an Ack/Nack exclusive channel for transmitting an Ack/Nack signal or a CQI signal which is the result of reception of downlink data to the base station is not made and the mobile terminal is not carrying out any transmission of uplink data (Uplink data, UL data) such as user data, the mobile terminal may transmit a reference signal for sounding (a reference signal for measurement of the quality of an uplink

communication path) to the base station at certain periodicity in order to maintain uplink synchronization with the base station. A case in which a mobile terminal transmits a reference signal 7901 for sounding at certain periodicity(n×TTI) is shown in Fig. 53. On the other hand, when a necessity to transmit uplink data occurs in the mobile terminal, the mobile terminal has to transmit an uplink scheduling request signal SR to the base station separately.

[0190]

Therefore, there may be a case in which an uplink scheduling request signal SR and a reference signal for sounding are transmitted simultaneously. When transmitted simultaneously, they are not transmitted with single carrier transmission, but are transmitted with multi carrier transmission. In the case in which such signals having no correlation among them are transmitted simultaneously, the PAPR becomes high because the time waveforms of the transmission signals have a high peak. A problem is that as the PAPR becomes high, the power consumption of the mobile terminal increases and therefore the cell coverage becomes narrow. A further problem is that as the PAPR becomes high, those signals become an interference wave to other mobile terminals and the communication system. In order to avoid these problems, there can be considered a measure of shifting the transmission timing of a reference signal for sounding from that of an uplink scheduling request signal SR, or the like, though the scheduling control in the base station and/or the mobile terminal becomes complicated.

In this Embodiment 8, a method of making a reference signal

for sounding serve as an uplink scheduling request signal SR in order to solve the above-mentioned problems will be explained.

[0191]

In above-mentioned Embodiment 7, the transmission method of transmitting a scheduling request in a state in which a mobile terminal does not transmit a reference signal for sounding in a case in which the mobile terminal is not transmitting uplink data is disclosed. In that case, the base station judges that there is a scheduling request when receiving a reference signal for sounding. Therefore, the base station does not have to have a function of judging whether a reference signal for sounding serves as an uplink scheduling request, and/or a function of judging whether or not there occurs scheduling.

However, there arises a new problem that in a case in which a mobile terminal transmits a reference signal for sounding at certain periodicity, in order to make the reference signal for sounding serve as an uplink scheduling request signal SR, the base station has to judge whether the received signal is the one sounding or the one for uplink scheduling, and/or has to judge whether or not there occurs scheduling. In order to solve this problem, in this Embodiment 8, a method of providing two types of pilot patterns for sounding, defining correspondences between these two types of pilot patterns and the presence and absence of an uplink scheduling request, and transmitting one of the two types of pilot patterns according to the presence or absence of an uplink scheduling request is disclosed (refer to Fig. 80).

[0192]

A method of, in a case in which a mobile terminal transmits a reference signal for sounding, allocating a pilot for sounding, and allocating a code specific to each mobile terminal is shown in Fig. 46. Reference numeral 7201 denotes the pilot for sounding, and reference numeral 7202 denotes the code specific to each mobile terminal. When the mobile terminal transmits the reference signal for sounding, the encoder unit or the modulating unit of the mobile terminal multiplies the pilot for sounding by the code specific to each mobile terminal to generate the reference signal for sounding.

After the reference signal for sounding is subjected to a modulation process and is converted into a baseband signal, the reference signal for sounding is converted into a signal having a radio frequency. After that, the reference signal for sounding is transmitted to the base station by way of an antenna. The code specific to each mobile terminal is used by the base station in order for the base station to, when receiving reference signals for sounding from a plurality of mobile terminals, identify which one of the reference signals for sounding is the one from the above-mentioned mobile terminal. It is preferable that the above-mentioned code is the one having orthogonality, or this code yields multiplication of a pilot pattern thereby having orthogonality.

[0193]

As an alternative, the above-mentioned code can be a spread code or a scramble code. A time-frequency region to which the reference signal for sounding is allocated is predetermined or is notified from the base station. A frequency region can have one of various bands. A time region can be

provided once during each TTI or during several TTIs. A correlation operation is performed on the reference signal for sounding which the base station has received by using a code specific to each mobile terminal, and, by using a code which yields a correlation operation result which is equal to or larger than a threshold, the base station can identify the mobile terminal. The base station restarts the synchronization of an uplink channel with the mobile terminal which the base station has identified by using the reference signal for sounding. The base station can also measure the uplink communication path quality by using the above-mentioned signal.

[0194]

One embodiment of making a reference signal for sounding have the functions of an uplink scheduling request signal SR will be disclosed hereafter. A method of generating a reference signal for sounding having the functions of an uplink scheduling request signal SR is shown in Fig. 44. Reference numeral 7001 denotes a pilot pattern 1 for sounding, reference numeral 7002 denotes a pilot pattern 2 for sounding, reference numeral 7003 denotes a switch for switching between the two types of patterns, reference numeral 7004 denotes a control unit for controlling the switch, and reference numeral 7005 denotes a code specific to each mobile terminal. Each of the above-mentioned pilots 1 and 2 for sounding can be a single symbol or can be a plurality of symbols. It is preferable that the above-mentioned code is the one having orthogonality, or this code yields multiplication of a pilot pattern thereby having orthogonality. As an alternative, the above-mentioned code can be a spread code

or a scramble code. However, in a case in which the code is a scramble code, it is preferable that each of the above-mentioned pilots 1 and 2 for sounding is a plurality of symbols.

As the pilot patterns for sounding, there are provided two types of patterns according to the presence and absence of an uplink scheduling request. As shown in a table of the figure, in a case in which there is no uplink scheduling request, the pattern 1 is allocated in advance, whereas in a case in which there is an uplink scheduling request, the pattern 2 is allocated in advance.

[0195]

Fig. 45 shows a diagram of sequences between the mobile terminal and the base station. The mobile terminal transmits a reference signal for sounding at certain periodicity. A time-frequency region to which the reference signal for sounding is allocated is predetermined or is notified from the base station. The mobile terminal, in ST7101, judges whether an uplink data transmission request has occurred. When no uplink data transmission request has occurred, the mobile terminal carries out ST7102 because the mobile terminal does not transmit any scheduling request. The control unit 7004, in ST7102, changes the state of the switch 7003 in such a way as to select the pilot pattern 1 for sounding.

[0196]

In contrast, when an uplink data transmission request has occurred, the mobile terminal carries out ST7103 because the mobile terminal transmits an uplink scheduling request. The control unit 7004, in ST7103, changes the state of the switch

7003 in such a way as to select the pilot pattern 2 for sounding. The mobile terminal, in ST7104, multiplies the pilot pattern for sounding selected in either of the cases by the code 7005 specific to each mobile terminal to generate a reference signal for sounding. The mobile terminal, in ST7105, performs a modulation process, baseband signal conversion, and radio frequency conversion on the reference signal for sounding, and transmits the reference signal for sounding to the base station with the time-frequency region allocated to the reference signal for sounding by way of the antenna. The base station, in ST7106, receives the reference signal for sounding. The base station, in ST7107, performs a correlation operation on this reference signal for sounding with the code specific to each mobile terminal, and identifies the mobile terminal when the result of the operation is equal to or larger than a threshold.

[0197]

Next, the base station, in ST7108, judges whether the pilot for sounding has the pattern 1 or the pattern 2. When judging that the pilot for sounding has the pattern 1, the base station, in ST7109, carries out the processing by judging that there does not occur uplink scheduling. In contrast, when judging that the pilot for sounding has the pattern 2, the base station, in ST7110, carries out a process in the case in which there occurs uplink scheduling.

When, in ST7107, the result of the correlation operation is smaller than the threshold, the base station ends the processing by judging that the reference signal for sounding has been transmitted thereto from another mobile terminal other than the above-mentioned mobile terminal.

In one example of the two types of pilot patterns for sounding which enable the base station to judge whether the pilot for sounding has the pattern 1 or the pattern 2, a code and a reverse code are allocated to the pilot pattern 1 and the pilot pattern 2, respectively (when a certain symbol allocated to one of them is "1", "0" is allocated to the other one). By carrying out the allocation of codes to the two types of pilot patterns in this way, the base station, in ST7108, can judge whether the pilot for sounding is the pilot 1 or the pilot 2 by judging whether the result of the correlation operation is positive or negative.

The base station can also restart the synchronization of the uplink channel with this identified mobile terminal by using the pilot pattern 1 or 2 for sounding.

[0198]

With the above-mentioned structure, the mobile terminal can suppress the increase in the PAPR which appears when transmitting an uplink scheduling request signal SR and a reference signal for sounding simultaneously.

Furthermore, because it becomes unnecessary to ensure the region of an S-RACH for a scheduling request, the waste of the time-frequency resource can be eliminated.

In addition, because the mobile terminal does not have to carry out a process of shifting the transmission timing of a reference signal for sounding and that of an uplink scheduling request signal SR from each other, and so on, the scheduling control in the base station and/or the mobile terminal can be prevented from becoming complicated.

Furthermore, by forming a reference signal for uplink

sounding in such a way that the reference signal for uplink sounding serves as an uplink scheduling request signal SR, as mentioned above, the base station is enabled to, when receiving this signal, judge whether this signal has an uplink scheduling request.

In addition, because only one type of specific code has only to be allocated to each mobile terminal, many code resources can be ensured and the number of mobile terminals from which the base station can receive signals simultaneously can be increased.

Furthermore, because a frequency band wider than that at the time of using an S-RACH or an Ack/Nack exclusive channel can be used, transmission further resistant to the frequency selective fading can be implemented.

[0199]

Hereafter, variants will be explained.

In a first variant, a symbol or two or more symbols of the pilot for sounding [[is]] are a symbol or two or more symbols for scheduling request. A pilot pattern in which a ~~part~~ symbols or two or more symbols of the pilot for sounding [[is]] are a symbol or two or more symbols for scheduling request is shown in Fig. 47.

When there is no scheduling request, 1 is allocated to the symbol for scheduling request, whereas when there is a scheduling request, 0 is allocated to the symbol for scheduling request.

[0200]

This variant will be explained with reference to a sequence diagram of Fig. 48. The mobile terminal, in ST7401,

judges whether an uplink data transmission request has occurred. When no uplink data transmission request has occurred, the mobile terminal carries out ST7402 because the mobile terminal does not transmit any scheduling request. The mobile terminal, in ST7402, sets 1 to the symbol for scheduling request. In contrast, when an uplink data transmission request has occurred, the mobile terminal carries out ST7403 because the mobile terminal transmits a scheduling request. The mobile terminal, in ST7403, sets 0 to the symbol for scheduling request. The mobile terminal, in ST7404, multiplies the pilot pattern for sounding selected in either of the cases by a code A specific to each mobile terminal to generate a reference signal for sounding.

[0201]

The mobile terminal, in ST7405, performs a modulation process, baseband signal conversion, and radio frequency conversion on the reference signal for sounding, and transmits the reference signal for sounding to the base station with the time-frequency region allocated to the reference signal for sounding by way of the antenna. The base station, in ST7406, receives the reference signal for sounding. The base station, in ST7407, performs a correlation operation on this reference signal for sounding with the code A specific to each mobile terminal, and identifies the mobile terminal when the result of the operation is equal to or larger than a threshold. Next, the base station, in ST7408, judges whether the symbol for scheduling request is 1 or 0. When judging that the symbol for scheduling request is 1, the base station, in ST7409, carries out the processing by judging that there does not occur uplink

scheduling. In contrast, when judging that the symbol for scheduling request is 0, the base station, in ST7410, carries out a process in the case in which there occurs uplink scheduling.

[0202]

The number of symbols which are used for a scheduling request can be one or can be two or more. By using two or more symbols for a scheduling request, there can be provided an advantage of increasing the composite electric power in the base station and therefore reducing the error rate.

[0203]

Furthermore, the symbols for sounding can be multiplied by a code specific to each mobile terminal according to the number of the symbols for sounding and the one or more symbols for scheduling request can be multiplied by another code specific to the mobile terminal according to the number of the symbols for scheduling request, and the reference signal for sounding and scheduling request can be multiplexed with respect to time. Thereby, a scrambling code can be used as the code specific to each mobile terminal. Furthermore, because the base station can perform the correlation operation by using only the reference signal for sounding, there is provided an advantage of improving the synchronization accuracy and the accuracy of evaluation of channel conditions (the quality of the uplink communication path). In addition, in a case in which the number of the symbols for sounding is the same as the number of the one or more symbols for scheduling request, both of them can be multiplied by an identical code specific to each mobile terminal. Thereby, there is provided an advantage of making

effective use of the code resources.

[0204]

In a second variant, two codes specific to each mobile terminal are prepared, and the pilot for sounding is multiplied by one of the two codes specific to each mobile terminal which is according to the presence or absence of an uplink scheduling request.

An example of generation of a reference signal for sounding is shown in Fig. 49. Reference numeral 7501 denotes a pilot for sounding, reference numeral 7503 denotes a code A specific to each mobile terminal, reference numeral 7504 denotes another code B specific to each mobile terminal, reference numeral 7502 denotes a switch for selecting a code by which the pilot for sounding is multiplied, and reference numeral 7505 denotes a control unit for transmitting a signal for selecting a code (7503 or 7504) according to the presence or absence of a scheduling request by using the switch 7502. As shown in a table of the figure, as the code specific to each mobile terminal, when there is no uplink scheduling request, the code A is allocated, whereas when there is an uplink scheduling request, the code B is allocated.

[0205]

The operation of the variant will be explained with reference to a sequence diagram of Fig. 50. The mobile terminal, in ST7601, judges whether an uplink data transmission request has occurred. When no uplink data transmission request has occurred, the mobile terminal carries out ST7602 because the mobile terminal does not transmit any scheduling request. The mobile terminal, in ST7602, selects the code A by using the

switch 7502 according to a control signal from the control unit 7505 in such a way as to carry out multiplication with the code A. As a result, the pilot for sounding is multiplied by the code A 7503. In contrast, when an uplink data transmission request has occurred, the mobile terminal carries out ST7603 because the mobile terminal transmits a scheduling request. The mobile terminal, in ST7603, selects the code B 7504 by using the switch 7502 according to the control signal from the control unit 7505 in such a way as to carry out multiplication with the code B. As a result, the pilot for sounding is multiplied by the code B.

[0206]

The mobile terminal, in ST7604, performs a modulation process, baseband signal conversion, and radio frequency conversion on the reference signal for sounding, and transmits the reference signal for sounding to the base station with the time-frequency region allocated to the reference signal for sounding by way of the antenna. The base station, in ST7605, receives the reference signal for sounding. The base station, in ST7606, performs a correlation operation on this reference signal for sounding with the code A first, and identifies the mobile terminal when the result of the operation is equal to or larger than a certain threshold, though the base station handles the reference signal for sounding by judging that the reference signal does not include a scheduling request. In contrast, when the result of the operation is smaller than the certain threshold, the base station, in ST7608, performs a correlation operation on the above-mentioned reference signal for sounding with the code B. When the result of the operation

is equal to or larger than a certain threshold, the base station identifies the mobile terminal and then handles the reference signal for sounding by judging that the reference signal includes a scheduling request.

When, in ST7606, the result of the correlation operation with the code A is less than the certain threshold, and when, in ST7608, the result of the correlation operation with the code B is less than the certain threshold, the base station judges that the reference signal for sounding is the one from another mobile terminal other than the mobile terminal, and ends the processing.

[0207]

Because this variant is constructed as mentioned above, there is provided an advantage of eliminating the necessity to provide two types of pilot patterns for sounding, and a further advantage of eliminating the necessity to judge whether the result of each correlation operation is positive or negative because an orthogonal code is also used for judgment of the presence or absence of a scheduling request. Furthermore, because an orthogonal code is also used for judgment of the presence or absence of a scheduling request, there is provided another advantage of improving the judgment precision, the synchronization accuracy, and the accuracy of evaluation of channel conditions.

[0208]

In a third variant, one type of code for judgment of the presence or absence of a scheduling request is prepared, and there is provided a method of controlling whether to carry out multiplication with this code according to the presence or

absence of an uplink scheduling request.

An example of generation of a reference signal for sounding is shown in Fig. 51. Reference numeral 7701 denotes a pilot for sounding, reference numeral 7703 denotes a code a for judgment of the presence or absence of a scheduling request, reference numeral 7702 denotes a switch for selecting whether to multiply the sounding pilot by the code a, reference numeral 7705 denotes a control unit for transmitting a signal indicating whether to multiply the sounding pilot by the code a with the switch 7702, and reference numeral 7704 denotes a code specific to each mobile terminal. As shown in a table of the figure, when there is no uplink scheduling request, the code for judgment of the presence or absence of a scheduling request is not allocated, whereas when there is an uplink scheduling request, the code a is allocated.

[0209]

The operation of this variant will be explained with reference to a sequence diagram of Fig. 52. The mobile terminal, in ST7801, judges whether an uplink data transmission request has occurred. When no uplink data transmission request has occurred, the mobile terminal performs a selection so as not to carry out multiplication by the code a by using the switch 7702 according to the control signal from the control unit 7705 because the mobile terminal does not transmit any scheduling request, and then carries out ST7803. In contrast, when an uplink data transmission request has occurred, the mobile terminal carries out ST7802 because the mobile terminal transmits a scheduling request. The mobile terminal, in ST7802, selects the code a 7703 by using the switch 7702 according to

the control signal from the control unit 7705 in such a way as to carry out multiplication with the code a. As a result, the pilot for sounding is multiplied by the code a for judgment of the presence or absence of a scheduling request. In ST7803, the pilot for sounding is multiplied by the code A specific to each mobile terminal.

[0210]

The mobile terminal, in ST7804, performs a modulation process, baseband signal conversion, and radio frequency conversion on the reference signal for sounding, and transmits the reference signal for sounding to the base station with the time-frequency region allocated to the reference signal for sounding by way of the antenna. The base station, in ST7805, receives the reference signal for sounding. The base station, in ST7806, performs a correlation operation on this reference signal for sounding with the code A specific to each mobile terminal, and identifies the mobile terminal when the result of the operation is equal to or larger than a threshold.

The base station then, in ST7807, performs a correlation operation on the above-mentioned reference signal for sounding with the code a, and, when the result of the operation is equal to or larger than a threshold, handles the reference signal for sounding by judging that the reference signal has a scheduling request. In contrast, when the result of the operation is smaller than the threshold, the base station handles the reference signal for sounding by judging that the reference signal does not include a scheduling request.

The scheduling request presence or absence identification code a and the code A specific to each mobile

terminal can be scramble codes or spread codes.

[0211]

Because this variant is constructed as mentioned above, there is provided an advantage of eliminating the necessity to judge whether the result of each correlation operation is positive or negative because an orthogonal code can also be used for judgment of the presence or absence of a scheduling request. Furthermore, because an orthogonal code is also used for judgment of the presence or absence of a scheduling request, there is provided another advantage of improving the judgment precision. In addition, there is provided a further advantage of eliminating the necessity to double the amount of codes specific to each mobile terminal, unlike the second variant.

[0212]

As mentioned above, with the structure as mentioned in this Embodiment 8, the mobile terminal can suppress the increase in the PAPR which appears when transmitting an uplink scheduling request signal SR and a reference signal for sounding simultaneously.

Furthermore, because it becomes unnecessary to ensure the region of an S-RACH for a scheduling request, the waste of the time-frequency resource can be eliminated.

In addition, because the mobile terminal does not have to carry out a process of shifting the transmission timing of a reference signal for sounding and that of an uplink scheduling request signal SR from each other, and so on, the scheduling control in the base station and/or the mobile terminal can be prevented from becoming complicated.

Furthermore, by forming a reference signal for uplink

sounding in such a way that the reference signal for uplink sounding serves as an uplink scheduling request signal SR, as mentioned above, the base station is enabled to, when receiving this signal, judge whether this signal has an uplink scheduling request.

In addition, because a frequency band wider than that at the time of using an S-RACH or an Ack/Nack exclusive channel can be used, transmission further resistant to the frequency selective fading can be implemented.

[0213]

Embodiment 9.

When a necessity for transmission of uplink data occurs in a mobile terminal in a state in which the mobile terminal is receiving downlink data (Downlink data, DL data) transmitted from a base station or in a state in which allocation of an Ack/Nack exclusive channel for transmitting an Ack/Nack signal, which is the result of reception of downlink data, and/or a CQI signal to the base station is made, the mobile terminal has to transmit an uplink scheduling request signal SR to the base station. In this case, the mobile terminal may transmit the Ack/Nack signal and/or the CQI signal, and the uplink scheduling request signal SR simultaneously. When transmitted simultaneously, they are not transmitted with single carrier transmission, but are transmitted with multi carrier transmission. In the case in which such signals having no correlation among them are transmitted simultaneously, the PAPR becomes high because the time waveforms of the transmission signals have a high peak. A problem is that as the PAPR becomes high, the power consumption of the mobile terminal increases

and therefore the cell coverage becomes narrow.

A further problem is that as the PAPR becomes high, those signals become an interference wave to other mobile terminals and the communication system.

[0214]

In order to avoid these problems, in Embodiments 1 and 2, the method of transmitting an uplink scheduling request signal by using an S-RACH, and DTXing an Ack/Nack and/or a CQI signal at the same timing is disclosed. In Embodiments 3 and 4, the method of incorporating an uplink scheduling request signal into an Ack/Nack exclusive channel to transmit the uplink scheduling request signal is disclosed.

In this Embodiment 9, a method of transmitting an uplink scheduling request signal by using a region for sounding RS will be disclosed. In this Embodiment 9, a case in which there is no sounding RS which is transmitted for uplink timing synchronization at certain periodicity will be disclosed.

[0215]

The region for sounding RS is already explained in Embodiment 7. In Embodiment 7, the case in which no allocation of an Ack/Nack exclusive channel is made is disclosed. In contrast, in this embodiment, a case in which allocation of an Ack/Nack exclusive channel is made will be disclosed.

Fig. 55 shows a figure of a time-frequency resource in a case in which there are regions for an Ack/Nack exclusive channel. Regions A and B are regions for an Ack/Nack exclusive channel. The region for sounding RS is allocated to a region other than channel for Ack/Nack, in this example, the allocation to the first LB is carried out once within 2 TTIs.

Each of a plurality of mobile terminals under the control of the base station transmits a reference signal for sounding using this region for sounding RS. The plurality of mobile terminals can be divided into one or more groups. Furthermore, the region for sounding reference symbols can also be divided into one or more regions. Transmission of an RS for sounding by a mobile terminal included in a certain mobile terminal group can be carried out by using a certain divided region.

[0216]

A transmission signal of a mobile terminal in a case in which a scheduling request occurs is shown in Fig. 60. When a necessity for transmission of uplink data occurs in a mobile terminal in a state in which the mobile terminal is receiving downlink data (Downlink data, DL data) transmitted from a base station, or in a state in which allocation of an Ack/Nack exclusive channel for transmitting an Ack/Nack signal, which is the result of reception of downlink data, and/or a CQI signal to the base station is made, and the mobile terminal then transmits an uplink scheduling request signal SR to the base station, the mobile terminal transmits the uplink scheduling request signal by using a region for sounding RS allocated to this mobile terminal, and transmits an Ack/Nack signal, a CQI signal, or a reference signal for demodulation with other LBs or SBs by using the Ack/Nack exclusive channel. In contrast, when there is no uplink scheduling request, the mobile terminal does not transmit an uplink scheduling request signal, but transmits an Ack/Nack signal and/or a CQI signal by using the Ack/Nack exclusive channel.

[0217]

Fig. 59 shows mapping of transmission symbols in a mobile terminal in the case in which the mobile terminal transmits an uplink scheduling request signal with the region for sounding RS. A pilot symbol for sounding is inserted into a leading LB within 2 TTIs. An Ack/Nack or a CQI symbol is inserted into other LBs. The pilot for sounding is multiplied by a code a specific to each mobile terminal which is used in the region for sounding. This code a is used in order for the base station to identify from which mobile terminal the base station has received the transmission because the region for sounding is shared by a plurality of mobile terminals. The symbol for sounding which is multiplied by the code a specific to each mobile terminal, which is used in the region for sounding, is mapped to the region for sounding RS.

[0218]

An Ack/Nack or a CQI symbol is multiplied by a code A specific to each mobile terminal, and is mapped to the resource for Ack/Nack exclusive channel. This code A is used to identify the mobile terminal in the Ack/Nack exclusive channel, as mentioned in Embodiment 3. These two types of codes specific to each mobile terminal are predetermined, or are notified from the base station.

Fig. 62 is a sequence diagram. The mobile terminal, in ST8901, judges whether an uplink data transmission request has occurred. When no uplink data transmission request has occurred, the mobile terminal carries out ST8904 because the mobile terminal does not transmit any scheduling request. The mobile terminal, in ST8904, inserts an Ack/Nack or a CQI symbol into each of all LBs within 2 TTIs, and multiplies each of them

by the code A. In contrast, when an uplink data transmission request has occurred, the mobile terminal carries out ST8902 and ST8903 because the mobile terminal transmits a scheduling request.

[0219]

The mobile terminal, in ST8902, inserts the pilot for sounding into the first LB within 2 TTIs, and multiplies this LB by the code a. The mobile terminal, in ST8903, inserts an Ack/Nack and/or a CQI into a second or subsequent LBs, and multiplies these LBs by the code A. The mobile terminal, in ST8905, carries out allocation of the pilot for sounding which is multiplied by the code a to the region for sounding RS, and carries out allocation of the Ack/Nack or the CQI which is multiplied by the code A to the resource for Ack/Nack exclusive channel, and then transmits them to the base station. The base station which, in ST8906, received the signals, in ST8907, performs a correlation operation on the signal in the region for sounding by using the code a, and, when the result of the correlation operation is equal to or larger than a certain threshold, can identify the mobile terminal and judge that the base station has received an uplink scheduling request from this identified mobile terminal.

[0220]

The base station which has judged that the base station has received an uplink scheduling request, in ST8910, handles the uplink scheduling request. The base station then, in ST8911, performs a correlation operation on the signal in the second or subsequent LBs or SBs, which is transmitted via the Ack/Nack exclusive channel, by using the code A, and, in ST8912, performs

judgment of the Ack/Nack or the CQI. When, in ST8907, the result of the correlation operation with the code a is smaller than the certain threshold, the base station still cannot identify the mobile terminal and handles the signal by judging that the signal does not have an uplink scheduling request. In that case, the base station, in ST8909, performs a correlation operation on signals in all the LBs and SBs, which are transmitted via the Ack/Nack exclusive channel, by using the code A, and, when the result of the correlation operation is equal to or larger than a certain threshold, identifies the mobile terminal. After identifying the mobile terminal, the base station, in ST8912, performs judgment of the Ack/Nack or the CQI.

[0221]

With the structure as mentioned above, the mobile terminal can suppress the increase in the PAPR which appears when transmitting both an Ack/Nack signal or a CQI signal, and an uplink scheduling request signal SR simultaneously.

Furthermore, because it becomes unnecessary to ensure the region of an S-RACH for a scheduling request in advance, the waste of the time-frequency resource can be eliminated.

In addition, by transmitting an uplink scheduling request signal SR by using a reference signal for sounding, the base station is enabled to, when receiving this signal, judge whether this signal has an uplink scheduling request.

Furthermore, because the mobile terminal transmits an uplink scheduling request signal SR by using a reference signal for sounding, the base station can evaluate the status of the uplink channel used for carrying out uplink scheduling.

[0222]

In addition, because a frequency band wider than that at the time of using an S-RACH or an Ack/Nack exclusive channel can be used, transmission further resistant to the frequency selective fading can be implemented.

Furthermore, the base station can measure the status of the frequency selective fading, and can carry out appropriate uplink scheduling.

In the above-mentioned embodiments, when a mobile terminal does not have an uplink scheduling request, the mobile terminal inserts an Ack/Nack or a CQI symbol into the first LB. As the mapping method, the method disclosed in Embodiment 2 can be applied. By doing in this way, there is provided an advantage of improving the quality of reception of an Ack/Nack or a CQI.

As shown in above-mentioned Embodiment 1, also in the case in which a mobile terminal has an uplink scheduling request, the mobile terminal can insert an Ack/Nack or a CQI symbol into each of all the LBs and SBs, like in the case in which there is no uplink scheduling request, and, only when the mobile terminal has an uplink scheduling request, can DTX only the first LB and transmit a sounding pilot in this LB by using the RS region for sounding. As a result, the complexity of the process of multiplexing symbols can be reduced.

[0223]

In the above-mentioned embodiments, the case in which an Ack/Nack and/or a CQI signal is transmitted by using an Ack/Nack exclusive channel is disclosed. In contrast, the method of this embodiment can also be applied to a case in which an Ack/Nack or a CQI signal is not transmitted by using an Ack/Nack exclusive channel. For example, when a scheduling request occurs in a

mobile terminal, the mobile terminal has only to transmit an RS for sounding by using the first LB in a region for sounding and not to transmit any other signals.

In the above-mentioned embodiments, when a scheduling request occurs in a mobile terminal, the mobile terminal inserts a pilot symbol for sounding into the first LB. The same advantage is acquired even if the mobile terminal changes an LB or SB into which the mobile terminal inserts the pilot symbol according to the region allocated to an RS for sounding.

[0224]

Hereafter, variants will be explained. In a first variant, the region for sounding RS is allocated to all the bands. Fig. 56 is a figure showing a time-frequency resource at the time of allocating the region for sounding RS to all the bands of the system. Regions A and B are regions for an Ack/Nack exclusive channel. In this example, the first LB is allocated, as the region for sounding RS, once within 2 TTIs. Each of a plurality of mobile terminals under the control of the base station transmits a reference signal for sounding by using this region for sounding RS. The plurality of mobile terminals can be divided into one or more groups. Furthermore, the region for a sounding reference signal can also be divided into one or more regions. Transmission of an RS for sounding by a mobile terminal included in a certain mobile terminal group can be carried out by using a certain divided region.

[0225]

A transmission signal of a mobile terminal in a case in which a scheduling request occurs is shown in Fig. 61. When a necessity for transmission of uplink data occurs in a mobile

terminal in a state in which the mobile terminal is receiving downlink data (Downlink data, DL data) transmitted from a base station, or in a state in which allocation of an Ack/Nack exclusive channel for transmitting an Ack/Nack signal, which is the result of reception of downlink data, and/or a CQI signal to the base station is made, and the mobile terminal then transmits an uplink scheduling request signal SR to the base station, the mobile terminal transmits the uplink scheduling request signal by using a region for sounding RS allocated to this mobile terminal, and transmits an Ack/Nack signal, a CQI signal, or a reference signal for demodulation in other LBs or SBs by using the Ack/Nack exclusive channel. In contrast, when there is no uplink scheduling request, the mobile terminal does not transmit any uplink scheduling request signal, and, furthermore, does not transmit any Ack/Nack signal or any CQI signal once with the first LB by using the Ack/Nack exclusive channel within 2 TTIs. This is because since all the bands of the system are allocated to the region for sounding RS and some other mobile terminals under the control of the base station transmit sounding RSs with this LB of the Ack/Nack exclusive channel, if the mobile transmits an Ack/Nack signal or a CQI signal with this LB, the base station cannot discriminate this Ack/Nack or CQI signal from any other signals.

In the mapping of transmission symbols in the mobile terminal, a pilot for sounding is inserted when there is an uplink scheduling request, like in the mapping shown in Fig. 59, whereas when there is no uplink scheduling request, it is preferable to insert either nothing or dummy data into the first LB and not to carry out any transmission with this LB.

[0226]

With the above-mentioned structure, this embodiment offers the same advantages as those provided by Embodiment 9. Furthermore, the base station can make an evaluation of uplink channel conditions with a wider band.

In addition, because the base station can make an evaluation of the channel conditions of an Ack/Nack exclusive channel, there is provided an advantage of performing scheduling of an Ack/Nack signal or a CQI signal of a mobile terminal to an Ack/Nack exclusive channel with a high degree of precision.

Furthermore, by dividing the plurality of mobile terminals into one or more groups, and/or by dividing the region for sounding reference signals into one or more regions, there is provided an advantage of bringing greater efficiency to the use of the code resources allocated to each mobile terminal.

[0227]

In a second variant, the region for sounding RS is divided into parts having the same frequency bandwidth as the Ack/Nack exclusive channel, and a divided part is allocated to a certain mobile terminal group.

Fig. 57 shows a figure of a time-frequency resource. Regions A and B are regions for an Ack/Nack exclusive channel. In this example, the first LB is allocated, as the region for sounding RS, once within 2 TTIs. The region for sounding RS is divided into parts having the same frequency bandwidth as the Ack/Nack exclusive channel, and a divided part is allocated to a certain mobile terminal group. Each of a plurality of mobile terminals in the certain mobile terminal group transmits

a reference signal for sounding by using this divided part of the region for sounding RS.

[0228]

Because the region with which a certain mobile terminal transmits a sounding RS has the same frequency bandwidth as the Ack/Nack exclusive channel, the length of a code for sounding pilot symbols can be made to be equal to that of a code for an Ack/Nack and/or CQI symbols. Therefore, the necessity to separately provide two codes specific to each mobile terminal for sounding pilot symbols and for an Ack/Nack or CQI symbols can be eliminated. In other words, the required number of types of spread codes can be reduced to one.

Therefore, with this structure, there is provided an advantage of being able to reduce the amount of codes specific to each mobile terminal, and hence to increase the number of mobile terminals allocated from the base station.

[0229]

In a third variant, a region for sounding RS is disposed also in an Ack/Nack exclusive channel.

Fig. 58 shows a figure of a time-frequency resource. Regions A and B are regions for the Ack/Nack exclusive channel. In this example, also in the Ack/Nack exclusive channel region, the first LB is allocated, as the region for sounding RS, once within 2 TTIs.

Because the region for sounding RS is disposed in the Ack/Nack exclusive channel, the necessity to separately provide two codes specific to each mobile terminal for sounding pilot symbols and for an Ack/Nack or CQI symbols can be eliminated. That is, the frequency band which is multiplied by the spread

code becomes equal. Therefore, with this structure, there is provided an advantage of being able to reduce the amount of codes specific to each mobile terminal, and hence to increase the number of mobile terminals allocated from the base station.

Furthermore, there is provided an advantage of eliminating the necessity to separately carry out allocation to the time-frequency resources for sounding pilot symbols and for an Ack/Nack and/or CQI symbols at the time of transmission of a signal, thereby being able to simplify the control of each mobile terminal.

[0230]

Since Embodiment 9 uses a sounding reference signal for transmitting a scheduling request signal, when combined with above-mentioned Embodiment 7, Embodiment 9 can be applied to a mobile terminal regardless of whether or not an Ack/Nack exclusive channel is allocated to the mobile terminal. More specifically, what is necessary is just to apply Embodiment 7 in a case in which any Ack/Nack exclusive channel is not allocated to the mobile terminal, and to apply Embodiment 9 in a case in which an Ack/Nack exclusive channel is allocated to the mobile terminal.

[0231]

This Embodiment 9 discloses the case in which a mobile terminal does not transmit any sounding RS for uplink timing synchronization at certain periodicity. Furthermore, when combined with Embodiment 8, Embodiment 9 can also be applied to a case in which a mobile terminal transmits a sounding RS for uplink timing synchronization at certain periodicity. That is, in Embodiment 9, when receiving transmission of a

sounding RS from a mobile terminal, the base station can recognize that the mobile terminal has made a scheduling request, though when the mobile terminal has originally transmitted a sounding RS for uplink timing synchronization, the base station cannot discriminate the sounding RS for uplink timing synchronization which the mobile terminal has originally transmitted from any scheduling request. In order to solve this problem, what is necessary is just to use the method disclosed in Embodiment 8.

Furthermore, also in the case in which a mobile terminal transmits a sounding RS for uplink timing synchronization at certain periodicity, Embodiment 9 can be applied to the mobile terminal regardless of whether or not an Ack/Nack exclusive channel is allocated to the mobile terminal, when combined with the method disclosed in Embodiment 7.

[0232]

Embodiment 10.

A method of enabling a mobile terminal to transmit an uplink scheduling request by using a sounding RS regardless of whether the mobile terminal transmits a sounding RS for uplink timing synchronization at certain periodicity will be disclosed.

A time-frequency region for sounding RS is allocated as shown in Fig. 42 or 55. Fig. 42 shows a case in which no allocation of resources of an Ack/Nack exclusive channel is made, and Fig. 55 shows a case in which allocation of resources of an Ack/Nack exclusive channel is made. In either of the cases, a sounding RS from a mobile terminal is transmitted with an allocated region for sounding RS. It is assumed that the length

of time intervals at which a sounding RS for uplink timing synchronization is transmitted is n×TTI (n>=2).

[0233]

Fig. 63 shows a transmission signal of a mobile terminal when an uplink scheduling request has occurred. Hereafter, it is assumed that the length of time intervals at which a sounding RS for uplink timing synchronization is transmitted is 10TTI. In a case in which a necessity for transmission of uplink data occurs in a mobile terminal, when the timing at which the mobile terminal transmits an uplink scheduling request is the same as that at which the mobile terminal transmits a sounding RS for uplink timing synchronization, the mobile terminal transmits this sounding RS for synchronization while forming the sounding RS in such a way that the sounding RS have the functions of the scheduling request.

As a method of forming a sounding RS for synchronization in such a way that the sounding RS have the functions of a scheduling request, the method disclosed in above-mentioned Embodiment 8 can be used. For example, a method of providing two types of sounding pilot patterns corresponding to the presence and absence of an uplink scheduling request can be used. In a case in which a necessity for transmission of uplink data occurs in a mobile terminal, when the timing at which the mobile terminal transmits an uplink scheduling request differs from that at which the mobile terminal transmits a sounding RS for uplink timing synchronization, the mobile terminal transmits the sounding RS as an uplink scheduling request.

[0234]

Fig. 64 shows a diagram of sequences between the mobile

terminal and the base station. The mobile terminal, in ST9101, judges whether an uplink data transmission request has occurred. When no uplink data transmission request has occurred, the mobile terminal carries out ST9104. In contrast, when an uplink data transmission request has occurred, the mobile terminal, in ST9102, judges whether the transmission timing of an uplink scheduling request is the same as that of a sounding RS for uplink timing synchronization. If those transmission timings are the same as each other, the mobile terminal carries out ST9103. The mobile terminal, in ST9103, selects a pattern 2 as a pilot for sounding. The mobile terminal then carries out ST9105. When, in ST9102, judging that the transmission timing of the uplink scheduling request differs from that of a sounding RS for uplink timing synchronization, the mobile terminal carries out ST9104. The mobile terminal, in ST9104, selects a pattern 1 as a pilot for sounding. The mobile terminal then carries out ST9105. The mobile terminal, in ST9105, multiplies the transmission signal by a code A specific to each mobile terminal. The mobile terminal, in ST9106, transmits the transmission signal to the base station with the region for sounding (RB). The base station which, in ST9107, has received the transmission signal with the region for sounding (RB), in ST9108, judges whether or not the received signal has the timing of a sounding RS for uplink timing synchronization.

[0235]

Because the base station carries out scheduling of the timing of a sounding RS for uplink timing synchronization and notifies the timing to the mobile terminal in advance, or the timing is predetermined, the base station can make the judgment.

When, in ST9108, judging that the received signal has the same timing, the base station carries out ST9110. The base station, in ST9110, performs a correlation operation on the received signal by using the code A. When the result of the correlation operation is equal to or larger than a certain threshold, the base station identifies the mobile terminal. The base station then carries out ST9111. The base station, in ST9111, judges whether the pilot for sounding is the pattern 1 or the pattern 2. As a method of judging whether the pilot for sounding is the pattern 1 or the pattern 2, a method disclosed in Embodiment 8 can be used. When judging that the pilot for sounding is the pattern 1, the base station handles the signal by judging that the signal does not include an uplink scheduling request. When, in ST9111, judging that the pilot for sounding is the pattern 2, the base station carries out ST9112. When, in ST9108, judging that the received signal has a timing different from that of a sounding RS for uplink timing synchronization, the base station carries out ST9109. The base station, in ST9109, performs a correlation operation on the received signal by using the code A, and, when the result of the correlation operation is equal to or larger than a certain threshold, the base station identifies the mobile terminal, and, in ST9112, handles the signal by judging that the signal includes an uplink scheduling request.

[0236]

With the above-mentioned structure, the same advantages as those provided by Embodiment 8 can be offered. Furthermore, there is provided an advantage of enabling a mobile terminal to transmit an uplink scheduling request regardless of whether

the mobile terminal transmits a sounding RS for uplink timing synchronization at certain periodicity.

[0237]

Hereafter, variants will be explained.

In a first variant, when the transmission timing of an uplink scheduling request coincides with that of a sounding RS for uplink timing synchronization, the timing at which an uplink scheduling request is transmitted is delayed by 2 TTIs.

Fig. 65 shows a transmission signal of a mobile terminal when an uplink scheduling request occurs in the mobile terminal. In this case, the transmission time during which a sounding RS for uplink timing synchronization is transmitted is 10TTI. In a case in which a request for transmission of uplink data occurs in a mobile terminal, when the timing at which the mobile terminal transmits an uplink scheduling request is the same as that at which the mobile terminal transmits a sounding RS for uplink timing synchronization, the mobile terminal transmits the scheduling request by delaying its transmission timing by 2TTI. In contrast, when the timing at which the mobile terminal transmits an uplink scheduling request differs from that at which the mobile terminal transmits a sounding RS for uplink timing synchronization, the mobile terminal transmits the scheduling request without delaying its transmission timing by 2TTI.

[0238]

Fig. 66 shows a diagram of sequences between the mobile terminal and the base station. The mobile terminal, in ST9301, judges whether an uplink data transmission request has occurred. When no uplink data transmission request has occurred, the

mobile terminal carries out ST9304. In contrast, when an uplink data transmission request has occurred, the mobile terminal, in ST9302, judges whether the transmission timing of an uplink scheduling request is the same as that of a sounding RS for uplink timing synchronization. If those transmission timings are the same as each other, the mobile terminal carries out ST9303. The mobile terminal, in ST9303, carries out a process of delaying the transmission timing of the scheduling request by 2TTI. In this case, about the sounding RS signal for uplink timing synchronization, the mobile terminal carries out a process of transmitting the sounding RS signal without delaying its transmission timing. The mobile terminal, in ST9304, multiplies the transmission signal by a code A specific to each mobile terminal. The mobile terminal, in ST9305, transmits the transmission signal to the base station with the region for sounding (RB). The base station which, in ST9306, has received the signal with the RB for sounding carries out ST9307.

[0239]

The base station, in ST9307, judges whether or not the received signal has the timing of a sounding RS for uplink timing synchronization. When judging that the received signal has the timing of a sounding RS for uplink timing synchronization, the base station, in ST9308, performs a correlation operation on the received signal by using the code A, and, when the result of the correlation operation is equal to or larger than a certain threshold, identifies the mobile terminal and then carries out ST9309. The base station, in ST9309, handles the signal by judging that the signal does not include an uplink scheduling request. More specifically, in this case, the base station

handles the signal as a normal sounding RS for uplink timing synchronization. When, in ST9307, judging that the received signal has a timing different from that of a sounding RS for uplink timing synchronization, the base station, in ST9310, performs a correlation operation on the received signal by using the code A, and, when the result of the correlation operation is equal to or larger than a certain threshold, the base station identifies the mobile terminal and carries out ST9311. The base station, in ST9311, handles the signal by judging that the signal includes an uplink scheduling request.

[0240]

With the above-mentioned structure, the same advantages as those provided by Embodiment 10 can be offered. Furthermore, there is provided an advantage of reducing the number of types of sounding pilot patterns to only one. Thereby, there is provided another advantage of reducing the processing carried out by the base station and the processing carried out by the mobile terminal. Compared with a case in which in, for example, Embodiment 10, the method of using the two types of codes (the codes A and B), as disclosed in Embodiment 8, is used in order to discriminate a sounding RS for uplink timing synchronization and an uplink scheduling request from each other, there is provided an advantage of reducing the number of codes to one-half that in the above-mentioned case, and increasing the number of mobile terminals to each of which a mobile-terminal-specific code can be allocated.

In the above-mentioned variant, an uplink scheduling request is transmitted with its transmission timing being delayed by 2TTI. As an alternative, an uplink scheduling

request can be transmitted at any timing at which no sounding RS for uplink timing synchronization is transmitted. In this case, a mobile terminal is allowed to transmit a scheduling request with a time delay depending on its processing capability.

[0241]

A combination of Embodiment 10 or the first variant with Embodiment 9 can be applied regardless of whether or not resource allocation of an Ack/Nack exclusive channel is made.

Industrial Applicability

[0242]

As mentioned above, the present invention is suitable for a communication system which needs to prevent the increase in the radio resource load due to temporary increase in the physical channels.

Electronic Acknowledgement Receipt	
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Application Number:	14587726
International Application Number:	
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First Named Inventor/Applicant Name:	Miho Maeda
Customer Number:	22850
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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		445600US-response.pdf	73933 39ac20b2820bf10c49bd628f858fb662eb761503	yes	3

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Miscellaneous Incoming Letter	1	1
	Applicant Response to Pre-Exam Formalities Notice	2	3

Warnings:					
Information:					
2	Specification	445600US-SubSpec.pdf	360119 8de2fa75429f46ef25e29decafe30912c716dd8c	no	162
Warnings:					
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3	Applicant Arguments/Remarks Made in an Amendment	445600US-SubSpec-MU.pdf	327516 0cfaed02bb036fdddc3f0e57332a4b62f541a32d	no	162
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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.

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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.

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OBLON

Docket No.: 445600US20CONT

ATTORNEYS AT LAW

COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313

RE: Application Serial No.: 14/587,726
Applicants: Miho MAEDA, et al.
Filing Date: December 31, 2014
For: DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL
Group Art Unit: 2414
Examiner: Unassigned

Commissioner:

Attached hereto for filing are the following papers:

STATEMENT UNDER 37 C.F.R. § 1.125(b)
SUBSTITUTE SPECIFICATION with Marked-Up Copy

Credit card payment is being made online (if electronically filed), or is attached hereto (if paper filed), in the amount of **$0.00** to cover any required fees. In the event any variance exists between the amount enclosed and the Patent Office charges for filing the above-noted documents, including any fees required under 37 C.F.R. 1.136 for any necessary Extension of Time to make the filing of the attached documents timely, please charge or credit the difference to our Deposit Account No. **15-0030**. Further, if these papers are not considered timely filed, then a petition is hereby made under 37 C.F.R. 1.136 for the necessary extension of time.

Respectfully submitted,

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I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

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[ ] Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

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Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

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Assignee Name and Address: Mitsubishi Electric Corporation
7-3, Marunouchi 2-chome Chiyodaku
Tokyo 100-8310 JAPAN

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be Filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of The practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record
The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature		Date	February 26, 2014
Name	Mitsuyuki Takada	Telephone	
Title	Department Manager, Patent Administration Department, Corporate Intellectual Property Division, Mitsubishi Electric Corporation		

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

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Miho MAEDA, et al.

Application No./Patent No.: 14/587,726 Filed/Issue Date: December 31, 2014

Entitled: DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL

MITSUBISHI ELECTRIC CORPORATION ; Corporation
(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, government agency, etc.)

States that it is:

1. ■ the assignee of the entire right, title, and interest; or
2. ☐ an assignee of less than the entire right, title and interest.
   The extent (by, percentage) of its ownership interest is _____%

in the patent application/patent identified above by virtue of:

■ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 022186, Frame 0806, or for which a copy therefore is attached.

■ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

Eckhard H. Kuesters 2/12/2015
Signature Date

Eckhard H. Kuesters 703-413-3000
Printed Name: Registration No. 28,870 - Attorney of Record Telephone Number

Registration Number Eckhard H. Kuesters
Registration No. 28,870

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	445600US20CONT
	Application Number	14/587,726
Title of Invention	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL	

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

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Miho		MAEDA	

Residence Information	Non US Residency		
City	Tokyo	Country of Residence	Japan

Mailing Address of Inventor:

Address 1	c/o Mitsubishi Electric Corporation		
Address 2	7-3, Marunouchi 2-chome		
City	Chiyoda-ku	State/Province	Tokyo
Postal Code	100-8310	Country	Japan

Inventor 2

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Mitsuru		MOCHIZUKI	

Residence Information	Non US Residency		
City	Tokyo	Country of Residence	Japan

Mailing Address of Inventor:

Address 1	c/o Mitsubishi Electric Corporation		
Address 2	7-3, Marunouchi 2-chome		
City	Chiyoda-ku	State/Province	Tokyo
Postal Code	100-8310	Country	Japan

Inventor 3

Legal Name

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	445600US20CONT
	Application Number	14/587,726
Title of Invention	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL	

Prefix	Given Name	Middle Name	Family Name	Suffix
	Keiko		TADA	

Residence Information	**Non US Residency**		
City	Tokyo	**Country of Residence**	Japan

Mailing Address of Inventor:

Address 1	c/o Mitsubishi Electric Corporation		
Address 2	7-3, Marunouchi 2-chome		
City	Chiyoda-ku	**State/Province**	Tokyo
Postal Code	100-8310	**Country**	Japan

Inventor 4

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Yasushi		IWANE	

Residence Information	**Non US Residency**		
City	Tokyo	**Country of Residence**	Japan

Mailing Address of Inventor:

Address 1	c/o Mitsubishi Electric Corporation		
Address 2	7-3, Marunouchi 2-chome		
City	Chiyoda-ku	**State/Province**	Tokyo
Postal Code	100-8310	**Country**	Japan

Correspondence Information:

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

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

Customer Number	22850
Email Address	oblonpat@oblon.com

Application Information:

Title of the Invention	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL		
Attorney Docket Number	445600US20CONT	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		

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TCL Comm Tech Holdings Ltd. v. Mitsubishi Electric Corp. - IPR2023-00957
Page 556

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	445600US20CONT
	Application Number	14/587,726
Title of Invention	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL	

Subject Matter			
Total Number of Drawing Sheets (if any)	60	**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	22850		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this 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 blank.

Prior Application Status	Pending		
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Continuation of	12/375,574	2009-01-29
Prior Application Status	Pending		

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	445600US20CONT
	Application Number	14/587,726
Title of Invention	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL	

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
12/375,574	a 371 of international	PCT/JP2006/326117	2006-12-27

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(d). When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(h)(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).

Application Number	Country	Filing Date (YYYY-MM-DD)	Access Code (if applicable)
2006-292641	Japan	2006-10-27	

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.

Authorization to Permit Access:

☐ Authorization to Permit Access to the Instant Application by the Participating Offices

If 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 World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date of filing this Authorization.

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.

Ex. 1002 - TCL Comm Tech Holdings Ltd.
TCL Comm Tech Holdings Ltd. v. Mitsubishi Electric Corp. - IPR2023-00957
Page 558

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	445600US20CONT
	Application Number	14/587,726
Title of Invention	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL	

Applicant 1

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

■ 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	MITSUBISHI ELECTRIC CORPORATION

Mailing Address Information For Applicant:

Address 1	7-3, Marunouchi 2-chome		
Address 2			
City	Chiyoda-ku	**State/Province**	Tokyo
Country	Japan	Postal Code	100-8310
Phone Number		Fax Number	
Email Address			

Assignee Information including Non-Applicant Assignee Information:

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

Assignee 1

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

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

Organization Name	MITSUBISHI ELECTRIC CORPORATION

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1	7-3, Marunouchi 2-chome

Ex. 1002 - TCL Comm Tech Holdings Ltd.
TCL Comm Tech Holdings Ltd. v. Mitsubishi Electric Corp. - IPR2023-00957
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	445600US20CONT
	Application Number	14/587,726
Title of Invention	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL	

Address 2			
City	Chiyoda-ku	**State/Province**	Tokyo
Country	Japan	Postal Code	100-8310
Phone Number		Fax Number	
Email Address			

Signature:

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

Signature				Date (YYYY-MM-DD)	FEB 13 2015
First Name		Last Name		Registration Number	

James H. Knebel
Registration No. 22,630

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

Title of Invention	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL

As a below named inventor, I hereby declare that:

This declaration is directed to:

☐ The attached application, or

☒ United States application or PCT international application number 14/587,726 Filed on December 31, 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.

LEGAL NAME OF INVENTOR

Inventor: Miho MAEDA Date (Optional): January 19, 2015

Signature: Miho Maeda

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

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

Title of Invention	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL

As a below named inventor, I hereby declare that:

This declaration is directed to:

☐ The attached application, or

☒ United States application or PCT international application number 14/587,726 Filed on December 31, 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.

LEGAL NAME OF INVENTOR

Inventor: Mitsuru MOCHIZUKI Date (Optional): January 20, 2015

Signature: Mitsuru Mochizuki

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

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

Title of Invention	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL

As a below named inventor, I hereby declare that:

This declaration is directed to:

☐ The attached application, or

☒ United States application or PCT international application number 14/587,726 Filed on December 31, 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.

LEGAL NAME OF INVENTOR

Inventor: Keiko TADA Date (Optional): January 21, 2015

Signature: Keiko Tada

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

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

Title of Invention	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL

As a below named inventor, I hereby declare that:

This declaration is directed to:

☐ The attached application, or

☒ United States application or PCT international application number 14/587,726 Filed on December 31, 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.

LEGAL NAME OF INVENTOR

Inventor: Yasushi IWANE Date (Optional): January 21, 2015

Signature: Yasushi Iwane

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

Electronic Acknowledgement Receipt	
EFS ID:	21500299
Application Number:	14587726
International Application Number:	
Confirmation Number:	6371
Title of Invention:	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL
First Named Inventor/Applicant Name:	Miho Maeda
Customer Number:	22850
Filer:	Bradley Davis Lytle/candice kinard
Filer Authorized By:	Bradley Davis Lytle
Attorney Docket Number:	445600US20CONT
Receipt Date:	13-FEB-2015
Filing Date:	31-DEC-2014
Time Stamp:	16:27:15
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		445600USPOA_DEC.pdf	453538 0f7c958b6d21a90a90e6f05dcdac794dbc4eddda1	yes	12

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Power of Attorney	1	1
	Assignee showing of ownership per 37 CFR 3.73.	2	2
	Application Data Sheet	3	8
	Oath or Declaration filed	9	12
Warnings:			
Information:			
	Total Files Size (in bytes):	453538	

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

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/587,726	12/31/2014	Miho Maeda	445600US20CONT

CONFIRMATION NO. 6371

FORMALITIES LETTER

22850
OBLON, MCCLELLAND, MAIER & NEUSTADT, L.L.P.
1940 DUKE STREET
ALEXANDRIA, VA 22314

OC000000072959305

Date Mailed: 01/22/2015

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Filing Date Granted

An application number and filing date have been accorded to this application. The application is informal since it does not comply with the regulations for the reason(s) indicated below. Applicant is given TWO MONTHS from the date of this Notice within which to correct the informalities indicated below. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

The required item(s) identified below must be timely submitted to avoid abandonment:

- A substitute specification in compliance with 37 CFR 1.52, 1.121(b)(3), and 1.125, is required. The substitute specification must be submitted with markings and be accompanied by a clean version (without markings) as set forth in 37 CFR 1.125(c) and a statement that the substitute specification contains no new matter (see 37 CFR 1.125(b)). The specification, claims, and/or abstract page(s) submitted is not acceptable and cannot be scanned or properly stored because:
  - The application contains drawings, but the specification does not contain a brief description of the several views of the drawings as required by 37 CFR 1.74 and 37 CFR 1.77(b)(9).

Applicant is cautioned that correction of the above items may cause the specification and drawings page count to exceed 100 pages. If the specification and drawings exceed 100 pages, applicant will need to submit the required application size fee.

Items Required To Avoid Processing Delays:

Applicant is notified that the above-identified application contains the deficiencies noted below. No period for reply is set forth in this notice for correction of these deficiencies. However, if a deficiency relates to the inventor's oath or declaration, the applicant must file an oath or declaration in compliance with 37 CFR 1.63, or a substitute statement in compliance with 37 CFR 1.64, executed by or with respect to each actual inventor no later than the expiration of the time period set in the "Notice of Allowability" to avoid abandonment. See 37 CFR 1.53(f).

- A properly executed inventor's oath or declaration has not been received for the following inventor(s):
  Miho Maeda
  Mitsuru Mochizuki
  Keiko Tada
  Yasushi Iwane

Ex. 1002 - TCL Comm Tech Holdings Ltd.
TCL Comm Tech Holdings Ltd. v. Mitsubishi Electric Corp. - IPR2023-00957
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Replies must be received in the USPTO within the set time period or must include a proper Certificate of Mailing or Transmission under 37 CFR 1.8 with a mailing or transmission date within the set time period. For more information and a suggested format, see Form PTO/SB/92 and MPEP 512.

Replies should be mailed to:

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web, including a copy of this Notice and selecting the document description "Applicant response to Pre-Exam Formalities Notice". https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html

For more information about EFS-Web please call the USPTO Electronic Business Center at **1-866-217-9197** or visit our website at http://www.uspto.gov/ebc.

If you are not using EFS-Web to submit your reply, you must include a copy of this notice.

/khoang/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

Ex. 1002 - TCL Comm Tech Holdings Ltd.
TCL Comm Tech Holdings Ltd. v. Mitsubishi Electric Corp. - IPR2023-00957
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 14/587,726

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	600
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))	3 minus 20 =	*			OR	x 80 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	*				x 420 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						800
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	2400

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 =	
AMENDMENT A	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
AMENDMENT A	Application Size Fee (37 CFR 1.16(s))									
AMENDMENT A	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($)	ADDITIONAL FEE($)		RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
AMENDMENT B	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
AMENDMENT B	Application Size Fee (37 CFR 1.16(s))									
AMENDMENT B	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".
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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
14/587,726	12/31/2014	2414	2540	445600US20CONT	3	3

CONFIRMATION NO. 6371

22850
OBLON, MCCLELLAND, MAIER & NEUSTADT, L.L.P.
1940 DUKE STREET
ALEXANDRIA, VA 22314

FILING RECEIPT

OC000000072959304

Date Mailed: 01/22/2015

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)

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Keiko Tada, Tokyo, JAPAN;
Yasushi Iwane, Tokyo, JAPAN;

Assignment For Published Patent Application

MITSUBISHI ELECTRIC CORPORATION, Chiyoda-ku, JAPAN

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application is a CON of 12/375,574 01/29/2009
which is a 371 of PCT/JP2006/326117 12/27/2006

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.)
JAPAN 2006-292641 10/27/2006

Request to Retrieve - This application either claims priority to one or more applications filed in an intellectual property Office that participates in the Priority Document Exchange (PDX) program or contains a proper **Request to**

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If Required, Foreign Filing License Granted: 01/21/2015

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 14/587,726**

Projected Publication Date: To Be Determined - pending completion of Corrected Papers

Non-Publication Request: No

Early Publication Request: No

Title

DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL

Preliminary Class

370

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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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.

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TCL Comm Tech Holdings Ltd. v. Mitsubishi Electric Corp. - IPR2023-00957
Page 571

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DOCKET NO: 445600US20CONT

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF		:
MIHO MAEDA, ET AL.		: ATTN: APPLICATION DIVISION
SERIAL NO: 14/587,726		:
FILED:	DECEMBER 31, 2014	:
FOR:	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL	:

PRELIMINARY AMENDMENT

COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313

Commissioner:

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

Amendments to the Specification begin on page 2 of this paper.

Amendments to the Claims are reflected in the listing of claims which begins on page 6 of this paper.

Remarks begin on page 8 of this paper.

IN THE SPECIFICATION

Please add the following paragraph at page 1, after line 3:

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. Patent Application Serial No. 12/375,574, filed January 29, 2009, which is a National Stage Application of PCT Application No. PCT/JP2006/326117, filed December 27, 2006, which claims priority to Japanese Patent Application No. 2006-292641, filed October 27, 2006. The entire contents of U.S. Patent Application Serial No. 12/375,574 are incorporated herein by reference in their entirety.

Please amend the paragraph at page 9, line 23 to page 10, line 5, as follows:

A scheduled channel is scheduled to be allocated to each target mobile terminal, unlike a channel, such as an S-RACH, in which collision (or referred to as competition) of signals from a plurality of mobile terminals is allowed. In this case, because a region which is allocated in advance to each mobile terminal is decided, there is no competition between signals from a plurality of mobile terminals, and therefore there is no necessity ~~to transmit, as an SR signal which each mobile terminal has transmitted, the ID number (the UE-ID) of each mobile terminal which is effective within the cell of the base station,~~ for the ID number (the UE-ID) of each mobile terminal which is effective within the cell of the base station to be mapped onto an SR signal which each mobile terminal has transmitted. Therefore, in a case in which an uplink SRA is transmitted by using a scheduled channel, the amount of information of the uplink SR signal can be reduced.

Please amend the specification at page 20, lines 3-6, as follows:

[Fig. 8] Fig. [[7]] 8 is a flow chart explaining the series of processes including from the process of transmitting an uplink scheduling request signal up to the process of starting

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transmission of uplink data;

Please amend the paragraph at page 23, lines 18-19, as follows:

[Fig. 43] Fig. 43 is an explanatory drawing in a case of ~~setting up~~ a Sounding RS region for each UE group;

Please amend the paragraph at page 36, line 28 to page 37, line 10, as follows:

[0047]

The mobile terminal then starts transmission of uplink data by using a UL-SCH (Uplink Shared channel). In this Embodiment 1, the example in which one subframe is allocated to transmission of an uplink scheduling request signal SR is explained. However, because there is a case in which a preamble and a message are sent at a time during a long transmission time, as shown in Fig. 7, and a case in which ~~they are sent at two times during short transmission time~~ a preamble is sent at a time during short transmission time and a message is sent at a time during another short transmission time, as shown in Fig. 8, the length of a transmission time during which an Ack/Nack cannot be transmitted, and the occurrence frequency can be changed according to the length and frequency of the transmission time of the uplink scheduling request signal SR.

Please amend the paragraph at page 40, line 21 to page 41, line 3, as follows:

In the case in which the transmission time of an uplink scheduling request signal SR is long, the time during which an Ack/Nack and/or a CQI cannot be transmitted (the DTX of the Ack/Nack symbol and/or the CQI symbol) becomes long, whereas in the case in which the transmission time of an uplink scheduling request signal SR are short, the time interval during which an Ack/Nack and/or a CQI cannot be transmitted becomes short. For each of

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the cases, a method of preventing the degradation of the communication quality ~~due to occurrence of errors in the~~ because no transmission of the Ack/Nack symbol information and/or the CQI symbol information is carried out during the time during which the uplink scheduling request signal SR is transmitted will be explained hereafter.

Please amend the paragraph at page 129, lines 8-11, as follows:

In a first variant, a symbol or two or more symbols of the pilot for sounding ~~are~~ [[is]] a symbol or two or more symbols for scheduling request. A pilot pattern in which a [[part]] symbol or two or more symbols of the pilot for sounding are [[is]] a symbol or two or more symbols for scheduling request is shown in Fig. 47.

Please amend the paragraph at page 140, lines 22-29, as follows:

[0218]

An Ack/Nack or a CQI symbol is multiplied by a code A specific to each mobile terminal, and is mapped to the resource for Ack/Nack exclusive channel. This code A is used to identify the mobile terminal in the Ack/Nack exclusive channel, as mentioned in Embodiment 3. These two types of codes specific to each mobile terminal are predetermined, or are notified from the base station.

Please amend the paragraph at page 141, lines 11-28, as follows:

[0219]

The mobile terminal, in ST8902, inserts the pilot for sounding into the first LB within 2 TTIs, and multiplies this LB by the code a. The mobile terminal, in ST8903, inserts an Ack/Nack and/or a CQI into a second or subsequent LBs, and multiplies these LBs by the code A. The mobile terminal, in ST8905, carries out allocation of the pilot for sounding

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which is multiplied by the code a to the region for sounding RS, and carries out allocation of the Ack/Nack or the CQI which is multiplied by the code A to the resource for Ack/Nack exclusive channel, and then transmits them to the base station. The base station which, in ST8906, received the signals, in ST8907, performs a correlation operation on the signal in the region for sounding by using the code a, and, when the result of the correlation operation is equal to or larger than a certain threshold, can identify the mobile terminal and judge that the base station has received an uplink scheduling request from this identified mobile terminal.

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IN THE CLAIMS

Please amend the claims as follows:

Claim 1 (Canceled).

Claim 2 (New): A data communication method which is implemented by a communication system, the method comprising:

transmitting data by a base station using an OFDM (Orthogonal Frequency Division Multiplexing) method as a downlink access method;

transmitting, by a mobile terminal, a quality notification signal for notifying downlink communication quality to said base station;

transmitting, by said mobile terminal, a scheduling request signal to said base station requesting allocation of radio resources from said base station before transmitting transmission data to said base station; and

performing, by said mobile terminal:

a quality notification process of transmitting said quality notification signal to said base station;

a scheduling request signal transmission process of transmitting said scheduling request signal to said base station; and

a control process of, when a processing timing of said quality notification process coincides with that of said scheduling request signal transmission process, stopping said quality notification process during a time interval during which said mobile terminal transmits said scheduling request signal.

3 (New): A communications system comprising:

a base station configured to transmit data by using an OFDM (Orthogonal Frequency

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Division Multiplexing) method as a downlink access method; and

a mobile terminal configured to transmit a quality notification signal for notifying downlink communication quality to said base station, and to transmit a scheduling request signal with which to make a request for allocation of radio resources to said base station before transmitting transmission data to said base station,

wherein said mobile terminal includes:

a transmitting unit configured to transmit said quality notification signal to said base station, and to transmit said scheduling request signal to said base station; and

a control unit configured to, when a transmission timing of said quality notification signal coincides with that of said scheduling request signal in said transmitting unit, stop the transmission process of transmitting said quality notification signal during a time interval during which said transmitting unit transmits said scheduling request signal.

4 (New): A mobile terminal configured to:

transmit a quality notification signal for notifying downlink communication quality to a base station, and

transmit a scheduling request signal with which to make a request for allocation of radio resources to said base station before transmitting transmission data to said base station,

wherein said mobile terminal includes:

a transmitting unit configured to transmit said quality notification signal to said base station, and to transmit said scheduling request signal to said base station; and

a control unit configured to, when a transmission timing of said quality notification signal coincides with that of said scheduling request signal in said transmitting unit, stop the transmission process of transmitting said quality notification signal during a time interval during which said transmitting unit transmits said scheduling request signal.

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REMARKS

Favorable consideration of this application, in view of the present amendments and in light of the following discussion, is respectfully requested.

By the present Preliminary Amendment, the specification is amended to include the Cross-reference to Related Applications section and to clarify certain disclosures therein at least for consistency with U.S. Patent Application Serial No. 12/375,574, which was incorporated by reference. In addition, Claims 2-4 are pending. Claim 1 is canceled without prejudice or disclaimer, and Claims 2-4 are newly added. No new matter has been added.

In view of the foregoing, it is believed that this application is in condition for formal examination on the merits. An early and favorable action is therefore respectfully requested.

Respectfully Submitted,

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MAIER & NEUSTADT, L.L.P.

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TCL Comm Tech Holdings Ltd. v. Mitsubishi Electric Corp. - IPR2023-00957
Page 580

Electronic Acknowledgement Receipt	
EFS ID:	21109498
Application Number:	14587726
International Application Number:	
Confirmation Number:	6371
Title of Invention:	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL
First Named Inventor/Applicant Name:	Miho MAEDA
Customer Number:	22850
Filer:	Marvin Jay Spivak/Yuriko Stankich
Filer Authorized By:	Marvin Jay Spivak
Attorney Docket Number:	445600US20CONT
Receipt Date:	02-JAN-2015
Filing Date:	
Time Stamp:	16:48:05
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		445600US-prelAME.pdf	299611 98b4c6902c952660c49b9b31360daba03e86423d	yes	9

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Miscellaneous Incoming Letter	1	1
	Preliminary Amendment	2	2
	Specification	3	6
	Claims	7	8
	Applicant Arguments/Remarks Made in an Amendment	9	9
Warnings:			
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Docket No. 445600US20CONT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

INVENTOR(S) Miho MAEDA, et al.

SERIAL NO: 14/587,726 ART UNIT: Unassigned

FILING DATE: December 31, 2014 EXAMINER: Unassigned

FOR: DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL

FEE TRANSMITTAL

■ No additional fee is required

☐ Small entity status of this application under 37 C.F.R. §1.9 and §1.27 is claimed.

☐ Track 1 Prioritized Examination

The Fee has been calculated as shown below:

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TOTAL CLAIMS	3 - 20 =	0	x $80 =	$0.00
INDEPENDENT CLAIMS	3 - 3 =	0	x $420 =	$0.00
☐ MULTIPLE DEPENDENT CLAIMS (If applicable)			+ $780 =	$0.00
☐ LATE FILING OF DECLARATION			+ $140 =	$0.00
☐ NON-ELECTRONIC FILING FEE			+ $400 =	$0.00
			BASIC FEES	$0.00
			TOTAL OF ABOVE CALCULATIONS	$0.00
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Submitted by: _____

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Docket No. 445600US20CONT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

INVENTOR(S) Miho MAEDA, et al.

SERIAL NO: New Continuation Application ART UNIT:

FILING DATE: Herewith EXAMINER:

FOR: DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL

FEE TRANSMITTAL

☐ No additional fee is required

☐ Small entity status of this application under 37 C.F.R. §1.9 and §1.27 is claimed.

☐ Track 1 Prioritized Examination

The Fee has been calculated as shown below:

FOR	NUMBER FILED	NUMBER EXTRA	RATE	CALCULATIONS
TOTAL CLAIMS	1 - 20 =	0	x $80 =	$0.00
INDEPENDENT CLAIMS	1 - 3 =	0	x $420 =	$0.00
UTILITY APPLICATION SIZE FEE	164* - 100 = (* 218 x .75)	2 (each addtl. 50 sheets over 100)	x $400 =	$800.00
☐ MULTIPLE DEPENDENT CLAIMS (If applicable)			+ $780 =	$0.00
■ LATE FILING OF DECLARATION			+ $140 =	$140.00
☐ NON-ELECTRONIC FILING FEE			+ $400 =	$0.00
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TOTAL OF ABOVE CALCULATIONS				$2,540.00
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☐ FILING FEE REDUCED IF E-FILED – SMALL ENTITY			+ $-70 =	$0.00
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			TOTAL	$2,540.00

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Submitted by:

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Docket No. 445600US20CONT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF: Miho MAEDA, et al. GAU:

SERIAL NO: New Continuation Application EXAMINER:

FILED: Herewith

FOR: DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL

SUBMISSION NOTICE REGARDING PRIORITY DOCUMENT(S)

COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313

Commissioner:

Certified copy of the Convention Application(s) corresponding to the above-captioned matter:

- ☐ are submitted herewith
- ☐ were filed in prior application Serial No. filed
- ■ was submitted to the International Bureau in PCT Application Number PCT/JP2006/326117
  Receipt of the certified copies by the International Bureau in a timely manner under PCT Rule 17.1(a) has been acknowledged as evidenced by the attached PCT/IB/304.

Respectfully Submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, L.L.P.

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Registration No. 28,870

Zachary S. Stern
Registration No. 54,719

Customer Number
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(OSMMN 07/09)

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION CONCERNING SUBMISSION OR TRANSMITTAL OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

To:

TAZAWA, Hiroaki
7F, Daito Bldg.
7-1, Kasumigaseki
3-chome, Chiyoda-ku
Tokyo 1000013
JAPON

Date of mailing *(day/month/year)* 09 March 2007 (09.03.2007)	
Applicant's or agent's file reference 563553WO01	**IMPORTANT NOTIFICATION**
International application No. PCT/JP2006/326117	International filing date *(day/month/year)* 27 December 2006 (27.12.2006)
International publication date *(day/month/year)* **Not yet published**	Priority date *(day/month/year)* 27 October 2006 (27.10.2006)
Applicant Mitsubishi Electric Corporation et al	

1. By means of this Form, which replaces any previously issued notification concerning submission or transmittal of priority documents, the applicant is hereby notified of the date of receipt by the International Bureau of the priority document(s) relating to all earlier application(s) whose priority is claimed. Unless otherwise indicated by the letters "NR", in the right-hand column or by an asterisk appearing next to a date of receipt, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).

2. *(If applicable)* The **letters "NR"** appearing in the right-hand column denote **a priority document which, on the date of mailing of this Form, had not yet been received by the International Bureau** under Rule 17.1(a) or (b). Where, under Rule 17.1(a), the priority document must be submitted by the applicant to the receiving Office or the International Bureau, but the applicant fails to submit the priority document within the applicable time limit under that Rule, **the attention of the applicant is directed** to Rule 17.1(c) which provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

3. *(If applicable)***An asterisk (*)** appearing next to a date of receipt, in the right-hand column, denotes **a priority document submitted or transmitted to the International Bureau but not in compliance with Rule 17.1(a) or (b)** (the priority document was received after the time limit prescribed in Rule 17.1(a) or the request to prepare and transmit the priority document was submitted to the receiving Office after the applicable time limit under Rule 17.1(b)). Even though the priority document was not furnished in compliance with Rule 17.1(a) or (b), the International Bureau will nevertheless transmit a copy of the document to the designated Offices, for their consideration. In case such a copy is not accepted by the designated Office as the priority document, Rule 17.1(c) provides that no designated Office may disregard the priority claim concerned before giving the applicant an opportunity, upon entry into the national phase, to furnish the priority document within a time limit which is reasonable under the circumstances.

Priority date	Priority application No.	Country or regional Office or PCT receiving Office	Date of receipt of priority document
27 October 2006 (27.10.2006)	2006-292641	JP	19 February 2007 (19.02.2007)

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. +41 22 338 82 70	Authorized officer Yoshiko Kuwahara Facsimile No. +41 22 338 82 70 Telephone No. +41 22 338 91 76

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	445600US20CONT
	Application Number	New Continuation
Title of Invention	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL	

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.)

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	445600US20CONT
	Application Number	New Continuation
Title of Invention	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL	

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Correspondence Information:

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

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

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Application Information:

Title of the Invention	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL		
Attorney Docket Number	445600US20CONT	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	445600US20CONT
	Application Number	New Continuation
Title of Invention	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL	

Subject Matter			
Total Number of Drawing Sheets (if any)	60	**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	22850		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this 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 blank.

Prior Application Status	Pending		
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Continuation of	12/375,574	2009-01-29
Prior Application Status	Pending		

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Title of Invention	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL	

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
12/375,574	a 371 of international	PCT/JP2006/326117	2006-12-27

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(d). When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(h)(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).

Application Number	Country	Filing Date (YYYY-MM-DD)	Access Code (if applicable)
2006-292641	Japan	2006-10-27	

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.

Authorization to Permit Access:

☐ Authorization to Permit Access to the Instant Application by the Participating Offices

If 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 World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date of filing this Authorization.

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.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	445600US20CONT
	Application Number	New Continuation
Title of Invention	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL	

Applicant 1

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

☐ 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. ☐

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Email Address			

Assignee Information including Non-Applicant Assignee Information:

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

Assignee 1

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

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

Organization Name	MITSUBISHI ELECTRIC CORPORATION

Mailing Address Information For Assignee including Non-Applicant Assignee:

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	445600US20CONT
	Application Number	New Continuation
Title of Invention	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL	

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Email Address			

Signature:

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

Signature				Date (YYYY-MM-DD)	2014-12-31
First Name	Zachary	Last Name	Stern	Registration Number	54719

Specification

DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM, AND MOBILE TERMINAL

Field of the Invention

[0001]

The present invention relates to a communication system which is called "Long Term Evolution" (LTE), a mobile terminal which constructs this communication system, and a communication method for an uplink control signal which this mobile terminal transmits to a base station.

Background of the Invention

[0002]

Commercial services which employ a W-CDMA (Wideband Code division Multiple Access) method which is included in communication methods called a third generation were started in Japan since 2001. Furthermore, a start of a service with HSDPA (High Speed Down Link Packet Access) which implements a further improvement in the speed of data transmission using downlinks (an individual data channel and an associated control channel) by adding a channel for packet transmission (HS-DSCH: High Speed-Downlink Shared Channel) to the downlinks has been planned. In addition, an HSUPA (High Speed Up Link Packet Access) method has also been suggested and studied in order to speed up uplink data transmission.

The W-CDMA is a communication method which was determined by the 3GPP (3rd Generation Partnership Project) which is the organization of standardization of mobile communication systems, and the technical specification of the release 6 has been being organized currently.

[0003]

In the 3GPP, as a communication method different from the W-CDMA, a new communication method having a wireless section, which is referred to as "Long Term Evolution" (LTE), and a whole system structure including a core network, which is referred to as "System Architecture Evolution" (SAE), has been studied.

The LTE has an access method, a radio channel configuration, and protocols which are different from those of the current W-CDMA (HSDPA/HSUPA). For example, while the W-CDMA uses, as its access method, code division multiple access (Code Division Multiple Access), the LTE uses, as its access method, OFDM (Orthogonal Frequency Division Multiplexing) for the downlink direction and uses SC-FDMA (Single Career Frequency Division Multiple Access) for the uplink direction. Furthermore, while the W-CDMA has a bandwidth of 5MHz, the LTE can have a bandwidth of 1.25/2.5/5/10/15/20MHz. In addition, the LTE uses only a packet communication method, instead of a circuit switching method which the W-CDMA uses.

[0004]

According to the LTE, because a communication system is constructed using a new core network different from a core network (General Packet Radio System GPRS) which complies with the W-CDMA, the communication system is defined as an independent radio access network which is separate from a W-CDMA network. Therefore, in order to distinguish from a communication system which complies with the W-CDMA, in a communication system which complies with the LTE, a base station (Base station) which communicates with a mobile terminal UE (User Equipment) is called eNB (E-UTRAN NodeB, eNodeB, or eNode-B), a base station control apparatus (Radio Network Controller) which performs exchange of control data and user

data with a plurality of base stations and is called an aGW (Access Gateway).

This communication system which complies with the LTE carries out point-to-multipoint (Point to Multipoint) communications, such as a multicast and broadcast type multimedia service called a E-MBMS (Evolved Multimedia Broadcast Multicast Service), and also provides a communication service such as a unicast (Unicast) service for each mobile terminal among a plurality of mobile terminals.

In the case of the LTE, because no individual channels (Dedicated Channel and Dedicated Physical Channel) destined for each mobile terminal exist in transport channels and physical channels, transmission of data to each mobile terminal is carried out by using a common channel (Shared channel), unlike in the case of the W-CDMA.

[0005]

When receiving data, via a downlink, from a base station, a mobile terminal transmits a signal indicating whether the mobile terminal has received the data perfectly, and a signal indicating either the quality of the received data or the quality of the downlink communication path to the base station via an uplink. The response signal indicating whether the mobile terminal could receive the data correctly from the base station is referred to as an Ack/Nack, and the quality information indicating the quality of the received data or the quality of the downlink communication path is referred to as a CQI (Channel Quality Indicator).

An Ack/Nack is a signal with which, when the mobile terminal has received downlink data, the mobile terminal notifies information indicating whether the mobile terminal

could receive the downlink data correctly to the base station, and the base station uses the Ack/Nack for retransmission control.

A CQI is a signal with which the mobile terminal notifies the downlink channel's state (the communication path's state) which the mobile terminal has measured to the base station, and the base station uses the CQI for downlink scheduling. Furthermore, when data which the mobile terminal has to transmit to the base station occur, the mobile terminal transmits a signal with which to make a request for allocation of uplink radio resources to the base station. Such a request signal is called a scheduling request, an uplink resource request, or an uplink scheduling request signal (SR: Scheduling Request). The Ack/Nack, the CQI, and the SR as mentioned above are called "uplink L1/L2 control signals" (an L1/L2 control signaling).

[0006]

Fig. 22 is an explanatory drawing for explaining uplink L1/L2 control signals.

As shown in Fig. 22, uplink L1/L2 control signals are roughly divided into two types of L1/L2 control signals. They are uplink-data-associated L1/L2 control signals (a data-associated L1/L2 control signaling), and uplink-data-non-associated L1/L2 control signals (a data-non-associated L1/L2 control signaling).

An uplink-data-associated L1/L2 control signal is information required for uplink data transmission (reception by a base station), such as a transport format, and is transmitted together with uplink data. Uplink-data-non-associated L1/L2 control signals include an Ack/Nack and a CQI which are relevant to a downlink, and random

access (Random Access) signals, such as a scheduling request (SR, UL SR) which is transmitted before uplink data transmission is started.

Although an Ack/Nack and a CQI are transmitted regardless of uplink data transmission because they are relevant to a downlink, there is a case in which they are transmitted at the same time when uplink data are transmitted. On the other hand, random access signals include a synchronous random access (Synchronous Random Access which is referred to as SRA from here on) signal and a non-synchronous random access (Non-Synchronous Random Access which is referred to as NSRA from here on) signal.

An SRA is transmitted in a state in which uplink time synchronization is established, whereas an NSRA is transmitted in a state in which uplink time synchronization is not established.

Not only uplink-data-associated L1/L2 control signals but also an Ack/Nack and a CQI are transmitted in a state in which uplink time synchronization is established. Hereafter, the fact that there is a state in which an Ack/Nack and/or a CQI, and an SRA in a case in which no uplink data transmission is carried out are transmitted simultaneously will be mentioned, and a problem with this state and a solution of this problem will be mentioned.

[0007]

An uplink Ack/Nack and an uplink CQI are relevant to a downlink. For allocation of an Ack/Nack and a CQI to physical resources to in the case in which no uplink data transmission is carried out, a method of monopolistically allocating one certain time-frequency region or a method of monopolistically allocating a plurality of time-frequency regions having

separated narrow bands is used (for example, refer to nonpatent reference 1).

Hereafter, these regions are referred to as an Ack/Nack exclusive channel.

That is, in a state in which uplink data transmission is not performed, an Ack/Nack and a CQI are transmitted by using an Ack/Nack exclusive channel.

In further explaining in detail, (1) in a case in which both an Ack/Nack and a CQI have to be transmitted, the Ack/Nack and the CQI are transmitted by using an Ack/Nack exclusive channel, (2) in a case in which an Ack/Nack has to be transmitted, but a CQI does not have to be transmitted, the Ack/Nack is transmitted by using an Ack/Nack exclusive channel, and (3) in a case in which an Ack/Nack does not have to be transmitted, but a CQI has to be transmitted, the CQI is transmitted by using an Ack/Nack exclusive channel. It can also be considered that, (4) even in a case in which an Ack/Nack does not have to be transmitted, and a CQI does not have to be transmitted, an Ack/Nack exclusive channel is allocated to them. In this case, both no Ack/Nack and no CQI are transmitted by using the above-mentioned channel.

Fig. 23 is an explanatory drawing showing radio resources to which an Ack/Nack and a CQI are allocated in the case in which uplink data transmission is carried out or in the case in which no uplink data transmission is carried out. Fig. 23 shows the method of monopolistically allocating one certain time-frequency region.

An Ack/Nack and a CQI in the case in which no uplink data transmission is carried out are allocated to a region having one or more subframes with respect to time and are allocated

to a region having one or more resource units with respect to frequency. In contrast, uplink data, and an Ack/Nack and a CQI in the case in which transmission of either an uplink-data-associated L1/L2 control signal or the uplink data is carried out are allocated to another region.

[0008]

By allocating an Ack/Nack and a CQI in the case in which no uplink data transmission is carried out, i.e., signals associated with only an Ack/Nack and a CQI to a monopolistic region intended only for the signals, a time during which the Ack/Nack and CQI signals are transmitted can be increased, and therefore a large coverage can be acquired.

Fig. 24 is an explanatory drawing showing radio resources in which an Ack/Nack and a CQI are allocated to an Ack/Nack exclusive channel. Fig. 24 shows the method of monopolistically allocating a plurality of time-frequency regions (A and B in Fig. 24) having separated narrow bands for an Ack/Nack and a CQI.

An Ack/Nack and a CQI in the case in which no uplink data transmission is carried out are allocated to some separated regions in units of a subframe with respect to time and are allocated to some separated regions in units of a subcarrier with respect to frequency. By separating the frequency region into some parts (e.g., A and B in Fig. 24), a frequency diversity gain can be acquired.

When using either of the methods, an Ack/Nack and a CQI of one or more mobile terminals can be allocated to one region. It has been studied to, in order to implement a method of multiplexing an Ack/Nack and a CQI of one or more mobile terminals into one region, establish the orthogonality of each

mobile terminal by using FDM (Frequency Division Multiplex) / TDM (Time Division Multiplex) / CDM (Code Division Multiplex). In order to ensure the quality of reception of an Ack/Nack and a CQI by a base station, it has been studied to increase the power by carrying out repetition (repetition) transmission of the Ack/Nack and the CQI. More specifically, there are a method of repeatedly transmitting the same subframe twice within one transmission time interval (Transmission Time Interval TTI), a method of repeatedly including a bit of an Ack/Nack and a bit of a CQI to a plurality of LBs (Long Block) in a subframe so as to transmit them, and so on.

[0009]

A synchronous random access (Synchronous Random Access SRA) is a signal used for a scheduling request (SR) which a mobile terminal transmits before starting uplink data transmission, which the mobile terminal transmits when the mobile terminal is placed in a state in which uplink time synchronization is established (in other words, the mobile terminal is placed in an Active mode). As a method of allocating an SRA to physical resources, there is provided a method of monopolistically allocating one certain time-frequency region (Nonpatent reference 3: TR25.814V7.0.0). Fig. 25 is an explanatory drawing showing radio resources in which an uplink scheduling request signal is allocated to an S-RACH. Fig. 25 shows the method of monopolistically allocating one certain time-frequency region.

An SRA is allocated to a region in units of a subframe with respect to time and is allocated to a region in units of one or more resource units with respect to frequency. Hereafter, these regions are referred to as an S-RACH (Synchronous Random

Access CHannel). In contrast, uplink data are allocated to other regions. Therefore, an SRA and data are multiplexed with respect to either or both of time and frequency.

With which region a mobile terminal transmits an SRA is predetermined or is notified in advance from a base station. An SRA of one or more mobile terminals is allocated to one region. When transmissions of SRAs of a plurality of mobile terminals occur with an identical region, the signals from the plurality of mobile terminals will collide with one another.

When the SRAs from the plurality of mobile terminals collide with one another and therefore the base station cannot receive them, each of the plurality of mobile terminals generally repeats transmission of its SRA again with either or both of a different periodicity and a different region. In order to reduce the probability that SRAs from a plurality of mobile terminals collide with one another, a method of establishing the orthogonality of each mobile terminal by using FDM/TDM/CDM has been studied.

[0010]

Use of a scheduled channel has been also studied as allocation of a synchronous random access SRA to physical resources (nonpatent reference 4).

A scheduled channel is scheduled to be allocated to each target mobile terminal, unlike a channel, such as an S-RACH, in which collision (or referred to as competition) of signals from a plurality of mobile terminals is allowed. In this case, because a region which is allocated in advance to each mobile terminal is decided, there is no competition between signals from a plurality of mobile terminals, and therefore there is no necessity to transmit, as an SR signal which each mobile

terminal has transmitted, the ID number (the UE-ID) of each mobile terminal which is effective within the cell of the base station. Therefore, in a case in which an uplink SRA is transmitted by using a scheduled channel, the amount of information of the uplink SR signal can be reduced.

[0011]

A process of transmitting an Ack/Nack and a CQI, and an synchronous random access (an SR or the like) simultaneously in the case in which no uplink data transmission is carried out will be explained.

An uplink Ack/Nack and an uplink CQI are the ones which, when a mobile terminal is receiving downlink data from a base station, the mobile terminal transmits to the base station according to the status of the reception. In contrast, an SRA is the one which the mobile terminal transmits to the base station for an SR or the like before starting transmission of uplink data. Because the descriptions of these signals are independent from one another, there can be a case in which the mobile terminal transmits them simultaneously.

Fig. 26 shows an example in which a mobile terminal transmits an Ack/Nack and an SRA simultaneously in the case in which the mobile terminal is not carrying out any uplink data transmission.

This example is a case in which transmission of uplink data occurs while the mobile terminal carries out continuous reception of downlink data. The mobile terminal is receiving downlink data continuously. The data are demodulated and decoded in units of each TTI. The mobile terminal transmits result information (Ack/Nack) indicating a result of judgment of the reception to the base station according to the status

of the reception of the downlink data. When receiving the transmission data normally from the base station, the mobile terminal transmits an Ack signal to the base station. The base station which has received the Ack transmits new data next time. In contrast with this, when not being able to receive the transmission data transmitted normally from the base station, the mobile terminal transmits a Nack signal to the base station. The base station which has received the Nack retransmits the data which the mobile terminal was not able to receive normally to the mobile terminal.

[0012]

Allocation of the uplink Ack/Nack to physical resources is implemented by monopolistically allocating a plurality of time-frequency regions having separated narrow bands, as previously explained. Therefore, the uplink Ack/Nack is also transmitted continuously. In contrast, when uplink data occurs in the mobile terminal, the mobile terminal transmits a scheduling request SR to the base station before transmitting the uplink data. Allocation of the SR to physical resource is implemented by monopolistically allocating one certain time-frequency region, as previously explained. Therefore, as shown in the figure, when uplink data occur at a certain time, an SR occurs with a short time delay.

When the base station is not able to receive the SR signal which the mobile terminal has transmitted, the mobile terminal transmits the SR signal again. As can be seen from the above explanation, there occurs a status in which, when transmission of uplink data occurs while, for example, a mobile terminal carries out continuous reception of downlink data, the mobile terminal has to transmit an uplink Ack/Nack and an uplink SRA

simultaneously. Furthermore, even though the mobile terminal does not receive the downlink data continuously, but receives the downlink data discontinuously, it is apparent that there may be a case in which the mobile terminal carries out the transmission of the uplink SR signal simultaneously if the mobile terminal transmits the uplink Ack/Nack which is a response to the received data.

[0013]

Similarly, it can be considered that, also when a scheduled channel is allocated as allocation of the scheduling request SR, which the mobile terminal transmits to the base station, to physical resources, there occurs a status in which the mobile terminal have to transmit the uplink Ack/Nack and the uplink SRA simultaneously.

Nonpatent reference 4 describes nothing about what type of channel is used as a scheduled channel and how to allocate a time-frequency region as a physical resource. It is therefore understood that even if there is provided, for example, a channel in which a 1-bit physical resource intended only for a scheduling request SR is allocated, the mobile terminal has to transmit an uplink Ack/Nack continuously when carrying out continuous reception of downlink data, and therefore there occurs a status in which, when transmission of uplink data occurs at that time, the mobile terminal has to transmit an uplink Ack/Nack and an uplink SRA simultaneously.

[0014]

Furthermore, the nonpatent reference 4 suggests nothing about "the problems of the invention" and "the advantages of the invention" which will be shown in the specification of the present invention.

Nonpatent reference 5 discloses transmitting an uplink scheduling request by using an individual uplink control channel, such as an existing channel (CQICH) for CQI transmission or an existing channel (ACHCH) for Ack/Nack transmission. The reference shows that, as a result, a transmission procedure of transmitting an uplink scheduling request with little delay (Delay) can be established.

However, the nonpatent reference 5 suggests nothing about "the problems of the invention" and "the advantages of the invention" which will be shown in the specification of the present invention.

[0015]

The nonpatent reference 5 discloses only transmitting an uplink scheduling request by using either a channel (CQICH) for CQI transmission or a channel (ACHCH) for Ack/Nack transmission, but discloses nothing about how to allocate the CQICH and the ACHCH, as physical resources, to a time-frequency region. It is therefore understood that even if a case in which an uplink scheduling request is transmitted by using, for example, a channel (CQICH) for CQI transmission, is considered, when a mobile terminal is carrying out continuous reception of downlink data, the mobile terminal has to transmit an uplink Ack/Nack continuously, and therefore there occurs a status in which, when transmission of uplink data occurs at that time, the mobile terminal has to transmit an uplink Ack/Nack (ACHCH) and an uplink scheduling request (CQICH) simultaneously.

It is therefore understood that the nonpatent reference 5 does not solve "the problems of the invention" shown in the specification of the present invention.

[0016]

[Nonpatent reference 1] 3GPP contributions R1-062741

[Nonpatent reference 2] 3GPP contributions R1-062742

[Nonpatent reference 3] 3GPP TR25.814V7.0.0

[Nonpatent reference 4] 3GPP contributions R1-062719

[Nonpatent reference 5] 3GPP contributions R1-062571

[0017]

Because conventional communication systems which comply with the LTE are constructed as mentioned above, an SC-FDMA (Single Career Frequency Division Multiple Access which is also referred to as DFT-spread OFDM) is used as an uplink access method. Because the SC-FDMA is single carrier transmission, compared with multi carrier transmission, such as OFDM, in which symbolic data are transmitted with them being piggybacked onto each subcarrier, the SC-FDMA has a feature of being able to reduce the PAPR (Peak to Average Power Ratio peak to average power ratio). Therefore, because the power consumption of a mobile terminal can be reduced at a time when the mobile terminal carries out transmission and the transmit power which satisfies defined adjacent channel leakage power can be increased, there is provided an advantage of widening the cell coverage. However, there may be a case in which a mobile terminal has to simultaneously carry out a process of transmitting an uplink Ack/Nack and an uplink CQI by using an Ack/Nack exclusive channel and a process of transmitting an uplink scheduling request signal (SR) by using an S-RACH or a scheduled channel, or a CQICH and an ACHCH according on its status. In this case, because those signals have no correlation among them, when transmitted simultaneously, they are not transmitted with single carrier transmission, but are transmitted with multi carrier transmission. In the case in which such signals having

no correlation among them are transmitted simultaneously, the PAPR becomes high because the time waveforms of the transmission signals have a high peak. A problem is that as the PAPR becomes high, the power consumption of the mobile terminal increases and therefore the cell coverage becomes narrow. A further problem is that as the PAPR becomes high, those signals become an interference wave to other mobile terminals and the communication system.

[0018]

The present invention is made in order to solve the above-mentioned problems, and it is therefore an object of the present invention to provide a data communication method, a communication system, and a mobile terminal which can prevent increase in the radio resources load due to temporary increase in the physical channels and can also reduce the PAPR (peak to average power ratio).

Disclosure of the Invention

[0019]

In accordance with the present invention, there is provided a data communication method with which a mobile terminal carries out a response signal transmission process of transmitting a response signal to a base station by using an uplink control channel in an uplink direction from the mobile terminal to the base station, a scheduling request signal transmission process of transmitting a scheduling request signal to the base station by using a physical channel different from the uplink control channel when transmission data to be transmitted to the base station occur, and a control process of, when a processing timing of the response signal transmission process coincides with that of the scheduling request signal

transmission process, stopping the response signal transmission process during a time interval during which the mobile terminal transmits the scheduling request signal.

[0020]

As a result, because it is not necessary to use a multi carrier method of simultaneously transmitting data associated with two physical channels (an Ack/Nack exclusive channel an S-RACH) which are allocated to two types of bands, there is provided an advantage of being able to prevent the increase in the radio resource load of the communication system due to temporary increase in the physical channels, and to reduce the PAPR (peak to average power ratio).

[0021]

In accordance with the present invention, there is provided a communications system in which a mobile terminal includes: a transmitting unit for transmitting a response signal to a base station by using an uplink control channel in an uplink direction from the mobile terminal to the base station, and for transmitting a scheduling request signal to the base station by using a physical channel different from the uplink control channel when transmission data to be transmitted to the base station occur; and a control unit for, when a transmission timing of the response signal coincides with that of the scheduling request signal in the transmitting unit, stopping the transmission process of transmitting the response signal during a time interval during which the transmitting unit transmits the scheduling request signal.

[0022]

As a result, because it is not necessary to use a multi carrier method of simultaneously transmitting data associated

with two physical channels (an Ack/Nack exclusive channel an S-RACH) which are allocated to two types of bands, there is provided an advantage of being able to prevent the increase in the radio resource load of the communication system due to temporary increase in the physical channels, and to reduce the PAPR (peak to average power ratio).

[0023]

In accordance with the present invention, there is provided a data communication method with which a mobile terminal carries out a control signal generation process of generating an uplink control signal including at least a response signal, while, when transmission data to be transmitted to a base station occur, performing time division multiplexing of a scheduling request signal and the response signal to generate the uplink control signal, and a control signal transmission process of transmitting a control signal including the uplink control signal generated through the control signal generation process to the base station by using an uplink control channel in an uplink direction from the mobile terminal to the base station.

[0024]

As a result, because it is not necessary to use a multi carrier method of simultaneously transmitting data associated with two physical channels (an Ack/Nack exclusive channel an S-RACH) which are allocated to two types of bands, there is provided an advantage of being able to prevent the increase in the radio resource load of the communication system due to temporary increase in the physical channels, and to reduce the PAPR (peak to average power ratio).

[0025]

In accordance with the present invention, there is provided a data communication method with which a mobile terminal selectively carries out either a process of coding individual data by using a first code or a process of coding the individual data including a scheduling request signal by using a second code when transmission data to be transmitted the base station occur, and also carries out a process of transmitting the coded individual data by using an uplink common channel.

[0026]

As a result, because it is not necessary to use a multi carrier method of simultaneously transmitting data associated with two physical channels (an Ack/Nack exclusive channel an S-RACH) which are allocated to two types of bands, there is provided an advantage of being able to prevent the increase in the radio resource load of the communication system due to temporary increase in the physical channels, and to reduce the PAPR (peak to average power ratio).

[0027]

In accordance with the present invention, there is provided a data communication method with which a mobile terminal carries out a control signal generation process of, when transmission data to be transmitted to a base station occur, performing time division multiplexing of at least a scheduling request signal and a response signal to generate an uplink control signal, and a control signal transmission process of transmitting a control signal including the uplink control signal generated through the control signal generation process to the base station by using a random access channel which is a physical channel.

[0028]

As a result, because it is not necessary to use a multi carrier method of simultaneously transmitting data associated with two physical channels (an Ack/Nack exclusive channel an S-RACH) which are allocated to two types of bands, there is provided an advantage of being able to prevent the increase in the radio resource load of the communication system due to temporary increase in the physical channels, and to reduce the PAPR (peak to average power ratio).

Brief Description of the Figures

[0029]

[Fig. 1] Fig. 1 is an explanatory drawing showing the structure of a mobile communication system mobile communication system which complies with LTE;

[Fig. 2] Fig. 2 is an explanatory drawing showing the structure of channels for use with the communications system which complies with LTE;

[Fig. 3] Fig. 3 is a block diagram showing the structure of a mobile terminal;

[Fig. 4] Fig. 4 is a block diagram showing the structure of a base station;

[Fig. 5] Fig. 5 is an explanatory drawing for explaining radio resources which are allocated to an Ack/Nack exclusive channel and an S-RACH for transmission of an uplink scheduling request signal SR;

[Fig. 6] Fig. 6 is a flow chart explaining processing carried out by a mobile terminal, including up to a process of transmitting an uplink scheduling request signal;

[Fig. 7] Fig. 7 is a flow chart explaining a series of processes including from the process of transmitting an uplink scheduling

request signal up to a process of starting transmission of uplink data;

[Fig. 8] Fig. 7 is a flow chart explaining the series of processes including from the process of transmitting an uplink scheduling request signal up to the process of starting transmission of uplink data;

[Fig. 9] Fig. 9 is an explanatory drawing for explaining examples of mapping of Ack/Nack symbols to be transmitted by using an Ack/Nack exclusive channel;

[Fig. 10] Fig. 10 is an explanatory drawing for explaining examples of mapping of Ack/Nack symbols to be transmitted by using an Ack/Nack exclusive channel;

[Fig. 11] Fig. 11 is an explanatory drawing for explaining radio resources which are allocated to an Ack/Nack exclusive channel and an S-RACH for transmission of an uplink scheduling request signal SR;

[Fig. 12] Fig. 12 is an explanatory drawing for explaining examples of mapping of Ack/Nack symbols to be transmitted by using an Ack/Nack exclusive channel;

[Fig. 13] Fig. 13 is a flow chart explaining processing carried out by a mobile terminal, including up to a process of transmitting an uplink scheduling request signal;

[Fig. 14] Fig. 14 is an explanatory drawing for explaining an example of mapping of an uplink scheduling request signal which is transmitted by using an Ack/Nack exclusive channel;

[Fig. 15] Fig. 15 is a flow chart for explaining processing carried out by a mobile terminal which transmits an uplink scheduling request signal, and processing carried out by a base station which receives the uplink scheduling request signal;

[Fig. 16] Fig. 16 is a flow chart for explaining processing

carried out by a mobile terminal which transmits an uplink scheduling request signal, and processing carried out by a base station which receives the uplink scheduling request signal;

[Fig. 17] Fig. 17 is an explanatory drawing showing allocation of radio resources of a UL-SCH and an RACH;

[Fig. 18] Fig. 18 is a flow chart explaining processing carried out by a mobile terminal, including up to a process of transmitting an uplink scheduling request signal;

[Fig. 19] Fig. 19 is an explanatory drawing showing radio resources in which a preamble and a message, an Ack/Nack, a CQI, and an SR are mapped onto an S-RACH;

[Fig. 20] Fig. 20 is an explanatory drawing showing radio resources in which a preamble and a message, an Ack/Nack, a CQI, and an SR are mapped onto an S-RACH;

[Fig. 21] Fig. 21 is an explanatory drawing showing radio resources in which a preamble and a message, an Ack/Nack, a CQI, and an SR are mapped onto an S-RACH;

[Fig. 22] Fig. 22 is an explanatory drawing for explaining an uplink L1/L2 control signal;

[Fig. 23] Fig. 23 is an explanatory drawing showing radio resources to which an Ack/Nack and a CQI are allocated in the case in which uplink data transmission is carried out or in the case in which no uplink data transmission is carried out;

[Fig. 24] Fig. 24 is an explanatory drawing showing radio resources in which an Ack/Nack and a CQI are allocated to an Ack/Nack exclusive channel;

[Fig. 25] Fig. 25 is an explanatory drawing showing radio resources in which an uplink scheduling request signal is allocated to an S-RACH;

[Fig. 26] Fig. 26 is an explanatory drawing showing an example

in which a mobile terminal transmits an Ack/Nack and an SRA simultaneously in a case in which the mobile terminal is not carrying out any uplink data transmission;

[Fig. 27] Fig. 27 is an explanatory drawing for explaining an example of mapping of an uplink scheduling request signal which is transmitted by using an Ack/Nack exclusive channel;

[Fig. 28] Fig. 28 is a sequence diagram in a case of a first example of a setting;

[Fig. 29] Fig. 29 is a flow diagram of processing carried out by a mobile terminal in the case of the first example of the setting;

[Fig. 30] Fig. 30 is a flow diagram of processing carried out by a base station in the case of the first example of the setting;

[Fig. 31] Fig. 31 is a sequence diagram in a case of a second example of the setting;

[Fig. 32] Fig. 32 is a flow diagram of processing carried out by a mobile terminal in the case of the second example of the setting;

[Fig. 33] Fig. 33 is a flow diagram of processing carried out by a base station in the case of the second example of the setting;

[Fig. 34] Fig. 34 is a detailed block diagram of a mobile terminal which transmits an uplink scheduling request signal;

[Fig. 35] Fig. 35 is an explanatory drawing of allocation of radio resources for a Sounding RS during transmission of uplink data in Embodiment 7;

[Fig. 36] Fig. 36 is a concrete sequence diagram in a case in which an uplink transmission request occurs in a state where no data communications are carried out via both an uplink and a downlink;

[Fig. 37] Fig. 37 is a flow chart showing a flow in a case in which a transmission request occurs in a state in which a mobile station is synchronized with a base station and is not carrying out transmission of uplink data;

[Fig. 38] Fig. 38 is an explanatory drawing showing a method of allocating radio resources in a case in which a base station sets up a plurality of BWs for a usual Sounding RS, and the circumstances of allocation of radio resources to a mobile terminal UE1;

[Fig. 39] Fig. 39 is a flow chart showing a setting of the BW of a Sounding RS by a base station eNodeB;

[Fig. 40] Fig. 40 is a flow chart showing a judging method in a case in which the base station eNodeB selects the BW;

[Fig. 41] Fig. 41 is a flow chart showing a judging method in a case in which a mobile terminal selects the BW;

[Fig. 42] Fig. 42 is an explanatory drawing of allocation of radio resources in a plurality of UEs in one UE group;

[Fig. 43] Fig. 43 is an explanatory drawing in a case of setting up a Sounding RS region for each UE group;

[Fig. 44] Fig. 44 is an explanatory drawing of a generation method of generating a reference signal for sounding having the functions of an uplink scheduling request signal;

[Fig. 45] Fig. 45 is a diagram of sequences between a mobile terminal and a base station;

[Fig. 46] Fig. 46 is an explanatory drawing of an allocation method of allocating a pilot for sounding and a mobile-terminal-specific code in a case in which a mobile terminal transmits a reference signal for sounding;

[Fig. 47] Fig. 47 is an explanatory drawing showing a pilot pattern in which a part of a sounding pilot is symbols for

scheduling request;

[Fig. 48] Fig. 48 is a diagram of sequences between a mobile terminal and a base station;

[Fig. 49] Fig. 49 is an explanatory drawing of an example of generation of a reference signal for sounding;

[Fig. 50] Fig. 50 is a diagram of sequences between a mobile terminal and a base station;

[Fig. 51] Fig. 51 is an explanatory drawing of an example of generation of a reference signal for sounding;

[Fig. 52] Fig. 52 is a diagram of sequences between a mobile terminal and a base station;

[Fig. 53] Fig. 53 is an explanatory drawing in a case in which a reference signal for sounding is transmitted at certain time intervals;

[Fig. 54] Fig. 54 is an explanatory drawing in a case in which a reference signal for sounding which is transmitted at certain time intervals serves as an uplink scheduling request signal;

[Fig. 55] Fig. 55 is an explanatory drawing of a time-frequency resource in a case in which there is an Ack/Nack exclusive channel region;

[Fig. 56] Fig. 56 is an explanatory drawing of a time-frequency resource in a case of allocating a region of RS for sounding to all of the entire band of the system;

[Fig. 57] Fig. 57 is an explanatory drawing of a time-frequency resource;

[Fig. 58] Fig. 58 is an explanatory drawing of a time-frequency resource;

[Fig. 59] Fig. 59 is an explanatory drawing of transmission symbol mapping in a mobile terminal in a case of transmitting an uplink scheduling request signal with a region for sounding

RS;

[Fig. 60] Fig. 60 is an explanatory drawing of a transmission signal of a mobile terminal when a scheduling request occurs;

[Fig. 61] Fig. 61 is an explanatory drawing of a transmission signal of a mobile terminal when a scheduling request occurs;

[Fig. 62] Fig. 62 is a diagram of sequences between a mobile terminal and a base station;

[Fig. 63] Fig. 63 is an explanatory drawing of a transmission signal of a mobile terminal when an uplink scheduling request occurs;

[Fig. 64] Fig. 64 is a diagram of sequences between a mobile terminal and a base station;

[Fig. 65] Fig. 65 is an explanatory drawing of a transmission signal of a mobile terminal when an uplink scheduling request occurs; and

[Fig. 66] Fig. 66 is a diagram of sequences between a mobile terminal and a base station.

Preferred Embodiments of the Invention

[0030]

Hereafter, in order to explain this invention in greater detail, the preferred embodiments of the present invention will be described with reference to the accompanying drawings.

Embodiment 1.

Fig. 1 is an explanatory drawing showing the structure of a mobile communication system which complies with LTE. In Fig. 1, an aGW 1 performs transmission and reception of control data and user data with a plurality of base stations (eNodeB) 2, and a base station 2 transmits and receives data to and from a plurality of mobile terminals 3. Between a base station 2 and a mobile terminal 3, broadcast information, information

used for processing a call, individual control data, individual user data, control data for E-MBMS, user data, and so on are transmitted. It has also been studied that base stations 2 communicate with each other.

A base station 2 has uplink and downlink schedulers. These schedulers of a base station 2 enable transmission and reception of data between the base station 2 and each mobile terminal 3, and carry out scheduling for improvements in the throughput of each mobile terminal 3 and that of the whole mobile communication system.

[0031]

A E-MBMS provides a broadcast type point-to-multipoint (Point to Multipoint PtoM) communication service with which data are transmitted at a time from a certain base station toward a plurality of mobile terminals. Concretely, an information service, such as news or weather forecast, and a large-volume broadcast service, such as mobile TV, have been studied.

The aGW 1 communicates with a service center 5 via a PDN 4 (Packet Data Network).

The service center 5 stores and distributes a content used for providing a service for users. A content provider transmits E-MBMS data, such as mobile TV broadcast data, to the service center 5. The service center 5 stores the E-MBMS data therein and also transmits the E-MBMS data to base stations 2 via the PDN 4 and the aGW 1.

[0032]

Fig. 2 is an explanatory drawing showing the structure of channels. Mapping of logical channels (Logical channels) and transport channels (Transport channels) is shown in Fig. 2.

The logical channels are classified according to the functions and logical characteristics of transmission signals. The transport channels are classified according to transmission forms. Broadcast information is piggybacked onto a BCCH (Broadcast Control Channel). A BCCH is mapped to a BCH (Broadcast Channel) and is transmitted from a base station to mobile terminals.

Information used for processing a call is piggybacked onto a PCCH (Paging Control Channel). A PCCH is mapped to a PCH (Paging Channel) and is transmitted from a base station to mobile terminals in the cell of the base station. Individual control data destined for each mobile terminal are piggybacked onto a DCCH (Dedicated Control Channel).

[0033]

Individual user data destined for each mobile terminal are piggybacked onto a DTCH (Dedicated Traffic Channel). A DCCH and a DTCH are mapped to a DL-SCH (Downlink Shared Channel), and are transmitted individually from a base station to each mobile terminal. In contrast with this, it is individually transmitted from each mobile terminal to a base station by using a UL-SCH (Uplink Shared Channel).

A DL-SCH and a UL-SCH are shared channels (Shared Channels).

Control data for E-MBMS and user data are piggybacked onto an MCCH (Multicast Control Channel) and an MTCH (Multicast Traffic Channel), respectively, and are mapped to a DL-SCH or an MCH (Multicast Channel) and are transmitted from a base station to a mobile terminal.

A connection request signal from a mobile terminal, e.g., a scheduling request signal SR is transmitted from each mobile

terminal to a base station by using a random access channel (Random Access Channel RACH). An S-RACH is one of RACHs.

[0034]

Fig. 3 is a block diagram showing the structure of a mobile terminal. A transmitting process of the mobile terminal 3 is carried out as follows.

First, control data from a protocol processing unit 6 and user data from an application unit 7 are stored in a transmission data buffer unit 8.

The data stored in the transmission data buffer unit 8 are delivered to an encoder unit 9, and the encoder unit performs an encoding process, such as an error correction, on the data. There can exist data on which no encoding process is performed and which are directly outputted from the transmission data buffer unit 8 to a modulating unit 10.

The modulating unit 10 performs a modulation process on the data on which the encoding process has been performed by the encoder unit 9. After the modulated data are converted into a baseband signal, this baseband signal is outputted to a frequency converting unit 11 and is then converted into a signal having a radio transmit frequency. After that, the transmission signal is transmitted to a base station 2 from an antenna 12.

[0035]

A receiving process of the mobile terminal 3 is carried out as follows. A radio signal from the base station 2 is received by the antenna 12. The received signal having a radio receive frequency is converted into a baseband signal by the frequency converting unit 11, and a demodulating unit 13 performs a demodulation process on the baseband signal. Data

which the demodulating unit obtains after demodulating the baseband signal are delivered to a decoder unit 14, and the decoder unit performs a decoding process, such as an error correction, on the data. Control data among the decoded data are delivered to the protocol processing unit 6, while user data among the decoded data are delivered to the application unit 7. The series of transmission and reception processes of the mobile terminal is controlled by a control unit 15.

[0036]

Fig. 4 is a block diagram showing the structure of a base station. A transmitting process of the base station 2 is carried out as follows.

An aGW communication unit 16 transmits and receives data between the base station 2 and an aGW 1. An other base station communication unit 17 transmits and receives data to and from another base station.

Each of the aGW communication unit 16 and the other base station communication unit 17 receives and sends information from and to a protocol processing unit 18. Control data from the protocol processing unit 18 and user data from the aGW communication unit 16 and the other base station communication unit 17 are stored in a transmission data buffer unit 19.

The data stored in the transmission data buffer unit 19 are delivered to an encoder unit 20, and the encoder unit performs an encoding process, such as an error correction, on the data. There can exist data on which no encoding process is performed and which are directly outputted from the transmission data buffer unit 19 to a modulating unit 21. The modulating unit 21 performs a modulation process on the data on which the encoding process has been performed by the encoder

unit.

[0037]

After the modulated data are converted into a baseband signal, this baseband signal is outputted to a frequency converting unit 22 and is then converted into a signal having a radio transmit frequency. After that, the transmission signal is transmitted from an antenna 23 to one or more mobile terminals 1.

A receiving process of the base station 2 is carried out as follows.

A radio signal from one or more mobile terminals 3 is received by the antenna 23. The received signal having a radio receive frequency is converted into a baseband signal by the frequency converting unit 22, and a demodulating unit 24 performs a demodulation process on the baseband signal. Data which the demodulating unit obtains after demodulating the baseband signal are delivered to a decoder unit 25, and the decoder unit performs a decoding process, such as an error correction, on the data. Control data among the decoded data are delivered to the protocol processing unit 18, and user data among the decoded data are delivered to the aGW communication unit 16 and the other base station communication unit 17. The series of transmission and reception processes of the base station 2 is controlled by a control unit 26.

[0038]

Hereafter, the operation of a mobile terminal in accordance with the present invention will be explained.

When a mobile terminal is not performing uplink data transmission and is receiving downlink data, the mobile terminal transmits an Ack/Nack signal indicating the result of

the reception of the downlink data (whether the mobile terminal has received the data properly) to the base station by using an Ack/Nack exclusive channel.

The mobile terminal also transmits a downlink communication path quality (CQI) signal for the downlink scheduling by the base station, as well as the Ack/Nack signal indicating the result of the reception of the downlink data, to the base station by using the Ack/Nack exclusive channel.

Furthermore, regardless of whether the mobile terminal has received the downlink data, in order to enable the downlink scheduling by the base station or maintain the synchronization between the base station and the mobile terminal, the mobile terminal transmits a CQI signal to the base station by using the Ack/Nack exclusive channel.

[0039]

When the mobile terminal starts transmission of uplink data in a state in which the mobile terminal transmits an Ack/Nack signal and/or a CQI signal to the base station, as mentioned, the mobile terminal has to transmit an uplink scheduling request signal SR independently from the above-mentioned Ack/Nack and/or the above-mentioned CQI to the base station. In this embodiment, a method of, when transmitting an uplink scheduling request signal SR to the base station by using a physical channel (S-RACH) different from the Ack/Nack exclusive channel, transmitting the uplink scheduling request signal by using an SC-FDMA method which implements a wider coverage and a lower PAPR will be explained.

[0040]

In this Embodiment 1, in a case in which a mobile terminal desires to start transmission of uplink data in a state in which

the mobile terminal transmits an Ack/Nack signal and/or a CQI signal by using an uplink Ack/Nack exclusive channel while receiving downlink data without performing transmission of uplink data, the mobile terminal transmits an uplink scheduling request signal SR for setting up a channel for uplink data transmission by using a physical channel (in this Embodiment 1, by using an S-RACH) to which a frequency band different from that of the Ack/Nack exclusive channel is allocated.

At that time, the mobile terminal does not use a multi carrier method of simultaneously transmitting data associated with two physical channels which are allocated to two types of bands, respectively, the mobile terminal does not transmit an Ack/Nack signal and/or a CQI signal by using the Ack/Nack exclusive channel (DTX Discontinuous Transmission) while transmitting an SR (preamble/message) which the mobile terminal temporarily transmits to the base station when starting transmission of uplink data.

As a result, increase in the radio resource load on the system due to temporary increase in the physical channels of one mobile terminal can be prevented, while transmission with a single carrier method which guarantees a low PAPR can be implemented.

[0041]

Fig. 5 is an explanatory drawing for explaining radio resources which are allocated to an Ack/Nack exclusive channel and an S-RACH for transmission of an uplink scheduling request signal SR. Fig. 6 is a flow chart explaining processing carried out by a mobile terminal, including up to a process of transmitting an uplink scheduling request signal.

Figs. 7 and 8 are flow charts explaining a series of

processes including from the process of transmitting an uplink scheduling request signal up to a process of starting transmission of uplink data. In Fig. 5, it is assumed that at the same time when the mobile terminal UE1 is not carrying out transmission of uplink data, such as user data, but is receiving only downlink data, the mobile terminal is transmitting an Ack/Nack and/or a CQI to these received data by using an Ack/Nack exclusive channel.

The modulating unit 10 of the mobile terminal shown in Fig. 3 performs a CDM multiplexing process (can alternatively perform an FDM multiplexing process or a TDM multiplexing process), which is specific to the mobile terminal, on the Ack/Nack signal, and transmits the Ack/Nack signal by using the Ack/Nack exclusive channel. Therefore, there can be a case in which the mobile terminal UE1 transmits the Ack/Nack signal continuously with respect to time by using the Ack/Nack exclusive channel.

[0042]

In this case, when an uplink data transmission request in ST601 of Fig. 6 occurs (if Yes in ST601), the mobile terminal, in ST602, checks the receiving state of the downlink data (DL data).

In this Embodiment 1, because the mobile terminal is receiving the downlink data, the mobile terminal advances to ST604 in which the mobile terminal determines the timing at which the mobile terminal transmits an uplink scheduling request signal SR (preamble or/and message) by using an S-RACH. If the mobile terminal is not receiving any downlink data and the synchronization with the base station is not established (if No in ST602), the mobile terminal, in ST603, carries out

an algorithm of transmitting an uplink scheduling request signal SR by using a physical channel called a Non-S-RACH.

After, in ST604, determining the transmission timing of the uplink scheduling request signal SR, at the same time when the mobile terminal UE1 transmits the uplink scheduling request signal SR by using the S-RACH, the mobile terminal, in ST605, stops the transmission of a predetermined Ack/Nack symbol (or LB) of the uplink Ack/Nack exclusive channel or a CQI symbol (or LB), which the mobile terminal was originally scheduled to transmit at the same timing, and suspends the transmission while the mobile terminal transmits the uplink scheduling request signal SR (symbol DTX or DTX of LB). This stop (DTX) of the transmission of the Ack/Nack symbol is performed by the modulating unit 10 under the control of the control unit 15.

[0043]

Fig. 5 shows an example of the allocation of radio resources to an S-RACH which is a physical channel via which an uplink scheduling request signal SR is transmitted, and an Ack/Nack exclusive channel.

In Fig. 5, the radio resources are divided into a plurality of time-frequency regions. In each time-frequency region, the time axis is divided into units of each subframe (=0.5ms), and the frequency axis is divided into units having different bands according to the amount of transmission data associated with the physical channel.

[0044]

In the allocation of the radio resources according to this Embodiment 1, the S-RACH and the channel for uplink data transmission use time-frequency unit regions having the same size, respectively, whereas the Ack/Nack exclusive channel uses

a frequency band unit region narrower than the time-frequency unit regions (the same time division). A subframe 1 of one subcarrier in the Ack/Nack exclusive channel is comprised of six long blocks (Long Blocks LB1 to LB6) and two short blocks (Short Blocks SB, small blocks).

A symbol for physical channel synchronization (a symbol for demodulation) is included in a short block SB. While the mobile terminal UE1 transmits the uplink scheduling request signal SR with the length of one subframe by using the time-frequency region of the S-RACH which is allocated as shown in Fig. 5, the mobile terminal stops the modulation and transmission of the symbol data of the long blocks LB1 to LB6 and the two short blocks SB which are currently allocated to the Ack/Nack exclusive channel (the mobile terminal carries out DTX).

[0045]

However, because, in the next subframe 2, there is no transmission of the uplink scheduling request signal SR using the S-RACH and there is also no transmission of uplink data such as user data, the mobile terminal transmits symbol data (LB2-1 to LB2-6) for the subframe 2 by using the Ack/Nack exclusive channel. Furthermore, in the next subframe (a subframe 1 during TTI No.2), an uplink scheduling request signal SR from another mobile terminal UE occurs, an S-RACH for this SR is allocated to a time-frequency region which exists in a frequency band different from that of the mobile terminal UE1.

In this case, the S-RACH of the other mobile terminal UE is transmitted, and Ack/Nack symbol data and/or CQI symbol data from the mobile terminal UE1 during this subframe interval are transmitted by using the Ack/Nack exclusive channel. The

sequence including from the transmission of an uplink scheduling request signal SR by using the S-RACH up to the uplink data transmission is shown in Figs. 7 and 8.

[0046]

Fig. 7 shows a flow chart in a case (ST701) in which the mobile terminal transmits an uplink scheduling request signal SR (preamble and message) in only one step.

Fig. 8 shows a flow chart in a case (ST801 and ST803) in which the mobile terminal transmits an uplink scheduling request signal SR by sequentially transmitting its preamble (preamble) and its message (message) in two steps.

In Fig. 7, after the mobile terminal notifies the uplink scheduling request to the base station with the preamble and the message, the mobile terminal receives information "uplink data resource allocation (Uplink Data Resource Allocation)" about allocation of radio resources for uplink data transmission and timing by using a downlink L1/L2 control signal from the base station.

In Fig. 8, the mobile terminal receives "scheduling request resource allocation (SR Resourece Allocation)" after transmitting the preamble, and, after notifying a message part of the scheduling request to the base station by using a resource which is allocated thereto with the scheduling request resource allocation, receives information (Uplink Data Resource Allocation) about radio resources allocation for uplink data transmission and timing by using a downlink L1/L2 control signal from the base station.

[0047]

The mobile terminal then starts transmission of uplink data by using a UL-SCH (Uplink Shared channel). In this

Embodiment 1, the example in which one subframe is allocated to transmission of an uplink scheduling request signal SR is explained. However, because there is a case in which a preamble and a message are sent at a time during a long transmission time, as shown in Fig. 7, and a case in which they are sent at two times during short transmission time, as shown in Fig. 8, the length of a transmission time during which an Ack/Nack cannot be transmitted, and the occurrence frequency can be changed according to the length and frequency of the transmission time of the uplink scheduling request signal SR.

The structure of long blocks and short blocks in a subframe shown in Fig. 5 is only an example, and, even if the structure of the subframe changes, the concept of the present invention can be applied.

[0048]

Hereafter, the preamble and message of an uplink scheduling request signal SR will be explained. It is considered that, for example, a "random ID (random ID (UE ID))" which is specific identifying information for identifying the terminal is allocated to the preamble. As the message, the amount of uplink transmission data (a buffer state in the UE), the QoS of the uplink transmission data, or a transmission power margin of the terminal, in addition to the "UE ID" previously shown, can be considered.

[0049]

In conventional communication methods (FDMA, TDMA, and CDMA), a stop (DTX) of transmission of symbols via an uplink provides an advantage of reducing the power consumption of a mobile terminal, reducing the highest transmit power of the mobile terminal to within a power range indicated by a base

station, and also reducing the transmit power of the whole system to within a fixed range. In contrast, by using the method of stopping transmission of symbols (DTX) in accordance with the present invention, because, for an uplink, not only the PAPR in the mobile terminal can be reduced, but single carrier transmission can be carried out, unlike in the case of using DTX of a conventional communication method, the scale of the implementation of the modulation and demodulation processes can be reduced in both the mobile terminal and the base station, and the processing load on the whole system can be reduced compared with the case of using a multi carrier transmission method.

[0050]

As mentioned above, by using Embodiment 1, there can be provided an advantage of, in a case in which a mobile terminal is not carrying out transmission of uplink data, but is receiving downlink data, enabling the mobile terminal which has to transmit an uplink scheduling request signal SR together with an Ack/Nack to perform the transmission of these signals simultaneously without increasing the PAPR in the mobile terminal.

[0051]

In contrast, there can be a case in which in the mobile communication system, even when a mobile terminal does not receive downlink data, an Ack/Nack exclusive channel is allocated to the mobile terminal.

More specifically, there can be considered a case in which even when there exist no downlink data in a base station, in order to prepare future downlink scheduling or maintain the synchronization between the base station and a mobile terminal,

the result (CQI) of measurement of the quality of a downlink communication path is notified from the mobile terminal to the base station. Also in such a case, there can be considered a case in which the transmission of the CQI using an Ack/Nack exclusive channel and an uplink scheduling request signal SR occur simultaneously. In such a mobile communication system, it is preferable that when performing judgment as shown in ST602, a mobile terminal judges whether or not an Ack/Nack exclusive channel is allocated thereto. In addition, even a mobile communication system in which when a mobile terminal does not receive downlink data no Ack/Nack exclusive channel is allocated to the mobile terminal can adopt this judgment.

[0052]

Embodiment 2.

In above-mentioned Embodiment 1, in a case in which a mobile terminal transmits an uplink scheduling request signal SR by using an S-RACH while transmitting an Ack/Nack signal and/or a CQI signal by using an Ack/Nack exclusive channel, the mobile terminal stops the transmission of the Ack/Nack signal and/or the CQI signal while transmitting the uplink scheduling request signal SR.

By stopping the transmission of the Ack/Nack signal and/or the CQI signal while transmitting the uplink scheduling request signal SR, the mobile terminal does not have to use a multi carrier method with which to simultaneously transmit data associated with the two physical channels (the Ack/Nack exclusive channel and the S-RACH) which are allocated to two types of bands, respectively. Therefore, increase in the radio resources load on the communication system due to temporary increase in the physical channels can be prevented, and

transmission with a single carrier method which guarantees a low PAPR can be implemented.

In contrast, in Embodiment 2 which will be explained hereafter, a mapping method for an Ack/Nack exclusive channel of, when performing a stop (DTX) of transmission of an Ack/Nack symbol, preventing a bad influence from being exerted upon the performance of communications of symbols on the Ack/Nack exclusive channel will be explained.

[0053]

In Embodiment 1, the processing including from the process of transmitting an uplink scheduling request signal SR by using an S-RACH up to a process of transmitting uplink data is explained with reference to Fig. 52. More specifically, the transmission of an uplink scheduling request signal SR (a preamble or/and a message) includes a case, as shown in Fig. 7, in which a long transmission time is needed in order to send the preamble and the message at a time and a case, as shown in Fig. 8, in which the preamble is transmitted at a time and the message is transmitted at another time and therefore their respective transmission time become short.

In the case in which the transmission time of an uplink scheduling request signal SR is long, the time during which an Ack/Nack and/or a CQI cannot be transmitted (the DTX of the Ack/Nack symbol and/or the CQI symbol) becomes long, whereas in the case in which the transmission time of an uplink scheduling request signal SR are short, the time interval during which an Ack/Nack and/or a CQI cannot be transmitted becomes short. For each of the cases, a method of preventing the degradation of the communication quality due to occurrence of errors in the transmission of the Ack/Nack symbol information

and/or the CQI symbol information during the time during which the uplink scheduling request signal SR is transmitted will be explained hereafter.

[0054]

First, the process in the case of Fig. 7 will be explained. Because the preamble and the message are collectively transmitted at a time in the transmission of the uplink scheduling request signal SR shown in Fig. 7, the time interval during which the Ack/Nack and/or the CQI cannot be transmitted becomes long, and can have a length of about one subframe as shown in Fig. 5. In order to prevent the degradation in the communication quality due to errors in the transmission of the Ack/Nack symbol information and/or the CQI symbol information which can occur during this time interval, in accordance with this Embodiment 2, a pattern of symbols to be sent by using the Ack/Nack exclusive channel is mapped in such a way that a pattern having a length of one subframe is repeated twice and is updated during each transmission time interval (TTI).

Furthermore, in order to ensure communication quality, a symbol pattern having a length of one subframe is formed to be a combination of symbols in which important information (higher-order bits) are given a higher priority and the number of repetitions of the important information is increased. Concrete examples of the mapping of symbol information which is to be transmitted by using an Ack/Nack exclusive channel are shown in Figs. 9 and 10.

[0055]

Fig. 9 is an explanatory drawing explaining examples of the mapping of Ack/Nack symbols to be transmitted by using an Ack/Nack exclusive channel. Fig. 9 shows an example of the

mapping of symbols to the Ack/Nack exclusive channel, which has been proposed by the 3GPP (3rd Generation Partnership Project) until now (refer to the nonpatent reference 2).

For each of a case in which only Ack/Nack symbols are mapped to long blocks LB (Fig. 9(a)), a case in which only CQI symbols are mapped to long blocks (Fig. 9(b)), and a case in which CQI symbols and Ack/Nack symbols are multiplexed and are mapped to long blocks LB (Fig. 9(c)), a symbol mapping structure with a transmission time interval length (TTI) is shown.

[0056]

A symbol pattern which is proposed in this Embodiment 2 is formed in such a way that even in a case in which an Ack/Nack and/or a CQI cannot be transmitted for a long period of time (= 1 subframe), a symbol pattern having a length of one subframe is repeated twice within 1 TTI for the purpose of preventing occurrence of errors in the transmission of the Ack/Nack and/or the CQI, thereby improving the communication quality.

In the symbol pattern shown in Fig. 9 in the case of CQI symbols, for one subframe A, CQI1, CQI2, CQI3, CQI4, CQI5, and CQI1 are mapped to long blocks, whereas for one subframe B, CQI2, CQI3, CQI4, CQI1, CQI2, and CQI1 are mapped to long blocks, and the CQI symbols are not arranged with the same symbol pattern in the subframes.

Therefore, when, for example, the one subframe A is DTXed, CQI5 is not transmitted once (one LB) during 1 TTI.
Also in the symbol pattern in which CQIs and Acks/Nacks are multiplexed with respect to time, they are not arranged with the same symbol pattern in both the one subframe A and the one subframe B.

[0057]

A mapping example of mapping the CQI symbols and a mapping example of multiplexing and mapping the CQI and the Ack/Nack, which are proposed by the present invention, are shown in Fig. 10.

First, in the mapping example of mapping the CQI symbols of Fig. 10(a), the same symbol mapping pattern is repeated in both a first subframe (single sub-frame A) and a second subframe (single sub-frame B) within 1 TTI. Furthermore, in the mapping of the symbols to each subframe length, symbols with a higher priority (i.e., symbols showing a higher-order digit of the CQI: in this example, CQI1) are repeated a larger number of times.

Furthermore, also in the mapping example of multiplexing and mapping the CQI symbols and the Ack/Nack symbol of Fig. 10(b), the same symbol mapping pattern is repeated in both a first subframe (single sub-frame A) and a second subframe (single sub-frame B) within 1 TTI, and, in the mapping of the symbols to each subframe length, symbols with a higher priority (the Ack/Nack and so on) are placed in a vicinity of a short block SB.

[0058]

In this Embodiment 2, an Ack/Nack and the higher-order bits of a CQI (CQI1 is the most significant bit) are considered as symbols having a higher priority. An Ack/Nack indicates the result of reception of downlink data, and therefore there arises a problem that retransmission of corresponding packet data occurs when this bit cannot be received properly by the base station. It is therefore necessary to increase the priority of the Ack/Nack in the symbol arrangement. It is further necessary to place the higher-order ones of the CQI bits indicating the reception state of the downlink data on a

priority basis so as to enable the base station to cope with transmission errors and so on.

[0059]

Thus, it is not necessary to limit the mapping pattern in the symbol mapping method of taking into consideration a risk of the Ack/Nack information not being transmitted while the uplink scheduling request signal SR is transmitted and the importance of the symbols to the pattern of Fig. 10 which is explained in this Embodiment 2.

Even though the symbol mapping is not performed as shown in Fig. 10, this Embodiment 2 can be implemented. Therefore, the concept about the symbol mapping will be mentioned hereafter.

(1) Repeat symbols having a higher priority a larger number of times. (2) Place symbols having a higher priority in a vicinity of a short block SB.

In general, an Ack/Nack and the higher-order bits of a CQI (CQI1 is the most significant bit) are symbols having a higher priority.

[0060]

An Ack/Nack indicates the result of reception of downlink data, and therefore there arises a problem that, when this symbol cannot be received properly by the base station, retransmission of the corresponding packet data occurs and the throughput of the downlink data falls as a result. It is therefore necessary to increase the priority of the Ack/Nack in the symbol arrangement.

Also in the case of the higher-order ones of the CQI bits indicating the state of the reception of the downlink data, when a transmission error occurs, the erroneous difference between

the downlink communication path quality which is measured by the mobile terminal and the downlink communication path quality which the base station has received becomes large, and therefore appropriate scheduling cannot be carried out by the base station and this results in reduction in the downlink throughput of the whole mobile communications system. It is therefore necessary to increase the priority of the higher-order ones of the CQI bits indicating the state of the reception of the downlink data in the symbol arrangement.

[0061]

The priority of the Ack/Nack and that of the CQI depend on the desired error rates of their respective signals.

Because increase in the number of repetitions (repetition) can increase the receive power of the base station, the larger number of repetitions (repetition) a symbol has the more rarely an error occurs in the symbol.

Because it can be considered that a short block is used for phase compensation when receiving the short block and then demodulating the short block, the phase compensation is carried out more correctly as the difference between the transmission timing of the short block and that of the corresponding symbol decreases. Therefore, an error occurs more rarely in a symbol which is placed nearer to a short block. Some predetermined patterns exist in the mapping of the symbols of Ack/Nack information (an Ack/Nack and/or a CQI), and the mobile station can select one pattern from among the predetermined patterns, one pattern can be selected and notified by the base station, or one pattern can be dynamically allocated to the mobile station. As previously explained, when transmission of an Ack/Nack symbol and/or CQI symbols using an Ack/Nack exclusive

channel cannot be carried out temporarily for a long period of time (= during one subframe) because of transmission of an uplink scheduling request signal SR by using an S-RACH, an transmission error can be preventing from occurring in the information symbols of the Ack/Nack exclusive channel and therefore high communication quality can be maintained.

[0062]

Next, a case in which the transmission time during which an uplink scheduling request signal SR is transmitted once is sufficiently short, like the sequence of Fig. 8, will be explained.

In a case in which a mobile terminal, in ST605 of Fig. 6, transmits an uplink scheduling request signal SR, as shown in the flow chart of Fig. 8, by dividing it into a preamble and a message or sending the preamble and the message of a small size together, the time interval during which the mobile terminal transmits the uplink scheduling request signal SR becomes short. Therefore, the transmission stop time interval during which transmission of an Ack/Nack symbol and/or a CQI symbol in the Ack/Nack exclusive channel is stopped during the transmission of the uplink scheduling request signal SR also becomes short.

An example of how, in such a case, the S-RACH used for the transmission of the uplink scheduling request signal SR and the Ack/Nack exclusive channel are allocated in time-frequency is shown in Fig. 11.

[0063]

Because the amount of information of the uplink scheduling request signal SR in the sequence diagram of Fig. 8 is sufficiently small, in Fig. 11, a region to which the S-RACH

of the mobile terminal UE1 is allocated in time-frequency is only one leading data symbol block included in one time-frequency unit region. An Ack/Nack symbol or a CQI symbol which is transmitted at the same timing as this block is a symbol in a long block LB1 of the Ack/Nack exclusive channel. While the uplink scheduling request signal SR using the S-RACH of the mobile terminal UE1 is transmitted, the Ack/Nack information symbol or the CQI symbol in the block which is the long block LB1 is not transmitted.

[0064]

Fig. 12 is an explanatory drawing for explaining examples of the mapping of an Ack/Nack symbol and CQI symbols which are transmitted by using the Ack/Nack exclusive channel.

Unlike Fig. 10, Fig. 12 shows cases in each of which different symbols are mapped in a first subframe (one sub-frame A) and a second subframe (one sub-frame B) within 1 TTI, respectively, and either the Ack/Nack or higher-order CQI bits having a higher priority are placed a larger number of repetitions within the TTI.

As shown in Fig. 12(a), in a case in which only CQI symbols are transmitted, when transmission of an uplink scheduling request signal SR occurs, a symbol CQI1 having a higher priority is allocated to the position of a long block LB (e.g., LB1) having a possibility of not being transmitted and the same symbol CQI1 is also allocated to the next long block LB2.

As a result, even in a case in which transmission of an uplink scheduling request signal SR occurs, the most important symbol CQI1 can be transmitted with the second long block LB2, and, even in a case in which no transmission of an uplink scheduling request signal SR occurs, the degradation in the

quality at the time of occurrence of a communication error can be prevented by transmitting the most important symbol CQI1 four times.

[0065]

Furthermore, in a case in which the CQI symbols and the Ack/Nack symbol are multiplexed and mapped, as shown in Fig. 12(b), even when transmission of an uplink scheduling request signal SR occurs through allocation of a low-priority symbol CQI5 to the position of an LB (LB1) having a possibility of not being transmitted, and the CQI5 symbol cannot be transmitted, other symbols having a higher priority can be sent without their repetition numbers being reduced, and therefore the communication quality can be maintained.

[0066]

It is not necessary to limit the mapping pattern in the symbol mapping method according to the importance of the symbols to the pattern which is explained in this Embodiment 2. Because the concept of the symbol mapping is already explained, the explanation of this concept will be omitted hereafter. Either the mobile terminal or the base station can select one pattern from among some predetermined patterns of the mapping of the symbols of Ack/Nack information (an Ack/Nack and/or a CQI), or one of them can be dynamically selected and allocated to the mobile terminal.

[0067]

As a case in which a region to which the S-RACH of the mobile terminal UE1 is allocated in time-frequency is only a part of data symbol blocks with respect to time, as shown in Fig. 11, there can be not only a case in which the information which is to be transmitted by using the S-RACH as shown in the

flow chart of Fig. 8, but also a case in which the amount of information of the uplink scheduling request signal SR is large as shown in the flow chart of Fig. 7.

In this case, the uplink scheduling request signal can be sent in a small amount of time by allocating the S-RACH to the time-frequency region whose band is extended in the frequency direction, and transmitting the uplink scheduling request signal by using the S-RACH. More specifically, compared with the case of allocation of Fig. 11, either a wider time-frequency region in the frequency direction or a plurality of time-frequency unit regions which are continuous in the frequency direction are allocated to the transmission of the uplink scheduling request signal SR.

[0068]

Embodiment 1 and Embodiment 2 are based on the CDM multiplexing of the Ack/Nack information which is carried out for each mobile terminal in the Ack/Nack exclusive channel. As an alternative, there can be another method of carrying out TDM multiplexing or FDM multiplexing of the pieces of Ack/Nack information about a plurality of mobile terminals. Also in such a case, the invention explained in above-mentioned Embodiment 1 can be applied.

By doing in the above-mentioned way, also in a case in which an uplink Ack/Nack symbol and/or CQI symbols which are allocated to the same timing as the time-frequency region to which the symbols of the uplink transmission request signal SR are allocated with the S-RACH cannot be modulated and transmitted (DTX) during the transmission time of the uplink scheduling request signal SR, there can be provided an advantage of being able to use the radio resources effectively and to

maintain the communication quality of the uplink or reduce the degradation in the communication quality of the uplink to a minimum.

[0069]

Embodiment 3.

In above-mentioned Embodiment 1, by stopping transmission of an Ack/Nack signal and/or a CQI signal while transmitting an uplink scheduling request signal SR by using an S-RACH, and by no using a multi carrier method with which to simultaneously transmit data associated with the two physical channels (the Ack/Nack exclusive channel and the S-RACH) which are allocated to two types of bands, respectively, increase in the radio resources load on the communication system due to temporary increase in the physical channels can be prevented, and transmission with a single carrier method which guarantees a low PAPR can be implemented.

In this Embodiment 3, a method of implementing transmission using an SC-FDMA method which implements a wider coverage and a lower PAPR (peak to average power ratio) by transmitting an Ack/Nack and/or a CQI and an uplink scheduling request signal SR by using an identical physical channel will be explained hereafter.

[0070]

In accordance with this Embodiment 3, a mobile terminal transmits an uplink scheduling request signal SR by mapping the uplink scheduling request signal SR to an Ack/Nack exclusive channel instead of an S-RACH. By transmitting an uplink scheduling request signal SR by using an Ack/Nack exclusive channel, increase in the radio resources load on the communication system due to temporary increase in the physical

channels can be prevented, and transmission with a single carrier method which guarantees a low PAPR can be implemented. As a result, even when the number of control signals (L1/L2 control signalings) which have to be temporarily transmitted increases in a certain mobile terminal, increase in the radio resources load on the communication system can be prevented, and transmission with a single carrier method which guarantees a low PAPR and high communication quality can be implemented.

[0071]

In this case, the Ack/Nack exclusive channel is a scheduled channel for which radio resources are scheduled in advance. As mentioned above, in the nonpatent reference 4, allocation of an synchronous random access SRA to a scheduled channel is studied. However, because the nonpatent reference 4 describes nothing about what type of channel is used as the scheduled channel and how a time-frequency region is allocated as a physical resource, in a case in which there is disposed a channel to which a 1-bit physical resource used for a scheduling request SR is allocated to a time-frequency region different from the Ack/Nack exclusive channel, a status in which an uplink Ack/Nack and/or a CQI and an uplink SR have to be transmitted simultaneously occurs, and these signals are transmitted simultaneously with respect to time. In this case, because they are not transmitted with single carrier transmission, but are transmitted with multi carrier transmission, there arises a problem that the PAPR increases.

[0072]

In order to solve this problem, in accordance with this Embodiment 3, a mobile terminal transmits an uplink scheduling request signal SR by mapping an Ack/Nack and a CQI with the uplink

scheduling request signal SR, to an Ack/Nack exclusive channel.

An important thing to satisfy request for a single carrier transmission from a mobile terminal is that the mobile terminal transmits all of an "Ack/Nack", a "CQI", and an "uplink scheduling request signal SR", which are signals having a possibility of having to be transmitted simultaneously, by using an Ack/Nack exclusive channel in a state in which uplink time synchronization is established and the mobile terminal is not transmitting uplink data. By transmitting an Ack/Nack and a CQI with an uplink scheduling request signal SR, by using an Ack/Nack exclusive channel, increase in the radio resources load on the communication system due to temporary increase in the physical channels can be prevented, and transmission with a single carrier method which guarantees a low PAPR can be implemented.

As a result, even when the number of control signals (L1/L2 control signalings) which has to be temporarily transmitted increases in a certain mobile terminal, increase in the radio resources load on the communication system can be prevented, and transmission with a single carrier method which guarantees a low PAPR and high communication quality can be implemented.

[0073]

Fig. 13 is a flow chart for explaining processing carried out by a mobile terminal, the processing including up to a process of transmitting an uplink scheduling request signal. Fig. 14 is an explanatory drawing for explaining an example of mapping of an uplink scheduling request signal which is transmitted by using an Ack/Nack exclusive channel.

Hereafter, the operation of a mobile terminal in accordance with Embodiment 3 of the present invention will be

explained with reference to Fig. 13. In Fig. 13, because the same reference numerals as those shown in Fig. 6 denote the same components or like components, the explanation of the components will be omitted hereafter.

[0074]

A mobile terminal is not carrying out uplink user data transmission, and, at the same time when receiving downlink data, is transmitting, via an uplink, an Ack/Nack and/or a CQI to the received data by using a physical channel for an Ack/Nack and /or a CQI.

For the Ack/Nack exclusive channel, multiplexing of signals from mobile terminals is carried out by using either one of a CDM method, an FDM method, and a TDM method. When a request for transmission of uplink data occurs in the mobile terminal (ST601), the state of the reception of the downlink data is checked in ST602.

In this Embodiment 3, because the mobile terminal is receiving the downlink data, the mobile terminal advances to ST1301 in which the mobile terminal transmits Ack/Nack information with an uplink scheduling request signal SR (only a part corresponding to a preamble or a part corresponding to the preamble and a message), by using the Ack/Nack exclusive channel.

[0075]

The sequence including from the transmission in ST1301 of the uplink scheduling request signal SR up to the transmission of the uplink data is shown in Fig. 8. In a case in which the information size of the uplink scheduling request signal SR is small and the transmission time is short, transmitting the uplink scheduling request signal SR by using

the Ack/Nack exclusive channel is very effective from the viewpoint of the two following aspects: the efficiency of use of radio resources; and the attainment of the communication quality of transmission (an L1/L2 control signaling) of an L1/L2 control signal having a small size, like an Ack/Nack or an uplink scheduling request signal SR.

[0076]

A time-frequency region having a length of one subframe in the Ack/Nack exclusive channel is comprised of six data symbol blocks which are called long blocks LB and symbol blocks for physical channel synchronization which are called short blocks SB.

In this Embodiment 3, an example of the mapping of symbols at the time of carrying out multiplexing of an uplink scheduling request signal SR, Ack/Nack information and/or CQI information within a time-frequency region of 1 TTI (= two subframes) with a predetermined positional relationship will be shown.

[0077]

Fig. 14 is an example of the symbol mapping in a case in which CQI information and Ack/Nack information are multiplexed, and an uplink scheduling request signal SR is further allocated to these pieces of multiplexed information. In this case, it is assumed that the Ack/Nack, the CQI, and the uplink scheduling request signal SR are multiplexed, and are mapped and updated in units of 1 TTI.

[0078]

First, the uplink scheduling request (UL scheduling request) is mapped to a leading symbol block (LB1) within the time-frequency region having a length of a transmission time interval (TTI) (= a length of two subframes). The number of

times that the uplink scheduling request signal SR is mapped and transmitted is one time/two subframes at the fastest rate. The description of the SR symbol is 1 bit long, and is information indicating either with request or without request.

Even though the symbol mapping is not carried out as shown in Fig. 14, this Embodiment 3 can be implemented. Therefore, the concept about the symbol mapping will be mentioned hereafter.

[0079]

(1) Repeat symbols having a higher priority a larger number of times. (2) Place symbols having a higher priority in a vicinity of a short block SB.

In general, an Ack/Nack, the higher-order bits of a CQI (CQI1 is the most significant bit), and an uplink scheduling request signal SR are symbols having a higher priority.

An Ack/Nack indicates the result of reception of downlink data, and therefore there arises a problem that, when this symbol cannot be received properly by the base station, retransmission of the corresponding packet data occurs and the throughput of the downlink data falls as a result. It is therefore necessary to increase the priority of the Ack/Nack in the symbol arrangement.

Also in the case of the higher-order ones of the CQI bits indicating the state of the reception of the downlink data, when a transmission error occurs, the erroneous difference between the downlink communication path quality which is measured by the mobile terminal and the downlink communication path quality which the base station has received becomes large, and therefore appropriate scheduling cannot be carried out by the base station and this results in reduction in the downlink throughput of the

whole mobile communications system. It is therefore necessary to increase the priority of the higher-order ones of the CQI bits indicating the reception state of the downlink data in the symbol arrangement.

[0080]

Furthermore, a case in which an uplink scheduling request signal SR is accidentally received by the base station will be considered. When the base station erroneously receives "presence" of an uplink scheduling request SR from a mobile terminal even though the mobile terminal shows "absence" of the uplink scheduling request SR, an unnecessary uplink resource is allocated to the mobile terminal and hence the radio resource goes to waste.

In contrast, when the base station erroneously receives "absence" of an uplink scheduling request SR from a mobile terminal even though the mobile terminal shows "presence" of the uplink scheduling request SR, there arises a problem that the mobile terminal has to retransmit the uplink scheduling request SR and the uplink throughput decreases as a result.

The priorities of the Ack/Nack, the CQI, and the uplink scheduling request SR depend on their error rates.

[0081]

Because increase in the number of repetitions (repetition) can increase the receive power of the base station, the larger number of repetitions (repetition) a symbol has the more rarely an error occurs in the symbol.

Because it can be considered that a short block is used for phase compensation when receiving data and then performing demodulation of the data, the phase compensation is carried out more correctly as the difference between the transmission

timing of the short block and that of the corresponding symbol decreases. Therefore, an error occurs more rarely in a symbol which is placed nearer to a short block.

[0082]

In the explanation of the concept of the symbol mapping, which is made until now, the case in which the multiplexing of a CQI and an Ack/Nack in an Ack/Nack exclusive channel is carried out by using the TDM method is shown. Even in a case in which the multiplexing is carried out by using another method, the concept of the above-mentioned symbol mapping can be applied as the method of mapping an uplink scheduling request signal SR.

Furthermore, an uplink scheduling request signal SR has a value which is defined as follows: "with request = ('1')" and "without request = ('0')", as mentioned above. However, the definition is not limited to this example, and, for example, an uplink scheduling request signal SR can alternatively have a value which is defined as follows: "with request = ('0')" and "without request = ('1')". Further speaking, an uplink scheduling request signal SR has only to show the presence or absence of an uplink scheduling request.

There can be considered the two following examples of the setting of the value of this bit.

[0083]

In the first example of the setting, when there is no uplink scheduling request signal SR, 0 is always transmitted. In contrast, in a case in which the mobile terminal transmits an uplink scheduling request signal SR, as shown in the flow chart of Fig. 8, the mobile terminal transmits "with request (= '1')", and then transmits 0 during the next transmission time

interval (TTI).

If there does not occur any receiving error, when "uplink data resource allocation (Uplink Data Resource Allocation)" which the base station ought to have transmitted to the mobile station does not arrive thereat, the mobile terminal judges that an receiving error has occurred in the base station, and then transmits the uplink scheduling request signal SR indicating "with request ('1')" again.

[0084]

The first example of the setting will be explained in greater detail with reference to Figs. 28, 29, and 30.

Fig. 28 is a sequence diagram, and Fig. 29 is a flow diagram of processing carried out by the mobile terminal. Fig. 30 is a flow diagram of processing carried out by the base station.

In Fig. 28, a time T shows a time limit (an upper limit) by which the mobile terminal has to receive uplink resource allocation made by the base station, and the mobile terminal uses a timer or the like in order to implement the time T.

The operation of the first example of the setting will be explained by mainly referring to Fig. 29.

[0085]

First, a case in which no receiving error occurs when the base station receives an uplink scheduling request signal SR will be explained. As a sequence diagram, Fig. 28(i) shows the case in which no receiving error occurs.

The mobile terminal, in ST2901, judges whether a request for transmission of uplink data has occurred. When a request for transmission of uplink data has occurred, the mobile terminal advances to ST2902. In contrast, when no request for transmission of uplink data has occurred, the mobile terminal

returns to the judgment of ST2901.

The mobile terminal, in ST2902, sets up information indicating the presence of an uplink scheduling request (UL Scheduling request= "1" currently allocated to LB1 in Fig. 14) in the Ack/Nack exclusive channel.

The mobile terminal then, in ST2903, transmits the information indicating the "presence" of uplink scheduling by using the Ack/Nack exclusive channel. This step corresponds to ST2801 in Fig. 28.

[0086]

After transmitting the information indicating the "presence" of uplink scheduling by using the Ack/Nack exclusive channel, the mobile terminal, in ST2904, sets up information indicating the absence of an uplink scheduling request (UL Scheduling request= "0" currently allocated to LB1 in Fig. 14) in the Ack/Nack exclusive channel.

The mobile terminal, in ST2905, judges whether the mobile terminal has received uplink data resource allocation "Uplink Data Resource Allocation" from the base station. That is, the mobile terminal judges whether the mobile terminal has received uplink transmission allocation from the base station.

When, in ST2905, has received uplink data resource allocation, the mobile terminal advances to ST2906. This step corresponds to ST2804 in Fig. 28. The mobile terminal, in ST2906, transmits uplink data according to the allocation from the base station.

In contrast, when, in ST2905, has not received uplink data resource allocation, the mobile terminal advances to ST2907. The mobile terminal, in ST2907, judges whether the current time exceeds the time limit by which the mobile terminal has to

receive "Uplink Data Resource Allocation" from the base station. More specifically, the mobile terminal judges whether the time which has elapsed since the mobile terminal transmitted the information indicating the "presence of an uplink scheduling request signal SR exceeds the time T as shown in Fig. 28.

[0087]

When, in ST2905, the elapsed time does not exceed the time T, the mobile terminal advances to ST2908. The mobile terminal, in ST2908, transmits the information indicating the "absence" of uplink scheduling by using the Ack/Nack exclusive channel (UL Scheduling request = "0" currently allocated to LB1 in Fig. 14).

After, in ST2908, transmitting the information indicating the "absence" of uplink scheduling by using the Ack/Nack exclusive channel, the mobile terminal returns to the judgment of ST2905. This step corresponds to ST2802 and ST2803 in Fig. 28.

[0088]

Next, a case in which an receiving error occurs when the base station receives an uplink scheduling request signal SR will be explained. As a sequence diagram, Fig. 28(ii) shows the case in which a receiving error occurs.

Because the explanation of the steps of ST2901 to ST2906 is the same as that in the above-mentioned case in which no receiving error occurs, the explanation will be omitted.

The mobile terminal, in ST2907, judges whether the current time exceeds the time limit by which the mobile terminal has to receive "Uplink Data Resource Allocation" from the base station, like in the above-mentioned case in which no receiving error occurs. More specifically, the mobile terminal judges

whether the time which has elapsed since the mobile terminal transmitted the information indicating the "presence" of an uplink scheduling request signal SR exceeds the time T as shown in Fig. 28.

[0089]

In this case, as shown in Fig. 28(ii), an receiving error has occurred in the information indicating the presence or absence of an uplink scheduling request currently allocated, in ST2807, to the Ack/Nack exclusive channel. Therefore, at the timing (time '"t"' of (ii) of Fig. 28) at which the mobile terminal should have originally received "Uplink Data Resource Allocation" from the base station, the mobile terminal does not accept any uplink transmission allocation from the base station. As a result, the mobile terminal, in ST2907, judges that the time which has elapsed since the mobile terminal, in ST2811 of Fig. 28, transmitted the information indicating the "presence" of an uplink scheduling request signal SR exceeds the time T.

In this case, the mobile terminal returns to ST2902, sets up information indicating the presence of an uplink scheduling request (UL Scheduling request= "1" currently allocated to LB1 in Fig. 14) in the Ack/Nack exclusive channel, and then retransmits the uplink scheduling request signal SR (ST2903). This step corresponds to ST2811 in Fig. 28.

[0090]

Next, a flow of processing performed by the base station in the first example of the setting will be explained with reference to Fig. 30.

The base station, in step ST3001, judges whether the information indicating the presence or absence of an uplink scheduling request currently allocated to the Ack/Nack

exclusive channel in ST3001 shows the "presence." When the information indicates the "absence," the base station returns to the judgment of ST3001.

When the base station, in step ST3001, judges that the information indicates the "presence", the base station performs an uplink scheduling process for the mobile terminal which, in step ST3002, has transmitted the uplink scheduling request thereto by using the Ack/Nack exclusive channel. This step corresponds to ST2801 or ST2811 in Fig. 28.

In order to perform uplink transmission allocation for the mobile terminal, the base station, in ST3003, transmits the result as "Uplink Data Resource Allocation." This step corresponds to ST2804 or ST2814 in Fig. 28.

[0091]

In the second example of the setting, when not receiving any uplink scheduling request signal SR, the base station always transmits 0, like in the case of the first example of the setting. In contrast, in the flow chart of Fig. 8, when the mobile terminal transmits an uplink scheduling request signal SR, the mobile terminal continues transmitting the information indicating "the presence of a request (= '1')" until "Uplink Data Resource Allocation" is transmitted thereto from the base station, and, after receiving "Uplink Data Resource Allocation", the mobile terminal transmits the information indicating "the absence of a request (= '0')".

[0092]

The second example of the setting will be explained in greater detail with reference to Figs. 31, 32, and 33.

Fig. 31 is a sequence diagram, and Fig. 32 is a flow diagram showing processing carried out by the mobile terminal. Fig.

33 is a flow diagram showing processing carried out by the base station.

The operation of the second example of the setting will be explained by mainly referring to Fig. 32.

First, a case in which no receiving error occurs when the base station receives an uplink scheduling request signal SR will be explained. As a sequence diagram, Fig. 31(i) shows the case in which no receiving error occurs.

[0093]

The mobile terminal, in ST3201, judges whether a request for transmission of uplink data has occurred. When a request for transmission of uplink data has occurred, the mobile terminal advances to ST3202. In contrast, when no request for transmission of uplink data has occurred, the mobile terminal returns to the judgment of ST3201.

The mobile terminal, in ST3202, sets up information indicating the presence of an uplink scheduling request (UL Scheduling request= "1" currently allocated to LB1 in Fig. 14) in the Ack/Nack exclusive channel.

The mobile terminal then, in ST3203, transmits an uplink scheduling request by using the Ack/Nack exclusive channel. This step corresponds to ST3101 in Fig. 31.

[0094]

The mobile terminal, in ST3204, judges whether the mobile terminal has received "uplink data resource allocation (Uplink Data Resource Allocation)" from the base station. That is, the mobile terminal judges whether the mobile terminal has received uplink transmission allocation from the base station.

When, in ST3204, has received uplink transmission allocation, the mobile terminal advances to ST3205. In

contrast, when has not received uplink transmission allocation, the mobile terminal returns to ST3202. This step corresponds to ST3104 in Fig. 31.

The mobile terminal, in ST3205, sets up information indicating the absence of an uplink scheduling request (UL Scheduling request= "0" currently allocated to LB1 in Fig. 14) in the Ack/Nack exclusive channel. This step corresponds to ST3105 in Fig. 31.

The mobile terminal, in ST3206, transmits uplink data according to the allocation from the base station.

[0095]

Next, a case in which a receiving error occurs when the base station receives an uplink scheduling request signal SR will be explained. As a sequence diagram, Fig. 31(ii) shows the case in which a receiving error occurs.

Because the flow of the processing carried out by the mobile terminal in this case is the same as that in the above-mentioned case in which no receiving error occurs, the flow will be omitted.

The case (ii) shown in Fig. 31 will be explained.

A receiving error occurs in the information indicating the presence or absence of an uplink scheduling request currently allocated, in ST3107, to the Ack/Nack exclusive channel. Therefore, at the timing (time '"t"' in the case (ii) of Fig. 31) at which the mobile terminal should have originally received "Uplink Data Resource Allocation" from the base station, the mobile terminal does not accept any uplink transmission allocation from the base station.

[0096]

However, in the second example of the setting, following

the step of ST3107, the mobile terminal, also in ST3108, transmits the information indicating the presence of an uplink scheduling request (UL Scheduling request= "1" currently allocated to LB1 in Fig. 14) by using the Ack/Nack exclusive channel. Therefore, when normally receiving the information indicating the presence or absence of an uplink scheduling request currently allocated to the Ack/Nack exclusive channel transmitted in ST3108, the base station, in ST3111, transmits "Uplink Data Resource Allocation." That is, the mobile terminal receives the uplink transmission allocation from the base station.

[0097]

Next, a flow of processing carried out by the base station in the second example of the setting will be explained with reference to Fig. 33.

The base station, in step ST3301, judges whether the information indicating the presence or absence of an uplink scheduling request currently allocated to the Ack/Nack exclusive channel shows the "presence". When the information indicates the "absence," the base station returns to the judgment of ST3301.

When the base station, in step ST3301, judges that the information indicates the "presence," the base station, in ST3302, judges whether or not the base station is performing an uplink scheduling process for the mobile terminal.

When, in ST3302, judging that the base station is performing an uplink scheduling process for the mobile terminal (corresponding to ST3102, ST3103, ST3109, and ST3110 in Fig. 31), the base station advances to ST3303. The base station, in ST3303, continues performing the uplink scheduling process

which the base station has been performing.

[0098]

In contrast, when, in ST3302, judging that the base station is not performing any uplink scheduling process for the mobile terminal (corresponding to ST3101 and ST3108 in Fig. 31), the base station advances to ST3304. The base station, in ST3304, starts performing an uplink scheduling process for the mobile terminal.

When, in ST3303 or ST3304, completing the uplink scheduling process for the mobile terminal, the base station, in ST3305, transmits the result of the process as "Uplink Data Resource Allocation" in order to perform uplink transmission allocation for the mobile terminal. This step corresponds to ST3104 or ST3111 in Fig. 31.

[0099]

The advantages of the first example of the setting and the second example of the setting will be explained.

Compared with the second example of the setting, the merits of the first example of the setting can be provided as follows:

(1) Because, when receiving an uplink scheduling request by using the Ack/Nack exclusive channel, the base station does not have to judge whether or not the base station is performing an uplink scheduling process for the mobile terminal (ST3302 in Fig. 33), the processing carried out by the base station can be simplified.

[0100]

Compared with the first example of the setting, the merits of the second example of the setting can be provided as follows:

(1) When a receiving error occurs in the information

indicating the presence or absence of an uplink scheduling request currently allocated to the Ack/Nack exclusive channel, the time which has elapsed until the mobile terminal actually receives "Uplink Data Resource Allocation" from the timing at which the mobile terminal was expected to receive "Uplink Data Resource Allocation" from the base station becomes short. In the first example of the setting, the time is equal to "a", as shown in Fig. 28. In contrast, in the second example of the setting, the time is equal to "b," as shown in Fig. 31.

(2) Because the mobile terminal does not have to judge whether the current time exceeds the time limit by which the mobile terminal has to receive "Uplink Data Resource Allocation" from the base station (ST2907 in Fig. 29) in its internal processing, the processing carried out by the mobile terminal can be simplified.

[0101]

Each of the first and second examples of the setting of a scheduling request signal SR which are explained above can also be used in any one of Embodiment 1, Embodiment 6, Embodiment 7, Embodiment 8, Embodiment 9, and Embodiment 10.

Furthermore, in a case in which the mobile terminal does not have to transmit an Ack/Nack and/or a CQI, but has to transmit only a scheduling request signal, the mobile terminal does not transmit any information about the Ack/Nack and the CQI by using the Ack/Nack exclusive channel, but can transmit only the scheduling request by using the Ack/Nack exclusive channel.

[0102]

An Ack/Nack symbol and CQI symbols are mapped to long blocks (LB2 to LB6) other than the leading LB (LB1), to which an uplink scheduling request signal SR is mapped, during a

transmission time interval (TTI). In this mapping, the Ack/Nack symbol and CQI symbols at higher-order digits with a higher priority among all the CQI symbols are given a higher priority so that they are repeatedly mapped. In Fig. 14, during 1 TTI (=2 subframes), the Ack/Nack symbol is repeatedly mapped three times, and CQI1 and CQI2 with a higher priority are repeatedly mapped twice.

[0103]

As previously explained, in a case in which the transmission time of an uplink scheduling request signal SR is sufficiently small as shown in the sequence of Fig. 8, the uplink scheduling request signal SR, and Ack/Nack information symbols (an Ack/Nack and/or a CQI), is mapped to the Ack/Nack exclusive channel. As a result, even when a plurality of "data-non-associated L1/L2 control signals" which have to be transmitted occur simultaneously in a mobile terminal, while the communication quality of these important control signals is attained, increase in the radio resources load on the communication system can be prevented, and transmission with a single carrier method which guarantees a low PAPR and high communication quality can be implemented.

[0104]

Furthermore, because the Ack/Nack exclusive channel is not a channel (contention based channel), such as an S-RACH, which allows communications competition among a plurality of mobile terminals, compared with the case of using an S-RACH, the use of this method can also provide an advantage of eliminating the necessity to transmit the identification number (UE-ID) of the mobile terminal through transmission of an uplink scheduling request signal SR.

Therefore, in a case in which the frequency of the transmission of an SR is high, it can be said that it is an effective means because the required number of bits for transmitting an SR is small. In addition, a plurality of time-frequency regions (A and B in Fig. 24) having narrow bands which are separated as shown in Fig. 24 are allocated to the Ack/Nack exclusive channel. As a result, a scheduling request signal SR which is transmitted by using the Ack/Nack exclusive channel has high resistance to the frequency selective fading. In other words, a scheduling request signal SR can have a frequency diversity gain.

Furthermore, in a case in which a scheduling request signal SR is transmitted from the mobile terminal to the base station by not using an S-RACH, but using the Ack/Nack exclusive channel when the mobile terminal is not performing any transmission of uplink data, but is receiving downlink data, the radio resources (the frequency-time regions) which are beforehand allocated for the S-RACH can be released for a UL-SCH or the like, and the method is effective from the viewpoint of effective use of the radio resources.

[0105]

The Ack/Nack exclusive channel is a channel which the mobile terminal has been using in the state in which the mobile terminal is not performing any transmission of uplink data, but is receiving downlink data. Therefore, by mapping an Ack/Nack and a CQI with an uplink scheduling request signal SR, to the Ack/Nack exclusive channel, there is provided an advantage of being able to use the radio resources currently being used effectively, in addition to an advantage of being able to implement transmission by using a single carrier method which

guarantees both a low PAPR and high communication quality.

Furthermore, as mentioned above, by using a scheduled channel like the Ack/Nack exclusive channel, there can be provided a further advantage of eliminating the necessity to transmit the identification number (UE-ID) of the mobile terminal through transmission of an uplink scheduling request signal SR. Therefore, the processing load on the base station when receiving an uplink scheduling request signal can be reduced.

In addition, because the Ack/Nack exclusive channel is used with a frequency band narrower than usually being allocated thereto, the Ack/Nack exclusive channel has a small amount of information to be processed per a unit time. Therefore, because the processing time in each of the transmission and the reception also becomes short, the process delay (Latency) of the sequence (ST701 to ST703 of Fig. 7 and ST801 to ST804 of Fig. 8) including from the transmission of an uplink scheduling request signal SR up to a start of the transmission becomes short, and this can contribute to greater efficiency and a speedup of the processing of the whole communication system.

[0106]

On the other hand, there can be considered a mobile communication system in which even when a mobile terminal is not receiving any downlink data, an Ack/Nack exclusive channel is allocated to the mobile terminal. More specifically, there can be considered a case in which, in order to prepare for future downlink scheduling even when there exist no downlink data, or maintain synchronization between a base station and a mobile terminal, the mobile terminal notifies the result (CQI) of measurement of the quality of a downlink communication path.

Also in such a case, there may be a case in which transmission of a CQI using an Ack/Nack exclusive channel and that of an uplink scheduling request signal SR occur simultaneously. In such a mobile communication system, in the judgment of ST602, the mobile terminal had better to makes the judgment by judging whether the mobile terminal has received allocation of an Ack/Nack exclusive channel. In addition, even a mobile communication system in which when a mobile terminal is not receiving any downlink data no Ack/Nack exclusive channel is allocated to the mobile terminal can use this judgment.

In this Embodiment 3, an Ack/Nack exclusive channel to which a plurality of time-frequency regions having narrow bands which are separated as shown in Fig. 24 are allocated monopolistically is explained. However, this Embodiment 3 can also be adapted to an Ack/Nack exclusive channel not having a narrow band, as shown in Fig. 23.

[0107]

Embodiment 4.

In a case in which a mobile terminal is not transmitting any uplink data (Uplink data, UL data) such as user data, but is receiving downlink data (Downlink data, DL data) transmitted from a base station, the mobile terminal has to transmit an Ack/Nack signal, which is the result of the reception of the downlink data, and a CQI indicating the quality of a downlink communication path to the base station.

Furthermore, when a necessity for transmission of uplink data occurs in a mobile terminal, the mobile terminal has to transmit an uplink scheduling request signal SR to the base station.

Hereafter, a method of making a mobile terminal which has

to transmit an Ack/Nack and an uplink scheduling request signal SR simultaneously perform these transmissions simultaneously without increasing the PAPR will be explained.

[0108]

In accordance with above-mentioned Embodiment 3, by transmitting an Ack/Nack and a CQI with a scheduling request signal SR, by using an Ack/Nack exclusive channel, transmission through use of a single carrier method which guarantees both a low PAPR and high communication quality can be implemented. However, in a case of an example shown in Fig. 14, in the transmission, it is necessary to map a symbol indicating the presence or absence of a scheduling request signal SR to the Ack/Nack exclusive channel. Therefore, in the case of using above-mentioned Embodiment 3 to multiplex an Ack/Nack, a CQI and an uplink scheduling request signal SR (SR) to the Ack/Nack exclusive channel by using a TDM method, the following two problems newly arise.

[0109]

The first problem will be explained hereafter.

Even in a case in which an SR does not have to be transmitted, an LB to which an SR is mapped has to be allocated in advance. Therefore, a radio resource must always be allocated to the information which does not have to be transmitted. The problem is therefore that there cannot be provided an advantage of making effective use of the radio resources.

The second problem will be explained hereafter.

Compared with a case in which an SR is not multiplexed to an Ack/Nack exclusive channel by using a TDM method, there is a disadvantage of reducing the number of repetitions that

an Ack/Nack or a CQI is transmitted. In most cases, an encoding process with high error correction capability is not performed on an Ack/Nack and a CQI, unlike in the case of data. Therefore, in order to prevent a receiving error from occurring in a base station, repeating the same information to increase the receive power of the base station is important to improve the reception quality (repetition). The problem is therefore that from the viewpoint of maintaining the reception quality of the base station, reduction in the number of LBs which can be used for the repetition has to be avoided as much as possible.

[0110]

A method of solving the first and second problems arising newly will be explained hereafter.

Fig. 15 is a flow chart for explaining processing carried out by a mobile terminal which transmits an uplink scheduling request signal, and processing carried out by a base station which receives the uplink scheduling request signal. Fig. 15 shows processing in a case in which the mobile terminal is not performing transmission of uplink data, but is receiving downlink data.

The mobile terminal, in ST1500, judges whether a request for transmission of uplink data has occurred. When no request for transmission of uplink data has occurred (if No in ST1500), the mobile terminal advances to ST1501. The mobile terminal, in ST1501, maps either or both of an Ack/Nack and a CQI to an Ack/Nack exclusive channel.

As an example of the mapping, the example shown in Fig. 9 can be used. The mobile terminal, in ST1503, multiplies the Ack/Nack exclusive channel by a code (code a) indicating that either or both of the Ack/Nack and CQI are mapped to the Ack/Nack

exclusive channel.

[0111]

This multiplication by code is carried out by the modulating unit 10 or the encoder unit 9. After the multiplication by code is carried out, a process of ST1505 is carried out.

In contrast, when, in ST1500, a request for transmission of uplink data has occurred, a process of ST1502 is carried out. The mobile terminal, in ST1502, maps either or both of the Ack/Nack and the CQI to the Ack/Nack exclusive channel, and also maps an uplink scheduling request signal SR to the Ack/Nack exclusive channel.

As an example of the mapping, the example shown in Fig. 14 can be used. The mobile terminal, in ST1504, multiplies the Ack/Nack exclusive channel by a code (code b) indicating that either or both of the Ack/Nack and the CQI, and the uplink scheduling request signal SR are mapped to the Ack/Nack exclusive channel, the code being different from the code a. This multiplication by code is carried out by the modulating unit 10 or the encoder unit 9. After the multiplication by code is carried out, the process of ST1505 is carried out. As the codes a and b, codes which are perpendicular to each other can be used in order to reduce occurrence of an error in the judgment by the base station.

[0112]

In the mobile communication system, in a case in which code division multiplexing is used as multiplexing of signals from a plurality of mobile terminals in the Ack/Nack exclusive channel, the Ack/Nack exclusive channel is, in ST1505, multiplied by a code (a code A) for identifying the plurality

of mobile terminals. This multiplication by code is carried out by the modulating unit 10. After the multiplication by code is carried out, ST1506 is carried out.

Since the Ack/Nack exclusive channel is, in ST1505, multiplied by the code (the code A) for identifying the plurality of mobile terminals, the codes (the codes a and b) by which the Ack/Nack exclusive channel is multiplied in steps ST1503 and ST1504 can be used in common by the plurality of mobile terminals whose signals are multiplexed into the Ack/Nack exclusive channel. The order in which the Ack/Nack exclusive channel is multiplied by the codes a and A, and the order in which the Ack/Nack exclusive channel is multiplied by the codes b and A can be reverse. The mobile terminal, in ST1506, transmits the Ack/Nack exclusive channel to the base station.

[0113]

The base station, in ST1507, receives the signal transmitted thereto by using the Ack/Nack exclusive channel. The base station then performs a process of multiplying the signal by the codes which are used for the multiplexing of the signals from the plurality of mobile terminals in the Ack/Nack exclusive channel in order to demultiplex the signal transmitted thereto by using the Ack/Nack exclusive channel into the signals from the plurality of mobile terminals.

The base station, in ST1508, performs a correlation operation by using the code (code A) indicating the mobile terminal. When the result of the correlation operation is equal to or larger than a predetermined threshold (if Yes in ST1508), the base station judges that the reception is the one of the Ack/Nack exclusive channel from the mobile terminal, and carries out a process of ST1509.

[0114]

When the result of the correlation operation which the base station performed in step ST1508 is smaller than the predetermined threshold (if No in ST1508), the base station judges that the reception is not the one of Ack/Nack exclusive channel from the mobile terminal, and ends the processing. The correlation operation using the code A is carried out by the demodulating unit 24. The base station, in ST1509, performs a correlation operation by using the code a in order to judge whether or not only the Ack/Nack and the CQI are mapped to the Ack/Nack exclusive channel from the mobile terminal. When the result of the correlation operation is equal to or larger than the predetermined threshold (if Yes in ST1509), the base station judges that only the Ack/Nack and the CQI are mapped to the Ack/Nack exclusive channel from the mobile terminal (judges that any scheduling request signal SR is not mapped to the Ack/Nack exclusive channel), and carries out a process of ST1510.

The correlation operation using the code a is carried out by the demodulating unit 24 or the decoder unit 25. The base station, in ST1510, carries out the process by judging that only the Ack/Nack and the CQI are mapped to the received Ack/Nack exclusive channel from the mobile terminal.

[0115]

In contrast, when the result of the correlation operation which the base station, in ST1509, performed by using the code a is less than the predetermined threshold (if No in ST1509), the base station carries out ST1511. The base station, in ST1511, performs a correlation operation by using the code b in order to judge whether or not the scheduling request signal

SR, in addition to the Ack/Nack and the CQI, is mapped to the Ack/Nack exclusive channel from the mobile terminal. When the result of the correlation operation is equal to or larger than a predetermined threshold (if Yes in ST1511), the base station judges that the scheduling request signal SR, in addition to the Ack/Nack and the CQI, is mapped to the Ack/Nack exclusive channel from the mobile terminal, the base station carries out a process of ST1512.

The correlation operation using the code b is carried out by the demodulating unit 24 or the decoder unit 25. The base station, in ST1512, carries out the processing by judging that the scheduling request signal SR, in addition to the Ack/Nack and the CQI, is mapped to the received Ack/Nack exclusive channel from the mobile terminal. In contrast, when the result of the correlation operation which the base station, in ST1511, performed by using the code b is less than the predetermined threshold (if No in ST1511), the base station judges that a receiving error has occurred and ends the processing.

[0116]

As mentioned above, in Fig. 15, ST1503 in which the multiplication by the code a is performed, ST1504 in which the multiplication by the code b is performed, and ST1505 in which the multiplication by the code A is performed are carried out by the encoder unit 9 and the modulating unit 10 in the mobile terminal. A detailed block diagram showing the multiplication by the code a, the multiplication by the code b, and the multiplication by the code A is shown in Fig. 34.

A symbol pattern 3401 for the Ack/Nack exclusive channel in the transmission buffer 8 or the encoder unit 9 is multiplied by either the code a 3402 indicating that either or both of the

Ack/Nack and the CQI are mapped to the Ack/Nack exclusive channel, or the code b 3403 indicating that either or both of the Ack/Nack and the CQI and the scheduling request signal SR are mapped to the Ack/Nack exclusive channel.

[0117]

The multiplication by the code a 3402 and the multiplication by the code b 3403 are switched by a switch 3404. The switching condition of the switch 3404 is as shown in Fig. 34.

When a request for transmission of uplink data has occurred, i.e., when there is an uplink scheduling request, the switch operates in such a way that the symbol pattern 3401 for the Ack/Nack exclusive channel is multiplied by the code b. In contrast, when no request for transmission of uplink data has occurred, i.e., when there is no uplink scheduling request, the switch operates in such a way that the symbol pattern 3401 for the Ack/Nack exclusive channel is multiplied by the code a.

After multiplying the symbol pattern by the code a or b, the mobile terminal multiplies the symbol pattern by the code A 3405 for identifying the mobile terminal. After that, a modulation process is performed on the symbol pattern by the modulating unit 10.

[0118]

As previously explained, because the mobile terminal multiplies the Ack/Nack exclusive channel by a code which differs according to whether or not a scheduling request signal SR, in addition to an Ack/Nack and a CQI, is mapped to the Ack/Nack exclusive channel, the mobile terminal does not have to reserve a symbol for the scheduling request signal SR in the Ack/Nack exclusive channel. For example, the scheduling

request signal SR is mapped to the first long block LB1 shown in Fig. 14, though, when no scheduling request signal SR is transmitted, the Ack/Nack, the CQI, and so on can be mapped to the LB1. Furthermore, because the base station can identify easily whether a signal from a certain mobile terminal includes a scheduling request signal SR by using the code by which the signal is multiplied, the base station can perform an appropriate process on the signal according to whether or not the scheduling request signal SR is mapped.

[0119]

In accordance with the W-CDMA method which is a conventional technology, in order to enable a base station to demultiplex a received signal into signals associated with a plurality of channels transmitted simultaneously from a mobile terminal, a signal associated with each channel is multiplied by a different code (a channelization code) and the signals associated with the plurality of channels are simultaneously transmitted from the mobile terminal to the base station.

In contrast, in accordance with this Embodiment 4, in order to demultiplex the received signal into the several types of information: "Ack/Nack and CQI" or "Ack/Nack, CQI, and SR"), which are transmitted with the codes, the codes are used.

In this Embodiment 4, either "Ack/Nack and CQI" or "Ack/Nack, CQI, and SR" are transmitted from the mobile terminal to the base station, and both "Ack/Nack and CQI" and "Ack/Nack, CQI, and SR" which are demultiplexed with the codes are not transmitted simultaneously. In the above-mentioned point, this Embodiment 4 differs from the conventional technology (W-CDMA) which uses codes in order to demultiplex a received signal into a plurality of channels transmitted simultaneously.

[0120]

By using this Embodiment 4, the following advantages can be provided, like in the case of using above-mentioned Embodiment 3.

There can be provided an advantage of enabling a mobile terminal which has to transmit, an uplink scheduling request signal SR and an Ack/Nack in a case in which the mobile terminal is not performing any transmission of uplink data, but is receiving downlink data to simultaneously transmit them without increasing the PAPR of the mobile terminal.

[0121]

There can be provided another advantage of eliminating the necessity to add a UE-ID to an uplink scheduling request signal SR through transmission of the uplink scheduling request signal SR by using an Ack/Nack exclusive channel. Therefore, in a case in which the frequency of the transmission of an SR is high, it can be said that it is an effective means because the required number of bits for transmitting an SR is small. In addition, a plurality of time-frequency regions (A and B in Fig. 24) having narrow bands which are separated as shown in Fig. 24 are allocated to the Ack/Nack exclusive channel. As a result, a scheduling request signal SR which is transmitted by using the Ack/Nack exclusive channel has high resistance to the frequency selective fading.

In other words, a scheduling request signal SR can have a frequency diversity gain. Furthermore, in a case in which a scheduling request signal SR is transmitted from a mobile terminal to a base station by not using an S-RACH, but using an Ack/Nack exclusive channel when the mobile terminal is not performing any transmission of uplink data, but is receiving

downlink data, the radio resources (the frequency-time regions) which are beforehand allocated for the S-RACH can be released for a UL-SCH or the like, and the method is effective from the viewpoint of effective use of the radio resources.

[0122]

By using this Embodiment 4, the following advantages can be provided in addition to the advantages offered in the case of using above-mentioned Embodiment 3.

In a case in which no SR has occurred in a mobile terminal, an LB which is beforehand allocated for transmitting an SR in an Ack/Nack exclusive channel can be eliminated, and therefore the radio resources can be used more effectively. Furthermore, because the allocation for mapping an SR can be eliminated, in the case in which no SR has occurred in the mobile terminal, it becomes unnecessary to reduce the number of repetitions of an Ack/Nack or a CQI in the conventional Ack/Nack exclusive channel. Therefore, there can be provided an advantage of improving the quality of reception of the Ack/Nack or the CQI by a base station.

There can be considered a case in which in the mobile communication system, even when a mobile terminal is not receiving any downlink data, an Ack/Nack exclusive channel is allocated to the mobile terminal. More specifically, there can be considered a case in which, in order to prepare for future downlink scheduling even when there exist no downlink data, or maintain synchronization between a base station and a mobile terminal, the mobile terminal notifies the result (CQI) of measurement of the quality of a downlink communication path. Also in such a case, there may be a case in which transmission of a CQI using an Ack/Nack exclusive channel and that of an uplink

scheduling request signal SR occur simultaneously. This Embodiment 4 can also be used for such a mobile communication system.

[0123]

Hereafter, variants will be explained.

As a first variant, there can be considered a case in which in order to judge whether only an Ack/Nack and a CQI are mapped to an Ack/Nack exclusive channel, only one of the code a or the code b indicating that an uplink scheduling request signal SR is furthermore mapped to the Ack/Nack exclusive channel is used.

As a concrete example, the mobile terminal multiplies the Ack/Nack exclusive channel by the code a when only an Ack/Nack and a CQI are mapped to the Ack/Nack exclusive channel, whereas when an uplink scheduling request signal SR, in addition to an Ack/Nack and a CQI, is mapped to the Ack/Nack exclusive channel, the mobile terminal carries out the process of ST1505 without multiplying the Ack/Nack exclusive channel by the code b (ST1504 is omitted).

[0124]

The base station, in ST1509, performs a correlation operation by using the code a. When the result of the correlation operation is equal to or larger than a predetermined threshold, the base station judges that only an Ack/Nack and a CQI are mapped to the Ack/Nack exclusive channel and advances to ST1510.

In contrast, when the result of the correlation operation which the base station, in ST1509, performed is smaller than the predetermined threshold, the base station judges that a scheduling request signal SR, in addition to an Ack/Nack and a CQI, is mapped to the Ack/Nack exclusive channel and then

carries out ST1512.

By using this first variant, the number of the codes can be reduced, and the process of multiplying the Ack/Nack exclusive channel by the codes in the mobile terminal, and the process of performing correlation operations using the codes in the base station can be reduced. Furthermore, because the number of the codes is reduced, there is provided an advantage of increasing the number of mobile terminals which can be allocated to the Ack/Nack exclusive channel.

[0125]

As a second variant, there can be considered a case in which for each mobile terminal whose signals are multiplexed into the Ack/Nack exclusive channel, two codes (a code A and a code B) indicating that only an Ack/Nack and a CQI is mapped to the Ack/Nack exclusive channel or an uplink scheduling request signal SR, in addition to the Ack/Nack and the CQI, is mapped to the Ack/Nack exclusive channel are allocated.

As a concrete example, the mobile terminal multiplies the Ack/Nack exclusive channel by the code A when only an Ack/Nack and a CQI are mapped to the Ack/Nack exclusive channel (ST1503), whereas when an uplink scheduling request signal SR, in addition to the Ack/Nack and the CQI, are mapped to the Ack/Nack exclusive channel, the mobile terminal multiplies the Ack/Nack exclusive channel by the code B (ST1504) and advances to ST1506. That is, because the codes allocated for each mobile terminal are used, the mobile terminal, in ST1505, does not have to further multiply the Ack/Nack exclusive channel by a code indicating the mobile terminal.

[0126]

The base station, in ST1508, performs a correlation

operation by using the code (the code A) indicating the mobile terminal. When the result of the correlation operation is equal to or larger than a predetermined threshold, the base station judges that only an Ack/Nack and a CQI are mapped to the Ack/Nack exclusive channel from the mobile terminal, and then advances to ST1510.

In contrast, when the result of the correlation operation is smaller than the predetermined threshold, the base station further, in ST1508, performs a correlation operation by using the code (the code B) indicating the mobile terminal. When the result of the correlation operation is equal to or larger than a predetermined threshold, the base station judges that an uplink scheduling request signal SR, in addition to the Ack/Nack and the CQI, are mapped to the Ack/Nack exclusive channel, and then advances to ST1512. That is, the steps ST1509 and ST1511 among the steps of Fig. 15 can be omitted.

[0127]

Furthermore, in this Embodiment 4, the entire Ack/Nack exclusive channel is multiplied by either of the code a indicating that only an Ack/Nack and a CQI are mapped to the Ack/Nack exclusive channel and the code b indicating that an uplink scheduling request signal SR, in addition to the Ack/Nack and the CQI, is mapped to the Ack/Nack exclusive channel.

In a third variant, a long block on the Ack/Nack exclusive channel to which an Ack/Nack and a CQI are mapped is multiplied by the code a indicating that effect and a long block on the Ack/Nack exclusive channel to which an uplink scheduling request signal SR is mapped is multiplied by the code b indicating that effect.

[0128]

Concretely, the steps ST1503 and ST1504 among the steps shown in Fig. 15 are omitted, and, instead, a step of multiplying a long block on the Ack/Nack exclusive channel to which an Ack/Nack and a CQI are mapped by the code a indicating that effect, and multiplying a long block on the Ack/Nack exclusive channel to which an uplink scheduling request signal SR is mapped by the code b indicating that effect is added.

Furthermore, the steps of ST1509, ST1510, ST1511, and ST1512 among the steps carried out by the base station are omitted, and, instead, a process of performing a correlation operation by using the code a in order to judge whether or not a long block is the one to which an Ack/Nack and a CQI are mapped is added.

[0129]

When the result of the correlation operation is equal to or larger than a predetermined threshold, the base station judges that the long block is the one to which an Ack/Nack and a CQI are mapped, and then performs a subsequent process. In contrast, when the result of the correlation operation is smaller than the threshold, the base station performs a correlation operation by using the code b in order to judge whether or not the long block is the one to which an uplink scheduling request signal SR is mapped.

When the result of the correlation operation is equal to or larger than a predetermined threshold, the base station judges that the long block is the one to which an uplink scheduling request signal SR is mapped, and then performs a subsequent process. In this case, in addition to the advantages provided by Embodiment 4, there can be provided an advantage of being able to freely choose the location of a long block on

the Ack/Nack exclusive channel to which an uplink scheduling request signal SR is mapped.

[0130]

Hereafter, a fourth variant will be explained.

One type of mapping to the Ack/Nack exclusive channel is provided regardless of whether or not an SR is included in the mapping. The mapping can use the example of Fig. 9. Therefore, information which is, in ST1501 and ST1502, actually mapped to the Ack/Nack exclusive channel is only an Ack/Nack or/and a CQI.

Because subsequent processing carried out by the mobile terminal is the same as that of Fig. 15, the explanation of the subsequent processing will be omitted hereafter.

[0131]

The base station which has received the Ack/Nack exclusive channel, in ST1510, judges that the base station has not received an SR from the mobile terminal, and then performs a process on the Ack/Nack exclusive channel after judging that only an Ack/Nack or/and a CQI are mapped to the Ack/Nack exclusive channel.

The base station, in ST1512, judges that the base station has received an SR from the mobile terminal, and then performs the processing on the Ack/Nack exclusive channel by judging that only an Ack/Nack or/and a CQI are mapped to the Ack/Nack exclusive channel.

[0132]

Fig. 27 is an explanatory drawing for explaining an example of the mapping of information to the Ack/Nack exclusive channel according to the fourth variant of Embodiment 4. In accordance with the fourth variant of this Embodiment 4, it becomes unnecessary to map an SR to the Ack/Nack exclusive

channel, and it becomes possible to make further effective use of the radio resources. Furthermore, even in a case in which an uplink scheduling request signal SR is transmitted from the mobile terminal, the number of repetitions of an Ack/Nack or/and a CQI can be maintained. Therefore, there can be provided an advantage of being able to maintain the quality of reception of an Ack/Nack or/and a CQI by the base station even in a case in which an uplink scheduling request signal SR is transmitted to the base station, like in a case in which no SR is transmitted to the base station. That is, the use of this method can offer an advantage of, when desiring to transmit an uplink scheduling request signal SR, being able to not only use physical channels and radio resources which have already been used, but also hardly affect the amount of information and the quality of other data which are being transmitted by using the radio resources. Therefore, when, for example, allocating an uplink Ack/Nack exclusive channel to a radio resource, the base station does not have to take into consideration the influence of transmission of an uplink scheduling request signal SR upon selection of a condition of the radio resource (a frequency bandwidth or the like).

[0133]

In this Embodiment 4 and its variants, the case in which the multiplexing of a plurality of mobile terminals into an Ack/Nack exclusive channel is carried out by using a CDM method is explained. As an alternative, Embodiment 4 and the variants can also be applied to a case in which an FDM method or a TDM method is used as the multiplexing method. In this Embodiment 4 and its variants, an Ack/Nack exclusive channel to which a plurality of time-frequency regions having narrow bands

separated as shown in Fig. 24 are allocated monopolistically is explained. However, this Embodiment 4 and its variants can also be applied to an Ack/Nack exclusive channel not having a narrow band, as shown in Fig. 23.

[0134]

Embodiment 5.

Fig. 16 is a flow chart for explaining processing carried out by a mobile terminal which transmits an uplink scheduling request signal, and processing carried out by a base station which receives the uplink scheduling request signal.

The mobile terminal, in ST1601, judges whether or not the mobile terminal is transmitting uplink data. When the mobile terminal is transmitting uplink data, the mobile terminal advances to ST1602. The mobile terminal which is transmitting uplink data, i.e., which is scheduled to have an uplink resource from the base station does not have to transmit an uplink scheduling request signal SR, and therefore, when the mobile terminal is, in ST1601, transmitting uplink data, the mobile terminal can carry out a process of advancing to ST1602 without going via judgment of ST1604. In other words, it can be considered that in one mobile terminal, uplink data and an uplink scheduling request signal SR do not coexist in a UL-SCH, and the relation of SC-FDMA is not satisfied and hence no increase is produced in the PAPR in the mobile terminal.

[0135]

The mobile terminal, in ST1602, multiplies the UL-SCH by a code (a code c) indicating that a symbol mapped to the UL-SCH is uplink data. This multiplication by code is carried out by the modulating unit 10 or the encoder unit 9. After performing the multiplication by the code c, the mobile terminal advances

to ST1603.

The mobile terminal, in ST1603, maps the uplink data to a resource included in the UL-SCH on which scheduling has been performed by the base station, and advances to ST1607. In contrast, when, in ST1601, the mobile terminal is not transmitting any uplink data, the mobile terminal advances to ST1604.

The mobile terminal, in ST1604, judges whether a request for transmission of uplink data has occurred. When no request for transmission of uplink data has occurred, the mobile terminal returns to ST1601. In contrast, when a request for transmission of uplink data has occurred, the mobile terminal advances to ST1605.

[0136]

The mobile terminal, in ST1605, multiplies the UL-SCH by a code (a code d) indicating that the symbol mapped to the UL-SCH is an uplink scheduling request signal SR. This multiplication by code is carried out by the modulating unit 10 or the encoder unit 9. After performing the multiplication by the code d, the mobile terminal advances to ST1613. The mobile terminal, in ST1613, multiplies the UL-SCH by a code (a code A) for identifying the mobile terminal. This multiplication by code is carried out by the modulating unit 10. After performing the multiplication by the code, the mobile terminal carries out ST1606. The mobile terminal, in ST1606, maps an uplink scheduling request signal SR (a resource request, a preamble, a message, and so on) to a resource included in the UL-SCH, and advances to ST1607. The order in which the processes of ST1613 and ST1606 are carried out can be reverse. As the codes c and d, codes which are perpendicular to each other can be used in

order to reduce occurrence of errors in the judgment by the base station.

[0137]

The mobile terminal, in ST1607, transmits the UL-SCH to the base station. The base station, in ST1608, receives the UL-SCH transmitted thereto from the mobile terminal. The base station, in ST1609, performs a correlation operation by using the code c in order to judge whether or not uplink data are mapped to the UL-SCH.

When the result of the correlation operation is equal to or larger than a predetermined threshold, the base station judges that uplink data are mapped to the UL-SCH, and then advances to ST1610. The correlation operation using the code c is implemented by the demodulating unit or the decoder unit. The base station, in ST1610, carries out the processing by judging that uplink data are mapped to the UL-SCH.

[0138]

Because the mobile terminal transmits the uplink data by using a predetermined radio resource for the UL-SCH which the base station has allocated and notified, the base station can distinguish the reception of the UL-SCH channel from the mobile terminal from those from other mobile terminals. In contrast, when, in ST1609, the result of the correlation operation which the base station has carried out by using the code c is smaller than the predetermined threshold, the base station advances to ST1614.

The base station, in ST1614, performs a correlation operation by using the code (the code A) which is used for multiplexing of signals from mobile terminals into the UL-SCH. When the result of the correlation operation is equal to or

larger than a predetermined threshold (if Yes in ST1614), the base station judges that the base station has received the UL-SCH from the mobile terminal, and then carries out a process of ST1611. In contrast, when the result of the correlation operation which the base station, in ST1614, carried out is smaller than the predetermined threshold (if No in ST1614), the base station judges that the base station has not received the UL-SCH from the mobile terminal, and ends the processing. The correlation operation using the code A is carried out by the demodulating unit 24.

[0139]

The base station, in ST1611, performs a correlation operation by using the code d in order to judge whether or not an uplink scheduling request signal SR is mapped to the UL-SCH. When the result of the correlation operation is equal to or larger than a predetermined threshold, the base station judges that an uplink scheduling request signal SR is mapped to the UL-SCH, and then advances to ST1612. The correlation operation using the code d is implemented by the demodulating unit 24 or the decoder unit 25. The base station, in ST1612, carries out the processing by judging that an uplink scheduling request signal SR is mapped to the UL-SCH.

[0140]

As previously explained, because the base station can judge whether or not uplink data are mapped to the UL-SCH and whether or not an uplink scheduling request signal SR is mapped to the UL-SCH by using the codes c and d, there is provided an advantage of eliminating the necessity to reserve radio resources for the RACH (Non-S-RACH and S-RACH) transmission (Fig. 17). Therefore, there is provided an advantage of being

able to use the uplink radio resources efficiently. Furthermore, when a request for transmission of an uplink scheduling request signal SR occurs in a mobile terminal, the use of a conventional method does not make it possible for the mobile terminal to transmit the SR to the base station until an uplink resource timing reserved for the RACH (Non-S-RACH and S-RACH). In contrast, according to the present invention, the mobile terminal can transmit an uplink scheduling request signal SR to the base station at all times.

Therefore, there is provided an advantage of being able to reduce the control delay in the mobile communication system. Furthermore, because in a case in which a mobile terminal maps an uplink scheduling request signal to a UL-SCH, multiplexing is carried out by using a code (a code A) for identification of the mobile terminal, also when scheduling request signals SRs are simultaneously transmitted to the base station from a plurality of mobile terminals, the base station can receive the scheduling request signals from those terminals while discriminating them from one another. Therefore, collision among the scheduling request signals from the plurality of mobile terminals which can happen in the case of using an S-RACH can be prevented.

[0141]

In addition, this Embodiment 5 can also be applied to a multiplexing method of multiplexing transmission, via an uplink, of an Ack/Nack and a CQI for downlink data and uplink data (a UL-SCH) in a case in which a mobile terminal is receiving downlink data without performing any transmission of uplink data. Because the operation of the mobile communication system is the same as the processing shown in the flow chart of Fig.

16, the explanation of the operation will be omitted.

Like in the case of Embodiment 5, it can be considered that in one mobile terminal, transmission of an Ack/Nack and transmission of a CQI do not coexist in a case in which no uplink data exist in the UL-SCH and the mobile terminal is not performing any transmission of uplink data via the UL-SCH, but is receiving downlink data, and the relation of SC-FDMA is not satisfied and hence no increase is produced in the PAPR in the mobile terminal.

Therefore there is provided an advantage of, in a case in which a mobile terminal is receiving downlink data without performing any transmission of uplink data, eliminating the necessity to dispose an Ack/Nack exclusive channel (Figs. 23 and 24) for transmission of an Ack/Nack for downlink data via an uplink. Furthermore, the radio resources which are allocated for the Ack/Nack exclusive channel can be released for the UL-SCH or the like. Therefore, there can be provided another advantage of being able to use the uplink radio resources efficiently.

[0142]

Embodiment 6.

In a case in which a mobile terminal is not transmitting any uplink data (Uplink data, UL data) such as user data, but is receiving downlink data (Downlink data, DL data) transmitted from a base station, the mobile terminal has to transmit an Ack/Nack, which is the result of the reception of the downlink data, and a CQI signal to the base station.

Furthermore, when a necessity for transmission of uplink data occurs in a mobile terminal, the mobile terminal has to transmit an uplink scheduling request signal SR to a base

station. Hereafter, a method of making a mobile terminal which has to transmit an Ack/Nack and an uplink scheduling request signal SR simultaneously perform these transmissions simultaneously without increasing the PAPR in the mobile terminal will be explained.

[0143]

The nonpatent reference 1 discloses that in a case in which a mobile terminal is receiving downlink data without performing transmission of uplink data, an Ack/Nack or/and a CQI are transmitted by suing an Ack/Nack exclusive channel having a broad band as shown in Fig. 23.

The nonpatent reference 4 discloses that in the case in which a mobile terminal is receiving downlink data without performing transmission of uplink data, an SR is transmitted by using an S-RACH.

However, the above-mentioned two nonpatent references 1 and 4 suggest nothing about the problems of the present invention. The problems of the present invention will be explained hereafter, though they are already mentioned.

[0144]

There may be a case in which a mobile terminal has to simultaneously carry out a process of transmitting an uplink Ack/Nack and a CQI by using an Ack/Nack exclusive channel and a process of transmitting an SR by using an S-RACH. In this case, because those signals have no correlation among them, when transmitted simultaneously, they are not transmitted with single carrier transmission, but are transmitted with multi carrier transmission. In the case in which such signals having no correlation among them are transmitted simultaneously, the PAPR becomes high because the time waveforms of the transmission

signals have a high peak. A problem is that as the PAPR becomes high, the power consumption of the mobile terminal increases and therefore the cell coverage becomes narrow. A further problem is that as the PAPR becomes high, those signals become an interference wave to other mobile terminals and the communication system.

[0145]

In a case in which a mobile terminal has to transmit an uplink Ack/Nack, a CQI, and an SR simultaneously, the mobile terminal should use single carrier transmission in order to reduce the increase in the PAPR in the mobile terminal.

There can be considered a case in which, when a mobile terminal uses an Ack/Nack or/and a CQI which are transmitted by using an Ack/Nack exclusive channel having a broad band, which is disclosed by the conventional technology, and an SR which is transmitted by using an S-RACH, just as they are, a necessity for the mobile terminal to transmit those pieces of information simultaneously occurs.

Therefore, this Embodiment 6 presents multiplexing of an Ack/Nack or/and a CQI, and an SR into either one of an Ack/Nack exclusive channel to which one certain time-frequency region is allocated monopolistically, and an S-RACH.

[0146]

The multiplexing method will be explained hereafter. A method of transmitting an uplink scheduling request signal SR, an Ack/Nack, and a CQI together by using either an Ack/Nack exclusive channel to which one certain time-frequency region as shown in Fig. 23 is allocated monopolistically, or an S-RACH as shown in Fig. 25 will be explained.

Because a region in units of a subframe with respect to

time and in units of one or more resource units with respect to frequency is allocated to each of the Ack/Nack exclusive channel and the S-RACH, the present invention can be applied to each of the channels.

[0147]

In this Embodiment 6, a case in which when a necessity to simultaneously transmit an Ack/Nack or/and a CQI, and an uplink scheduling request signal SR occurs in a mobile terminal, the mobile terminal transmits the Ack/Nack and/or the CQI, with the uplink scheduling request signal SR together by using an S-RACH will be shown. In other words, it means that even a mobile terminal which receives downlink data and therefore has to transmit an Ack/Nack or/and a CQI does not use an Ack/Nack exclusive channel during a time interval during which the mobile terminal is performing transmission of an uplink scheduling request signal SR. Furthermore, during the time interval during which the mobile terminal is transmitting an uplink scheduling request signal SR, the mobile terminal can perform transmission of a CQI or transmission of an Ack/Nack and a CQI by using an S-RACH, and is therefore allowed not to use an Ack/Nack exclusive channel at that time.

[0148]

Fig. 18 is a flow chart for explaining processing carried out by a mobile terminal, the processing including up to a process of transmitting an uplink scheduling request signal. Hereafter, the operation of the mobile terminal will be explained with reference to Fig. 18. In Fig. 18, because each of the same steps as those shown in Fig. 6 denote the same step or a like step, the explanation of the steps will be omitted hereafter.

Steps ST601 to ST603 are the same as those shown in Fig. 6. When, in ST602, is receiving downlink data, the mobile terminal carries out ST1801. In ST1801, the mobile terminal, maps an Ack/Nack, and/or a CQI with an uplink scheduling request signal SR onto an S-RACH, and transmits them to the base station. Because the processing of the mobile communication system is the same as that shown in Fig. 52, the explanation of the processing will be omitted hereafter.

[0149]

Next, methods of mapping those pieces of information onto the S-RACH will be explained hereafter.

According to a first mapping method, a preamble and a message, an Ack/Nack, and a CQI are mapped onto the S-RACH. Fig. 19 is an explanatory drawing showing radio resources in which a preamble and a message, an Ack/Nack, and a CQI are mapped onto the S-RACH.

According to a second mapping method, a preamble, an Ack/Nack, and a CQI are mapped onto the S-RACH. Message information required for an uplink scheduling request signal SR is transmitted at the timing of the next S-RACH transmission or by using the uplink resources which are allocated to the mobile terminal by the base station.

[0150]

Fig. 20 is an explanatory drawing showing radio resources in which a preamble and a message, an Ack/Nack, and a CQI are mapped onto the S-RACH.

According to a third mapping method, a preamble and a message are mapped onto the S-RACH as usual. An Ack/Nack and a CQI are newly added into a message on the S-RACH which is transmitted in a state in which uplink time synchronization is

established. Fig. 21 is an explanatory drawing showing radio resources in which a preamble and a message, an Ack/Nack, and a CQI are mapped onto the S-RACH.

[0151]

As previously explained, by mapping both an uplink scheduling request signal SR and Ack/Nack information symbols (an Ack/Nack and/or a CQI) not to an Ack/Nack exclusive channel, but to an S-RACH with the uplink scheduling request signal SR and the Ack/Nack information symbols being separated with respect to time, they are not transmitted simultaneously because they are transmitted with them being separated with respect to time. As a result, even when a plurality of "data-non-associated L1/L2 control signals" which have to be transmitted occur simultaneously in one mobile terminal, while the communication quality of these important control signals is attained, increase in the radio resources load on the communication system can be prevented, and transmission with a single carrier method which guarantees a low PAPR and high communication quality can be implemented.

[0152]

Furthermore, compared with the case in which an Ack/Nack and a CQI are transmitted with a plurality of time-frequency regions having narrow bands which are separate from one another, in the case of using the method according to this embodiment of transmitting an Ack/Nack and a CQI by using either an Ack/Nack exclusive channel to which one certain time-frequency region as shown in Fig. 23 is allocated monopolistically, or an S-RACH as shown in Fig. 25, the bandwidth becomes large. Therefore, the amount of information which can be transmitted with the radio resources allocated monopolistically increases.

As a result, there can be provided an advantage of being able to change the repetition pattern of an Ack/Nack and a CQI (e.g., the number of repetitions) according to the environment of the communication path. By changing the repetition pattern under an instruction from the base station according to the environment of the communication path, the quality of reception of an Ack/Nack and a CQI can be maintained constant regardless of the environment of the communication path.

[0153]

Embodiment 7.

In a case in which a mobile terminal is synchronized with a base station, and is carrying out neither transmission of uplink data (Uplink data, UL data) nor reception of downlink data (Downlink data, DL data), there exists no Ack/Nack exclusive channel because the mobile terminal does not have to transmit an Ack/Nack to downlink data via an uplink. A method of, when an uplink transmission request occurs in such a case, transmitting an uplink scheduling request signal SR by using a signal for uplink communication quality measurement, which is called "sounding reference signal" (sounding reference signal, Sounding Reference Signal (RS)) without using radio resources for an S-RACH will be disclosed.

The use of this method makes it possible to not only release the radio resources reserved for an S-RACH, but also make effective use of the resources because a radio resource region which is shared with other mobile terminals is used for transmission of a Sounding RS. Furthermore, one sounding reference signal (Sounding RS) can be made to have the two following functions: measurement of the communication quality of a channel via which transmission is started; and the

functions of an uplink schedule request signal SR.

[0154]

A Sounding RS is transmitted from a mobile terminal UE to a base station eNB in order to enable the base station to measure the communication quality of the uplink. In the 3GPP, the specifications of two types of reference signals: a reference signal for demodulation (a Demoduration RS); and a reference signal for uplink channel quality measurement (a Sounding RS) are currently under debate as uplink reference signals (Reference signals).

A plurality of suggestions are currently written together in the nonpatent reference 3, and the specifications have not been determined yet.

In this Embodiment 7, a case in which a sounding reference signal (a Sounding RS) is transmitted only during transmission of uplink data will be considered.

[0155]

A part of allocation of radio resources for a Sounding RS during transmission of uplink data in this Embodiment 7 is shown in Figs. 35(a) and 35(b).

First, Fig. 35(a) shows an example in which a sounding RS is allocated to two short blocks (SB) within 2 TTIs with the total bandwidth of one time-frequency region. A radio resource allocation method in a case in which two mobile terminals (UE1 and UE2) use a part of one time-frequency region is shown in Fig. 35(a).

In the figure, reference numeral 501 denotes a data symbol of the mobile terminal UE1, reference numeral 502 denotes a Sounding RS which the mobile terminals UE1 and UE2, and which all mobile terminals using this time-frequency region use in

common, reference numeral 503 denotes a reference signal for demodulation (Demoduration) of the mobile terminal UE1, reference numeral 504 denotes a data symbol of the mobile terminal UE2, and reference numeral 505 denotes a reference signal for demodulation (Demoduration) of the mobile terminal UE2. Among these, two SBs with the total bandwidth of one time-frequency region is allocated within two 2 TTIs as the region of the Sounding RS 502.

[0156]

Similarly, an example in which a Sounding RS is allocated to two long blocks (LB) within 2 TTIs with the total bandwidth of one time-frequency region is shown in Fig. 35(b). A radio resource allocation method in a case in which three mobile terminals (UE1, UE2, and UE3) use a part of one time-frequency region is shown in Fig. 35(b). In the figure, reference numeral 506 denotes a data symbol of the mobile terminal UE1, reference numeral 507 denotes a reference signal for demodulation of the mobile terminal UE1, reference numeral 508 denotes a data symbol of the UE2, reference numeral 509 denotes a reference signal for demodulation of the mobile terminal UE2, reference numeral 511 denotes a data symbol of the mobile terminal UE3, reference numeral 512 denotes a reference signal for demodulation of the mobile terminal UE3, and reference numeral 510 denotes a Sounding RS which the mobile terminals UE1, UE2, and UE3, and all other mobile terminals using this time-frequency region use in common.

As mentioned above, two LBs with the total bandwidth of one time-frequency region is made available for the radio resources for a Sounding RS.

[0157]

In either of the cases of Fig. 35(a) and 35(b), a Sounding RS is code-multiplexed for each UE. Because radio resources having a wide band can be shared and used for a Sounding RS by a plurality of terminals, the base station can measure the status of the frequency selective fading and can therefore carry out appropriate uplink scheduling. Furthermore, because a signal of each of the plurality of mobile terminals is code-multiplexed, the base station can carry out high-accuracy quality measurement for each of the plurality of mobile terminals.

[0158]

As a case in which a mobile station is synchronized with a base station and a transmission request occurs in a state in which no transmission of uplink data is carried out, there can be considered a case in which the mobile terminal receives downlink data, and, in order for the mobile terminal to transmit an Ack/Nack and a CQI to the downlink received data via the uplink, an ACK/Nack exclusive channel is allocated to the mobile terminal, and a case in which the mobile terminal receives downlink data, but no ACK/Nack exclusive channel is allocated to the mobile terminal, as described in Embodiment 3. In a flow chart of Fig. 37, a method of transmitting an uplink scheduling request signal SR in each of the cases is shown.

[0159]

First, when recognizing occurrence of an uplink data transmission request (ST5201), the mobile terminal checks to see whether or not an Ack/Nack exclusive channel via which the mobile terminal transmits an Ack/Nack to downlink received data is allocated in the uplink (ST5202). When an Ack/Nack exclusive channel is allocated in the uplink, the mobile terminal

transmits an uplink scheduling request signal SR, as well as an Ack/Nack and a CQI, by using the Ack/Nack exclusive channel (ST5204). Processing in this case is the same as that explained in Embodiment 3. In contrast, when, in ST5202, no Ack/Nack exclusive channel is allocated in the uplink, the mobile terminal transmits a Sounding RS for uplink quality measurement (a Sounding Reference signal) which serves as an uplink scheduling request signal SR to the base station (ST5203).

[0160]

There can be considered a case in which in the mobile communication system, even when a mobile terminal is not receiving any downlink data, an Ack/Nack exclusive channel is allocated to the mobile terminal. More specifically, there can be considered a case in which, in order to prepare for future downlink scheduling even when there exist no downlink data, or maintain synchronization between a base station and a mobile terminal, the mobile terminal notifies the result (CQI) of measurement of the quality of the downlink communication path. In such a case, it can be considered that the judgment of ST5202 is suitable as mentioned above.

In contrast, there can be considered a case in which in the mobile communication system, only when there exist downlink data destined for a mobile terminal, an Ack/Nack exclusive channel is allocated to the mobile terminal. In such a case, in the judgment of ST5202, the mobile terminal can judge whether or not the mobile terminal is receiving downlink data.

[0161]

A concrete example of a sequence when an uplink transmission request occurs under a condition resulting in a "No" in a branch of ST5202 of Fig. 37, i.e., in a state in which

there is no allocation of an ACK/Nack exclusive channel will be explained in Fig. 36.

This embodiment is based on that synchronization is established between a mobile terminal and a base station. Therefore, synchronization has to be established between the mobile terminal and the base station by using a certain method before this embodiment is applied. As an example of the method, Fig. 36 shows a case in which a non-synchronous random access signal (Non-Synchronous Rrandom Access) is transmitted from the mobile terminal to the base station.

[0162]

The base station eNodeB, in ST5101, receives a synchronous request from the mobile terminal UE, specifies the mobile terminal which has made the request, and also establishes synchronization with this mobile terminal and then recognizes that the mobile terminal has changed to an Active state. Furthermore, the base station, in next ST5102, notifies the mobile terminal that synchronization with this mobile terminal is established, and also notifies the mobile station of L1/L2 control information which is required for settings of uplink and downlink communication paths and whose setting value is nearly fixed (semi-static) for the reason of being set to other UEs in common with the mobile terminal.

When transmitting an uplink scheduling request signal SR by using a sounding RS for measurement of the communication quality of the uplink, the base station notifies Sounding-RS-related control information as well as the notification of the synchronization establishment because the base station has to transmit a "Sounding RS which serves as an uplink scheduling request" if there is no transmission of uplink

data. Because the Sounding RS for measurement of the communication quality of the uplink also uses the radio resources which the mobile terminal shares with the other UEs, the base station eNodeB, in ST5102, notifies the mobile terminal UE of mobile terminal identifying information (a sequence number or a UE-ID) which is allocated to this mobile terminal and is used for the code division multiplexing, the mobile terminal identifying information being included in the L1/L2 control information for controlling the Sounding RS, the frequency bandwidth (BW) of a radio resource which is scheduled to be allocated to the transmission of the Sounding RS, and so on, thereby enabling the transmission of the Sounding RS also when any uplink data are not transmitted.

In a case in which the Sounding RS is not used for notification of an uplink scheduling request signal SR, but is transmitted only during transmission of uplink data, what is necessary is just not to carry out the transmission along with the notification of the synchronization establishment, but to notify the Sounding RS-related control information (the sequence number, the BW, etc.) at, for example, the time (ST5104) of resource allocation for uplink data, unlike in the above case. Furthermore, the above-mentioned transmission along with the notification of the synchronization establishment means that they do not have to be carried out at the same time.

[0163]

When an uplink transmission data request occurs in the mobile terminal, the mobile terminal UE transmits a Sounding RS according to the sequence number of the UE for the uplink Sounding RS, which the mobile terminal, in ST5102, received from

the base station, and/or the control information, such as the frequency band which is scheduled to be allocated to the Sounding RS transmission, so as to notify the base station that the specific mobile terminal UE has an uplink scheduling request (ST5103). Such a Sounding RS is called a "Sounding RS which serves as an uplink scheduling request."

A Sounding RS of each mobile terminal is multiplexed with a CAZAC sequence code which has occurred with the sequence number for the mobile terminal UE which the mobile terminal, in ST5102, received, and is transmitted with the frequency band and at the timing which are notified from the base station.

[0164]

By receiving the Sounding RS in the time-frequency region of the radio resources, which this mobile terminal uses, to correlate the reception, the base station can detect the reception of the Sounding RS of the mobile terminal. When detecting a Sounding RS from a mobile terminal which has not transmitted any uplink data through the reception detection, the base station can judge this Sounding RS to be an uplink scheduling request signal SR (ST5103). This is because this Embodiment 7 is based on that only during transmission of uplink data, a Sounding RS is transmitted.

In the above-mentioned example, the use of a CAZAC sequence code for the method of identifying a mobile terminal in a Sounding RS is shown. As an alternative, another method can be used.

[0165]

When judging that the sounding RS which the base station has received from the mobile terminal is a scheduling request signal SR, the base station notifies the control information,

such as radio resource allocation required for transmission of uplink data, by using an "Uplink Data Resource Allocation" message (ST5104). The mobile terminal then starts transmission of uplink data by using the radio resources received from the base station (ST5105).

A flow chart in the base station at the time when the base station eNodeB, in ST5102, notifies the BW is shown in Fig. 39.

First, a flow of instructions at the time when the base station eNodeB notifies the BW will be explained with reference to Fig. 39.

[0166]

The base station, in ST5401, checks whether or not synchronization is established with the mobile terminal UE, and, when synchronization is not established, waits until the base station receives a synchronous request via a Non-Sync RACH (ST5402). When receiving a synchronous request, the base station establishes synchronization with the mobile terminal, as shown in the explanation of ST5102 of Fig. 36 (ST5403), and then transmits L1/L2 control information for Sounding RS to the mobile terminal UE in semi-static mode (ST5404). The identification information (the sequence number or the UE-ID) of the UE for uplink Sounding RS, and the BW of uplink Sounding RS are included in this L1/L2 control information.

When judging that synchronization is established as a result of, in ST5401, checking synchronization with the UE, the base station, in ST5405, checks to see whether or not the mobile terminal is receiving downlink data. While receiving downlink data, the base station notifies L1/L2 control information for Sounding RS to the mobile terminal UE in dynamic mode, and changes the frequency bandwidth (BW) dynamically (ST5406).

[0167]

In the flow chart of Fig. 39, the base station notifies the BW of uplink Sounding RS by using both the L1/L2 control information in semi-static mode and the one in dynamic mode. In practice, the base station can notify the BW of uplink Sounding RS by using either one of the two types of L1/L2 control information: the semi-static L1/L2 control information and the dynamic L1/L2 control information.

[0168]

As a method of retransmitting an uplink Sounding RS which serves as an uplink scheduling request signal SR in a mobile terminal, in accordance with this Embodiment 7, there are provided the following two methods: a method of setting up a timer which times a predetermined time interval in the mobile terminal, and, when an "Uplink Data Resource Allocation" message cannot be received in ST5104 from the base station by the time the timer times out, retransmitting an uplink Sounding RS, and a method of continuing transmitting an uplink Sounding RS continuously until, in ST5104, receiving an "Uplink Data Resource Allocation" message. Because these methods are already explained in detail with reference to the explanatory figures 28 to 30 of Embodiment 3, and Figs. 31 to 33, the explanation of the methods will be omitted hereafter.

[0169]

When, in ST5103, transmitting a Sounding RS which serves as an uplink scheduling request signal SR, the mobile terminal naturally uses an SB or LB which the mobile terminal ought to use for Sounding RS for (usually) measurement of the communication quality of the uplink, and has to make the frequency band and bandwidth (BW: BandWidth) of the SB or LB

be equal to those of a general Sounding RS. This is because since for a Sounding RS, a plurality of mobile terminals to which an identical time-frequency region is allocated in such a way as to use the identical time-frequency region carries out code division multiplexing of the same SB (or LB) region to use this, if one mobile terminal changes the ends of the frequency band which the mobile terminal uses for Sounding RS in common with other mobile terminals or uses another block (LB or SB), data and reference signals of other mobile terminals are crushed. Therefore, in a case in which, for example, a Sounding RS for measurement (usually) of the communication quality of the uplink has a bandwidth equal to the entire bandwidth of the base station, a Sounding RS which serves as an uplink scheduling request SR also has the same bandwidth, and, when the base station sets up a plurality of BWs (frequency bands) for a Sounding RS for measurement (usually) of the communication quality of the uplink, the mobile terminal uses the same BW as that of another mobile terminal to which the same time-frequency region as that of the mobile terminal itself is allocated as a radio resource.

[0170]

There can be a case in which the base station eNodeB judges and selects the BW for a Sounding RS which serves as an uplink scheduling request SR, the BW being used for the mobile terminal, and a case in which the mobile terminal UE can judge and select the BW by itself.

A flow chart showing a judging method in the case in which the base station eNodeB selects the BW is shown in Fig. 40, and a flow of a judging method in the case in which the mobile terminal selects the BW is shown in Fig. 41.

[0171]

Next, a process flow in the case in which the base station eNodeB selects the BW of an uplink Sounding RS will be explained. This selection flow shows a method of determining the BW included in either the semi-static (semi-static) L1/L2 control information which is, in ST5404 of the flow chart shown in Fig. 39, notified to the UE, or the dynamic (dynamic) L1/L2 control information which is, in ST5406, notified to the UE.

Fig. 40 shows a process flow in the case in which the base station eNodeB selects the frequency bandwidth (Band Width: BW) of an uplink Sounding RS.

[0172]

First, the base station, in ST5501 of the figure, checks to see whether there exist two or more BWs with which an uplink Sounding RS is transmitted, and, if there exists only one BW, the base station sets the BW to be equal to the BWs of uplink Sounding RSs of all other mobile terminals UE (ST5502). In contrast, when there exist two or more BWs with which an uplink Sounding RS is transmitted, the base station checks whether or not the number of UEs each of which transmits a Sounding RS which serves as an uplink scheduling request signal SR with the same BW is appropriate (ST5504), checks whether or not one of the two or more BWs includes frequencies which can be allocated to the UE at the cell edge (ST5505), checks whether one of the two or more BWs shows a good result of reporting the downlink CQI (the channel quality or the downlink communication path quality) (ST5506), and then searches through the two or more BWs for one BW which satisfies these conditions (ST5507). The base station then determines one BW which satisfies the conditions of ST5504 to ST5506 as the BW for uplink Sounding

RS (ST5508).

[0173]

A process flow in the case in which the UE carries out the above-mentioned selection of one BW is shown in Fig. 41. The result of the selection of one BW for uplink Sounding RS which is carried out by the UE is reflected, referring to the flow chart of Fig. 39, in the BW notified by using the dynamic L1/L2 down control information when the mobile terminal is, in ST5405, receiving downlink data. First, the mobile terminal receives the number of BWs for uplink Sounding RS from the base station via a channel such as a BCH (ST5601). The mobile terminal checks to see whether there exist two or more BWs for uplink Sounding RS (ST5602), and, when there exist only one BW, selects the same BW as the BWs for uplink Sounding RSs of all other UEs (ST5603). In contrast, when there exist two or more BWs, the mobile terminal selects one BW from among them in order, and searches for one BW which satisfies the conditions "the quality of the downlink CQI is good" of ST5605 to determine one BW (ST5607). The mobile terminal then notifies the result of the determination to the base station.

[0174]

By using one of methods, such as the above-mentioned, the number of UEs which transmit with the same BW can be controlled, and the increase in the total receive power of the base station can be prevented. Furthermore, a frequency which a UE at the cell edge can allocate as an uplink frequency can be set up beforehand, and the uplink communication path quality at a frequency band to actually know can be acquired. Furthermore, by expecting and selecting a good BW of the uplink from the downlink CQI, the uplink communication path quality can be

acquired with radio resources which are most stabilized for the mobile terminal UE.

The above-mentioned determining method of determining one BW for a Sounding RS which serves as an uplink scheduling request SR which the mobile terminal uses (the method of determining one BW for Sounding RS in the case of notifying an uplink scheduling request SR by using a Sounding RS) can also be applied to Embodiment 8, Embodiment 9, and Embodiment 10.

[0175]

A concrete method of allocating radio resources for use in a base station and a mobile terminal, in ST5103 of the sequence of Fig. 36, will be explained.

Fig. 38 is a figure showing a method of allocating radio resources in a case in which the base station sets up a plurality of BWs for a Sounding RS for measurement (usually) of the communication quality of the uplink, and the circumstances of allocation of radio resources to the mobile terminal UE1 after a transmission request occurs. In Fig. 38, the radio resources which the base station manages are divided into three time-frequency regions whose bandwidths are expressed as BW#1, BW#2, and BW#3, respectively. A UE group A including a mobile terminal UE1 is allocated to the time-frequency region of BW#1, a UE group B is similarly allocated to the time-frequency region of BW#2, and a UE group C is similarly allocated to the time-frequency region of BW#3. In the figure, reference numeral 531 denotes a data region of the UE group A, reference numeral 532 denotes a sounding (Sounding RS) region of the UE group A, reference numeral 533 denotes an RS region for demodulation (Demoduration) of the UE group A, reference numeral 534 denotes a data region of the UE group B, reference

numeral 535 denotes a sounding (Sounding) RS region of the UE group B, and reference numeral 536 denotes an RS region for demodulation (Demoduration) of the UE group B. In this figure, the Sounding RS region is placed in two SBs within 2 TTIs, like in the example of Fig. 35(a), and its bandwidth is the same as the bandwidths (BW#1, BW#2, and BW#3) of the plurality of time-frequency regions respectively set for the plurality of UE groups. Each of the data region and the RS region for Demoduration in each UE group region is divided into a plurality of parts for the respective UEs in each UE group.

[0176]

A case in which, for example, the UE 1 included in the UE group A desires to transmit an uplink scheduling request signal SR in a subframe (1) of TTI #1 under the radio resources allocation conditions of Fig. 38 is shown in Fig. 38(b). Reference numeral 537 denotes a sounding (Sounding) RS region which serves as a scheduling request signal SR of the UE1, reference numeral 538 denotes a transmission data region after the UE1 starts data transmission, reference numeral 539 denotes an RS region for demodulation (Demoduration) of the UE1, and reference numeral 540 denotes a sounding (Sounding) RS region for measurement (usually) of the uplink communication quality of the UE1. The UE1 transmits a Sounding RS which serves as a scheduling request SR with an SB1 (537) which is allocated as a Sounding RS of the UE group A. The BW of the SB 537 which is used for a Sounding RS which serves as a scheduling request signal SR of the UE1 is the same as the BW#1 of Sounding RS of the UE group A. Because the UE1 is not performing any transmission of uplink data in the subframe (1), the region which the UE1 uses at that time is only the SB1. That is, there

is no transmission from the UE1 with LBs (LB1, LB2, LB3, LB4, and LB5) and SBs (SB2) other than the SB1 of the subframe (1). After that, the base station carries out an uplink scheduling process.

[0177]

In this case, while 3 TTIs elapse, allocation of radio resources for transmission of uplink data is notified from the base station to the UE1, and the UE1 starts transmission of uplink data from the subframe (7). After that, the data 538 for the UE1 are allocated to the LBs 1 to 6, the uplink Sounding RS 540 for measurement (usually) of the uplink communication quality of the UE1 is allocated to the SB1 in TTI#4 and the SB2 in TTI#5, and the RS for demodulation is allocated to the remaining SBs. As shown in the figure, the BW of the region of the uplink Sounding RS which serves as a scheduling request SR of the UE1, and the BW of the region of the uplink Sounding RS for measurement (usually) of the communication quality of the uplink are the same as the bandwidth BW#1 of the UE group A, and all mobile terminals UE of the UE group A in a data transmission state allocate the same region having the completely same timing as this region for transmission of an uplink Sounding RS. In contrast, the bandwidth of the data region of the UE1 and that of the region allocated to a Demoduration RS are smaller than BW#1, and, as these regions, regions distinguished from those of other UEs are used.

[0178]

Thus, the timing of transmission of an uplink Sounding RS which serves as an uplink scheduling request signal SR has to be synchronized with that of transmission of an uplink Sounding RS of another UE (there can be two or more other UEs)

under transmission to which the same BW is allocated.

[0179]

Fig. 42 shows in greater detail how each of a plurality of UEs is using radio resources allocated thereto at the same timing in the time-frequency region allocated to the UE group A. Unlike in the case of Fig. 38, in the case of Fig. 42, the region for uplink Sounding RS is placed in two LBs (LB1 in a first subframe, and LB6 in a second subframe) within 2 TTIs, like in the case of Fig. 35(b). In the figure, reference numeral 571 denotes a Sounding RS region of the UE group A, reference numeral 572 denotes an RS region for Demoduration of the UE group A, reference numeral 573 denotes a data region of the UE group A, reference numeral 574 denotes a Sounding RS region of the UE group B, reference numeral 575 denotes an RS region for Demoduration of the UE group B, reference numeral 576 denotes a data region of the UE group B, reference numeral 577 denotes a region of a Sounding RS which serves as an scheduling request signal SR of the UE1 for a start of transmission of uplink data, and a region of a Sounding RS of the UE2 under transmission, reference numeral 578 denotes a Demoduration RS region of the UE2, reference numeral 579 denotes a data region of the UE2, reference numeral 580 denotes a general Sounding RS region of the UE1 and the UE2, reference numeral 581 denotes an RS region for Demoduration of the UE1, and reference numeral 582 denotes a data region of the UE1 under transmission.

[0180]

Hereafter, it is assumed that in the two mobile terminals UE1 and UE2 in the same UE group A, at a time, the UE1 tries to start uplink transmission and the UE2 has been transmitting uplink data. The LB1 577 which is allocated to the uplink

Sounding RS region which all the mobile terminals of the UE group A use at the time of uplink transmission is used, in the UE1, for transmission of an uplink Sounding RS which serves as an uplink scheduling request signal SR notified from the mobile terminal to a base station for a start of uplink transmission, and is, in the UE2, used for transmission of an uplink Sounding RS used for usual measurement of the quality in a base station. As shown in the figure, these two UEs transmit uplink Sounding RSs having different meanings with the same block (LB) of the completely same bandwidth (=BW#1) at the completely same timing.

[0181]

When receiving this LB1, the base station demodulates the block with codes which are respectively generated from the sequence numbers of the UEs to receive the uplink Sounding RSs from the UE1 and the UE2. The base station then uses the Sounding RS signal from the UE1 from which the base station has not received any uplink data signal until now for measurement of the uplink quality of the UE1, and judges that this Sounding RS signal is a notification (an uplink scheduling request signal SR) of a start of transmission by the UE1. In contrast, the base station uses the Sounding RS signal from the UE2 from which the base station has so far received an uplink data signal at regular intervals for measurement of the uplink quality of the UE2.

[0182]

The region for data and the region for a Demoduration RS which are allocated while each of the UE1 and the UE2 carries out transmission are allocated to regions which are separated from each other, respectively, as shown in Fig. 42, unlike that

for an uplink Sounding RS.

[0183]

Furthermore, a time-frequency region via which an uplink Sounding RS can be transmitted is not configured similarly for any UE group, as explained with reference to Figs. 38 and 42, and therefore there is also provided a method of configuring a different time-frequency region for each UE group. Figs. 43(a) and 43(b) show examples in each of which the region to which an uplink Sounding RS is allocated is configured for each UE group in such a way that the time and frequency of the region are shifted in units of a resource unit (RU). Fig. 43(a) shows the example in which, in a case in which the BW of a Sounding RS is equal to the entire bandwidth of the base station, the region with which an uplink Sounding RS can be transmitted is allocated in the time-frequency region in such a way that the region differs for each UE group. The figure shows an example in which time sections during each of which a Sounding RS can be transmitted are allocated to the four UE groups in such a way that each of the time sections has a length of 2 TTIs and the time sections are shifted from one another by 1 TTI. More concretely, among the four UE groups, a UE in the team 1 transmits an uplink Sounding RS during a time section A of TTIs (1) and (2), a UE in the team 2 transmits an uplink Sounding RS during a time section B of TTIs (2) and (3), a UE in the team 3 transmits an uplink Sounding RS during a time section C of TTIs (3) and (4), and a UE in the team 4 transmits an uplink Sounding RS during a time section D of TTIs (4) and (5). The allocation is not limited to this example.

[0184]

Furthermore, as explained in this Embodiment 7, the

allocation of an uplink Sounding RS to a region is not limited to allocation to two blocks within 2 TTIs. As an alternative, the allocation can be carried out for each TTI, or the allocation can be carried out in such a way that an uplink Sounding RS is allocated to a predetermined fixed number of blocks over three or more subframes. Furthermore, there is no necessity to configure the time sections during each of which a Sounding RS can be transmitted in such a way that they are shifted from one another by 1 TTI, and what is necessary is just to configure the time sections according to a period which is enough to reduce the network load and to maintain the accuracy of the measurement of the uplink quality. Because using this method, the time sections during which the plurality of UE teams can transmit uplink sounding RSs respectively differ from one another, the number of UEs which the base station receive simultaneously can be reduced.

Furthermore, the distribution of the total transmit power of the base station can be optimized.

[0185]

Fig. 43(b) shows the example in which, in a case in which a plurality of BWs are configured an uplink Sounding RS, the time section during which an uplink Sounding RS can be transmitted is allocated in each of the time-frequency regions of the BWs in such a way that the time section differs for each UE group. Because using this method, the frequency bands with which the plurality of UE teams perform uplink transmissions respectively and the time sections during which the plurality of UE teams can transmit uplink sounding RSs respectively differ from one another, compared with Fig. 43(a), the number of UEs which the base station receive simultaneously with the same band

at the time of reception can be reduced and the receiving load of the wireless communication unit of the base station can be reduced. Furthermore, the distribution of the total transmit power of the base station can be optimized.

[0186]

The method of setting up the BW of an uplink Sounding RS, and allocating radio resources, which is explained in this Embodiment 7, can also be applied to a case in which when there exist no transmission of uplink data and a Sounding RS is transmitted for the purpose of transmitting a signal other than an uplink scheduling request signal SR. Furthermore, the method of configuring the BW of an uplink Sounding RS, and allocating radio resources, which is explained in this Embodiment 7, can also be applied to Embodiment 8, Embodiment 9, and Embodiment 10.

[0187]

The transmit power when transmitting a Sounding RS which serves as an uplink scheduling request signal SR has to be set to be equal to or higher than that at the time of transmitting a general uplink Sounding RS in view of the importance of the signal. For example, there is also provided a method of acquiring the transmit power of a Sounding RS which serves as an uplink scheduling request signal SR by using a predetermined equation as follows:

[Equation 1]

$$P_{SR} = P_{Sounding} + \frac{E/N_{SR}}{E/N_{sounding}} \times k$$

k : Constant

P_{SR} : Transmit Power of Sounding RS Serving as Scheduling Request

$P_{Sounding}$: Transmit Power of Uplink Sounding RS

E/N_{SR} : E_b/No of Uplink Sounding RS Serving as Scheduling Request

$E/N_{Sounding}$: E_b/No of Uplink Sounding RS

As mentioned above, by, for example, setting up the transmit powers of mobile terminals according to their respective desired power-to-noise ratios so as to make the transmit power of each mobile terminal at the time of transmitting a Sounding RS which serves as an uplink scheduling request signal SR be equal to or larger than that at the time of transmitting a general uplink Sounding RS, erroneous reception of uplink scheduling request signals by the base station can be reduced. As mentioned above, the method of setting up the transmit power of a Sounding RS which serves as an uplink scheduling request signal SR can also be applied to Embodiment 8, Embodiment 9, and Embodiment 10.

[0188]

As mentioned above, when a transmission request occurs in a case in which a mobile station is synchronized with a base station, and no transmission of uplink data is being carried out and no allocation of an Ack/Nack exclusive channel is made, a frequency band wider than that at the time of using an S-RACH can be used by transmitting an uplink scheduling request signal

SR by using a Sounding RS for measurement of the quality of the uplink. Therefore, transmission further resistant to the frequency selective fading can be implemented. Because by using a "sounding RS which serves as an uplink scheduling request signal SR", an uplink communication path quality measurement in the base station can be carried out while serving as transmission of an uplink scheduling request signal SR. Therefore, the necessity to transmit a sounding RS for measurement of the uplink quality independently from a scheduling request signal SR can be eliminated. Furthermore, because a wide frequency band is used, it is easy to incorporate the communication quality of the uplink into subsequent uplink scheduling. In addition, the radio resources of the S-RACH can be released, and the complexity in the uplink scheduling sequence between the mobile terminal and the base station can be reduced.

[0189]

Embodiment 8.

Even in a case in which a mobile terminal is synchronized with a base station, and is not receiving downlink data (Downlink data, DL data) transmitted from a base station, or allocation of an Ack/Nack exclusive channel for transmitting an Ack/Nack signal or a CQI signal which is the result of reception of downlink data to the base station is not made and the mobile terminal is not carrying out any transmission of uplink data (Uplink data, UL data) such as user data, the mobile terminal may transmit a reference signal for sounding (a reference signal for measurement of the quality of an uplink communication path) to the base station at certain periodicity in order to maintain uplink synchronization with the base

station. A case in which a mobile terminal transmits a reference signal 7901 for sounding at certain periodicity(n×TTI) is shown in Fig. 53. On the other hand, when a necessity to transmit uplink data occurs in the mobile terminal, the mobile terminal has to transmit an uplink scheduling request signal SR to the base station separately.

[0190]

Therefore, there may be a case in which an uplink scheduling request signal SR and a reference signal for sounding are transmitted simultaneously. When transmitted simultaneously, they are not transmitted with single carrier transmission, but are transmitted with multi carrier transmission. In the case in which such signals having no correlation among them are transmitted simultaneously, the PAPR becomes high because the time waveforms of the transmission signals have a high peak. A problem is that as the PAPR becomes high, the power consumption of the mobile terminal increases and therefore the cell coverage becomes narrow. A further problem is that as the PAPR becomes high, those signals become an interference wave to other mobile terminals and the communication system. In order to avoid these problems, there can be considered a measure of shifting the transmission timing of a reference signal for sounding from that of an uplink scheduling request signal SR, or the like, though the scheduling control in the base station and/or the mobile terminal becomes complicated.

In this Embodiment 8, a method of making a reference signal for sounding serve as an uplink scheduling request signal SR in order to solve the above-mentioned problems will be explained.

[0191]

In above-mentioned Embodiment 7, the transmission method of transmitting a scheduling request in a state in which a mobile terminal does not transmit a reference signal for sounding in a case in which the mobile terminal is not transmitting uplink data is disclosed. In that case, the base station judges that there is a scheduling request when receiving a reference signal for sounding. Therefore, the base station does not have to have a function of judging whether a reference signal for sounding serves as an uplink scheduling request, and/or a function of judging whether or not there occurs scheduling.

However, there arises a new problem that in a case in which a mobile terminal transmits a reference signal for sounding at certain periodicity, in order to make the reference signal for sounding serve as an uplink scheduling request signal SR, the base station has to judge whether the received signal is the one sounding or the one for uplink scheduling, and/or has to judge whether or not there occurs scheduling. In order to solve this problem, in this Embodiment 8, a method of providing two types of pilot patterns for sounding, defining correspondences between these two types of pilot patterns and the presence and absence of an uplink scheduling request, and transmitting one of the two types of pilot patterns according to the presence or absence of an uplink scheduling request is disclosed (refer to Fig. 80).

[0192]

A method of, in a case in which a mobile terminal transmits a reference signal for sounding, allocating a pilot for sounding, and allocating a code specific to each mobile terminal is shown in Fig. 46. Reference numeral 7201 denotes the pilot for

sounding, and reference numeral 7202 denotes the code specific to each mobile terminal. When the mobile terminal transmits the reference signal for sounding, the encoder unit or the modulating unit of the mobile terminal multiplies the pilot for sounding by the code specific to each mobile terminal to generate the reference signal for sounding.

After the reference signal for sounding is subjected to a modulation process and is converted into a baseband signal, the reference signal for sounding is converted into a signal having a radio frequency. After that, the reference signal for sounding is transmitted to the base station by way of an antenna. The code specific to each mobile terminal is used by the base station in order for the base station to, when receiving reference signals for sounding from a plurality of mobile terminals, identify which one of the reference signals for sounding is the one from the above-mentioned mobile terminal. It is preferable that the above-mentioned code is the one having orthogonality, or this code yields multiplication of a pilot pattern thereby having orthogonality.

[0193]

As an alternative, the above-mentioned code can be a spread code or a scramble code. A time-frequency region to which the reference signal for sounding is allocated is predetermined or is notified from the base station. A frequency region can have one of various bands. A time region can be provided once during each TTI or during several TTIs. A correlation operation is performed on the reference signal for sounding which the base station has received by using a code specific to each mobile terminal, and, by using a code which yields a correlation operation result which is equal to or

larger than a threshold, the base station can identify the mobile terminal. The base station restarts the synchronization of an uplink channel with the mobile terminal which the base station has identified by using the reference signal for sounding. The base station can also measure the uplink communication path quality by using the above-mentioned signal.

[0194]

One embodiment of making a reference signal for sounding have the functions of an uplink scheduling request signal SR will be disclosed hereafter. A method of generating a reference signal for sounding having the functions of an uplink scheduling request signal SR is shown in Fig. 44. Reference numeral 7001 denotes a pilot pattern 1 for sounding, reference numeral 7002 denotes a pilot pattern 2 for sounding, reference numeral 7003 denotes a switch for switching between the two types of patterns, reference numeral 7004 denotes a control unit for controlling the switch, and reference numeral 7005 denotes a code specific to each mobile terminal. Each of the above-mentioned pilots 1 and 2 for sounding can be a single symbol or can be a plurality of symbols. It is preferable that the above-mentioned code is the one having orthogonality, or this code yields multiplication of a pilot pattern thereby having orthogonality. As an alternative, the above-mentioned code can be a spread code or a scramble code. However, in a case in which the code is a scramble code, it is preferable that each of the above-mentioned pilots 1 and 2 for sounding is a plurality of symbols.

As the pilot patterns for sounding, there are provided two types of patterns according to the presence and absence of

an uplink scheduling request. As shown in a table of the figure, in a case in which there is no uplink scheduling request, the pattern 1 is allocated in advance, whereas in a case in which there is an uplink scheduling request, the pattern 2 is allocated in advance.

[0195]

Fig. 45 shows a diagram of sequences between the mobile terminal and the base station. The mobile terminal transmits a reference signal for sounding at certain periodicity. A time-frequency region to which the reference signal for sounding is allocated is predetermined or is notified from the base station. The mobile terminal, in ST7101, judges whether an uplink data transmission request has occurred. When no uplink data transmission request has occurred, the mobile terminal carries out ST7102 because the mobile terminal does not transmit any scheduling request. The control unit 7004, in ST7102, changes the state of the switch 7003 in such a way as to select the pilot pattern 1 for sounding.

[0196]

In contrast, when an uplink data transmission request has occurred, the mobile terminal carries out ST7103 because the mobile terminal transmits an uplink scheduling request. The control unit 7004, in ST7103, changes the state of the switch 7003 in such a way as to select the pilot pattern 2 for sounding. The mobile terminal, in ST7104, multiplies the pilot pattern for sounding selected in either of the cases by the code 7005 specific to each mobile terminal to generate a reference signal for sounding. The mobile terminal, in ST7105, performs a modulation process, baseband signal conversion, and radio frequency conversion on the reference signal for sounding, and

transmits the reference signal for sounding to the base station with the time-frequency region allocated to the reference signal for sounding by way of the antenna. The base station, in ST7106, receives the reference signal for sounding. The base station, in ST7107, performs a correlation operation on this reference signal for sounding with the code specific to each mobile terminal, and identifies the mobile terminal when the result of the operation is equal to or larger than a threshold.

[0197]

Next, the base station, in ST7108, judges whether the pilot for sounding has the pattern 1 or the pattern 2. When judging that the pilot for sounding has the pattern 1, the base station, in ST7109, carries out the processing by judging that there does not occur uplink scheduling. In contrast, when judging that the pilot for sounding has the pattern 2, the base station, in ST7110, carries out a process in the case in which there occurs uplink scheduling.

When, in ST7107, the result of the correlation operation is smaller than the threshold, the base station ends the processing by judging that the reference signal for sounding has been transmitted thereto from another mobile terminal other than the above-mentioned mobile terminal.

In one example of the two types of pilot patterns for sounding which enable the base station to judge whether the pilot for sounding has the pattern 1 or the pattern 2, a code and a reverse code are allocated to the pilot pattern 1 and the pilot pattern 2, respectively (when a certain symbol allocated to one of them is "1", "0" is allocated to the other one). By carrying out the allocation of codes to the two types of pilot patterns in this way, the base station, in ST7108, can judge

whether the pilot for sounding is the pilot 1 or the pilot 2 by judging whether the result of the correlation operation is positive or negative.

The base station can also restart the synchronization of the uplink channel with this identified mobile terminal by using the pilot pattern 1 or 2 for sounding.

[0198]

With the above-mentioned structure, the mobile terminal can suppress the increase in the PAPR which appears when transmitting an uplink scheduling request signal SR and a reference signal for sounding simultaneously.

Furthermore, because it becomes unnecessary to ensure the region of an S-RACH for a scheduling request, the waste of the time-frequency resource can be eliminated.

In addition, because the mobile terminal does not have to carry out a process of shifting the transmission timing of a reference signal for sounding and that of an uplink scheduling request signal SR from each other, and so on, the scheduling control in the base station and/or the mobile terminal can be prevented from becoming complicated.

Furthermore, by forming a reference signal for uplink sounding in such a way that the reference signal for uplink sounding serves as an uplink scheduling request signal SR, as mentioned above, the base station is enabled to, when receiving this signal, judge whether this signal has an uplink scheduling request.

In addition, because only one type of specific code has only to be allocated to each mobile terminal, many code resources can be ensured and the number of mobile terminals from which the base station can receive signals simultaneously can

be increased.

Furthermore, because a frequency band wider than that at the time of using an S-RACH or an Ack/Nack exclusive channel can be used, transmission further resistant to the frequency selective fading can be implemented.

[0199]

Hereafter, variants will be explained.

In a first variant, a symbol of the pilot for sounding is a symbol for scheduling request. A pilot pattern in which a part of the pilot for sounding is a symbol for scheduling request is shown in Fig. 47.

When there is no scheduling request, 1 is allocated to the symbol for scheduling request, whereas when there is a scheduling request, 0 is allocated to the symbol for scheduling request.

[0200]

This variant will be explained with reference to a sequence diagram of Fig. 48. The mobile terminal, in ST7401, judges whether an uplink data transmission request has occurred. When no uplink data transmission request has occurred, the mobile terminal carries out ST7402 because the mobile terminal does not transmit any scheduling request. The mobile terminal, in ST7402, sets 1 to the symbol for scheduling request. In contrast, when an uplink data transmission request has occurred, the mobile terminal carries out ST7403 because the mobile terminal transmits a scheduling request. The mobile terminal, in ST7403, sets 0 to the symbol for scheduling request. The mobile terminal, in ST7404, multiplies the pilot pattern for sounding selected in either of the cases by a code A specific to each mobile terminal to generate a reference signal for

sounding.

[0201]

The mobile terminal, in ST7405, performs a modulation process, baseband signal conversion, and radio frequency conversion on the reference signal for sounding, and transmits the reference signal for sounding to the base station with the time-frequency region allocated to the reference signal for sounding by way of the antenna. The base station, in ST7406, receives the reference signal for sounding. The base station, in ST7407, performs a correlation operation on this reference signal for sounding with the code A specific to each mobile terminal, and identifies the mobile terminal when the result of the operation is equal to or larger than a threshold. Next, the base station, in ST7408, judges whether the symbol for scheduling request is 1 or 0. When judging that the symbol for scheduling request is 1, the base station, in ST7409, carries out the processing by judging that there does not occur uplink scheduling. In contrast, when judging that the symbol for scheduling request is 0, the base station, in ST7410, carries out a process in the case in which there occurs uplink scheduling.

[0202]

The number of symbols which are used for a scheduling request can be one or can be two or more. By using two or more symbols for a scheduling request, there can be provided an advantage of increasing the composite electric power in the base station and therefore reducing the error rate.

[0203]

Furthermore, the symbols for sounding can be multiplied by a code specific to each mobile terminal according to the

number of the symbols for sounding and the one or more symbols for scheduling request can be multiplied by another code specific to the mobile terminal according to the number of the symbols for scheduling request, and the reference signal for sounding and scheduling request can be multiplexed with respect to time. Thereby, a scrambling code can be used as the code specific to each mobile terminal. Furthermore, because the base station can perform the correlation operation by using only the reference signal for sounding, there is provided an advantage of improving the synchronization accuracy and the accuracy of evaluation of channel conditions (the quality of the uplink communication path). In addition, in a case in which the number of the symbols for sounding is the same as the number of the one or more symbols for scheduling request, both of them can be multiplied by an identical code specific to each mobile terminal. Thereby, there is provided an advantage of making effective use of the code resources.

[0204]

In a second variant, two codes specific to each mobile terminal are prepared, and the pilot for sounding is multiplied by one of the two codes specific to each mobile terminal which is according to the presence or absence of an uplink scheduling request.

An example of generation of a reference signal for sounding is shown in Fig. 49. Reference numeral 7501 denotes a pilot for sounding, reference numeral 7503 denotes a code A specific to each mobile terminal, reference numeral 7504 denotes another code B specific to each mobile terminal, reference numeral 7502 denotes a switch for selecting a code by which the pilot for sounding is multiplied, and reference

numeral 7505 denotes a control unit for transmitting a signal for selecting a code (7503 or 7504) according to the presence or absence of a scheduling request by using the switch 7502. As shown in a table of the figure, as the code specific to each mobile terminal, when there is no uplink scheduling request, the code A is allocated, whereas when there is an uplink scheduling request, the code B is allocated.

[0205]

The operation of the variant will be explained with reference to a sequence diagram of Fig. 50. The mobile terminal, in ST7601, judges whether an uplink data transmission request has occurred. When no uplink data transmission request has occurred, the mobile terminal carries out ST7602 because the mobile terminal does not transmit any scheduling request. The mobile terminal, in ST7602, selects the code A by using the switch 7502 according to a control signal from the control unit 7505 in such a way as to carry out multiplication with the code A. As a result, the pilot for sounding is multiplied by the code A 7503. In contrast, when an uplink data transmission request has occurred, the mobile terminal carries out ST7603 because the mobile terminal transmits a scheduling request. The mobile terminal, in ST7603, selects the code B 7504 by using the switch 7502 according to the control signal from the control unit 7505 in such a way as to carry out multiplication with the code B. As a result, the pilot for sounding is multiplied by the code B.

[0206]

The mobile terminal, in ST7604, performs a modulation process, baseband signal conversion, and radio frequency conversion on the reference signal for sounding, and transmits

the reference signal for sounding to the base station with the time-frequency region allocated to the reference signal for sounding by way of the antenna. The base station, in ST7605, receives the reference signal for sounding. The base station, in ST7606, performs a correlation operation on this reference signal for sounding with the code A first, and identifies the mobile terminal when the result of the operation is equal to or larger than a certain threshold, though the base station handles the reference signal for sounding by judging that the reference signal does not include a scheduling request. In contrast, when the result of the operation is smaller than the certain threshold, the base station, in ST7608, performs a correlation operation on the above-mentioned reference signal for sounding with the code B. When the result of the operation is equal to or larger than a certain threshold, the base station identifies the mobile terminal and then handles the reference signal for sounding by judging that the reference signal includes a scheduling request.

When, in ST7606, the result of the correlation operation with the code A is less than the certain threshold, and when, in ST7608, the result of the correlation operation with the code B is less than the certain threshold, the base station judges that the reference signal for sounding is the one from another mobile terminal other than the mobile terminal, and ends the processing.

[0207]

Because this variant is constructed as mentioned above, there is provided an advantage of eliminating the necessity to provide two types of pilot patterns for sounding, and a further advantage of eliminating the necessity to judge whether the

result of each correlation operation is positive or negative because an orthogonal code is also used for judgment of the presence or absence of a scheduling request. Furthermore, because an orthogonal code is also used for judgment of the presence or absence of a scheduling request, there is provided another advantage of improving the judgment precision, the synchronization accuracy, and the accuracy of evaluation of channel conditions.

[0208]

In a third variant, one type of code for judgment of the presence or absence of a scheduling request is prepared, and there is provided a method of controlling whether to carry out multiplication with this code according to the presence or absence of an uplink scheduling request.

An example of generation of a reference signal for sounding is shown in Fig. 51. Reference numeral 7701 denotes a pilot for sounding, reference numeral 7703 denotes a code a for judgment of the presence or absence of a scheduling request, reference numeral 7702 denotes a switch for selecting whether to multiply the sounding pilot by the code a, reference numeral 7705 denotes a control unit for transmitting a signal indicating whether to multiply the sounding pilot by the code a with the switch 7702, and reference numeral 7704 denotes a code specific to each mobile terminal. As shown in a table of the figure, when there is no uplink scheduling request, the code for judgment of the presence or absence of a scheduling request is not allocated, whereas when there is an uplink scheduling request, the code a is allocated.

[0209]

The operation of this variant will be explained with

reference to a sequence diagram of Fig. 52. The mobile terminal, in ST7801, judges whether an uplink data transmission request has occurred. When no uplink data transmission request has occurred, the mobile terminal performs a selection so as not to carry out multiplication by the code a by using the switch 7702 according to the control signal from the control unit 7705 because the mobile terminal does not transmit any scheduling request, and then carries out ST7803. In contrast, when an uplink data transmission request has occurred, the mobile terminal carries out ST7802 because the mobile terminal transmits a scheduling request. The mobile terminal, in ST7802, selects the code a 7703 by using the switch 7702 according to the control signal from the control unit 7705 in such a way as to carry out multiplication with the code a. As a result, the pilot for sounding is multiplied by the code a for judgment of the presence or absence of a scheduling request. In ST7803, the pilot for sounding is multiplied by the code A specific to each mobile terminal.

[0210]

The mobile terminal, in ST7804, performs a modulation process, baseband signal conversion, and radio frequency conversion on the reference signal for sounding, and transmits the reference signal for sounding to the base station with the time-frequency region allocated to the reference signal for sounding by way of the antenna. The base station, in ST7805, receives the reference signal for sounding. The base station, in ST7806, performs a correlation operation on this reference signal for sounding with the code A specific to each mobile terminal, and identifies the mobile terminal when the result of the operation is equal to or larger than a threshold.

The base station then, in ST7807, performs a correlation operation on the above-mentioned reference signal for sounding with the code a, and, when the result of the operation is equal to or larger than a threshold, handles the reference signal for sounding by judging that the reference signal has a scheduling request. In contrast, when the result of the operation is smaller than the threshold, the base station handles the reference signal for sounding by judging that the reference signal does not include a scheduling request.

The scheduling request presence or absence identification code a and the code A specific to each mobile terminal can be scramble codes or spread codes.

[0211]

Because this variant is constructed as mentioned above, there is provided an advantage of eliminating the necessity to judge whether the result of each correlation operation is positive or negative because an orthogonal code can also be used for judgment of the presence or absence of a scheduling request. Furthermore, because an orthogonal code is also used for judgment of the presence or absence of a scheduling request, there is provided another advantage of improving the judgment precision. In addition, there is provided a further advantage of eliminating the necessity to double the amount of codes specific to each mobile terminal, unlike the second variant.

[0212]

As mentioned above, with the structure as mentioned in this Embodiment 8, the mobile terminal can suppress the increase in the PAPR which appears when transmitting an uplink scheduling request signal SR and a reference signal for sounding simultaneously.

Furthermore, because it becomes unnecessary to ensure the region of an S-RACH for a scheduling request, the waste of the time-frequency resource can be eliminated.

In addition, because the mobile terminal does not have to carry out a process of shifting the transmission timing of a reference signal for sounding and that of an uplink scheduling request signal SR from each other, and so on, the scheduling control in the base station and/or the mobile terminal can be prevented from becoming complicated.

Furthermore, by forming a reference signal for uplink sounding in such a way that the reference signal for uplink sounding serves as an uplink scheduling request signal SR, as mentioned above, the base station is enabled to, when receiving this signal, judge whether this signal has an uplink scheduling request.

In addition, because a frequency band wider than that at the time of using an S-RACH or an Ack/Nack exclusive channel can be used, transmission further resistant to the frequency selective fading can be implemented.

[0213]

Embodiment 9.

When a necessity for transmission of uplink data occurs in a mobile terminal in a state in which the mobile terminal is receiving downlink data (Downlink data, DL data) transmitted from a base station or in a state in which allocation of an Ack/Nack exclusive channel for transmitting an Ack/Nack signal, which is the result of reception of downlink data, and/or a CQI signal to the base station is made, the mobile terminal has to transmit an uplink scheduling request signal SR to the base station. In this case, the mobile terminal may transmit the

Ack/Nack signal and/or the CQI signal, and the uplink scheduling request signal SR simultaneously. When transmitted simultaneously, they are not transmitted with single carrier transmission, but are transmitted with multi carrier transmission. In the case in which such signals having no correlation among them are transmitted simultaneously, the PAPR becomes high because the time waveforms of the transmission signals have a high peak. A problem is that as the PAPR becomes high, the power consumption of the mobile terminal increases and therefore the cell coverage becomes narrow.

A further problem is that as the PAPR becomes high, those signals become an interference wave to other mobile terminals and the communication system.

[0214]

In order to avoid these problems, in Embodiments 1 and 2, the method of transmitting an uplink scheduling request signal by using an S-RACH, and DTXing an Ack/Nack and/or a CQI signal at the same timing is disclosed. In Embodiments 3 and 4, the method of incorporating an uplink scheduling request signal into an Ack/Nack exclusive channel to transmit the uplink scheduling request signal is disclosed.

In this Embodiment 9, a method of transmitting an uplink scheduling request signal by using a region for sounding RS will be disclosed. In this Embodiment 9, a case in which there is no sounding RS which is transmitted for uplink timing synchronization at certain periodicity will be disclosed.

[0215]

The region for sounding RS is already explained in Embodiment 7. In Embodiment 7, the case in which no allocation of an Ack/Nack exclusive channel is made is disclosed. In

contrast, in this embodiment, a case in which allocation of an Ack/Nack exclusive channel is made will be disclosed.

Fig. 55 shows a figure of a time-frequency resource in a case in which there are regions for an Ack/Nack exclusive channel. Regions A and B are regions for an Ack/Nack exclusive channel. The region for sounding RS is allocated to a region other than channel for Ack/Nack, in this example, the allocation to the first LB is carried out once within 2 TTIs.

Each of a plurality of mobile terminals under the control of the base station transmits a reference signal for sounding using this region for sounding RS. The plurality of mobile terminals can be divided into one or more groups. Furthermore, the region for sounding reference symbols can also be divided into one or more regions. Transmission of an RS for sounding by a mobile terminal included in a certain mobile terminal group can be carried out by using a certain divided region.

[0216]

A transmission signal of a mobile terminal in a case in which a scheduling request occurs is shown in Fig. 60. When a necessity for transmission of uplink data occurs in a mobile terminal in a state in which the mobile terminal is receiving downlink data (Downlink data, DL data) transmitted from a base station, or in a state in which allocation of an Ack/Nack exclusive channel for transmitting an Ack/Nack signal, which is the result of reception of downlink data, and/or a CQI signal to the base station is made, and the mobile terminal then transmits an uplink scheduling request signal SR to the base station, the mobile terminal transmits the uplink scheduling request signal by using a region for sounding RS allocated to this mobile terminal, and transmits an Ack/Nack signal, a CQI

signal, or a reference signal for demodulation with other LBs or SBs by using the Ack/Nack exclusive channel. In contrast, when there is no uplink scheduling request, the mobile terminal does not transmit an uplink scheduling request signal, but transmits an Ack/Nack signal and/or a CQI signal by using the Ack/Nack exclusive channel.

[0217]

Fig. 59 shows mapping of transmission symbols in a mobile terminal in the case in which the mobile terminal transmits an uplink scheduling request signal with the region for sounding RS. A pilot symbol for sounding is inserted into a leading LB within 2 TTIs. An Ack/Nack or a CQI symbol is inserted into other LBs. The pilot for sounding is multiplied by a code a specific to each mobile terminal which is used in the region for sounding. This code a is used in order for the base station to identify from which mobile terminal the base station has received the transmission because the region for sounding is shared by a plurality of mobile terminals. The symbol for sounding which is multiplied by the code a specific to each mobile terminal, which is used in the region for sounding, is mapped to the region for sounding RS.

[0218]

An Ack/Nack or a CQI symbol is multiplied by a code A specific to each mobile terminal, and is mapped to the Ack/Nack exclusive channel. This code A is used to identify the mobile terminal in the Ack/Nack exclusive channel, as mentioned in Embodiment 3. These two types of codes specific to each mobile terminal are predetermined, or are notified from the base station.

Fig. 62 is a sequence diagram. The mobile terminal, in

ST8901, judges whether an uplink data transmission request has occurred. When no uplink data transmission request has occurred, the mobile terminal carries out ST8904 because the mobile terminal does not transmit any scheduling request. The mobile terminal, in ST8904, inserts an Ack/Nack or a CQI symbol into each of all LBs within 2 TTIs, and multiplies each of them by the code A. In contrast, when an uplink data transmission request has occurred, the mobile terminal carries out ST8902 and ST8903 because the mobile terminal transmits a scheduling request.

[0219]

The mobile terminal, in ST8902, inserts the pilot for sounding into the first LB within 2 TTIs, and multiplies this LB by the code a. The mobile terminal, in ST8903, inserts an Ack/Nack and/or a CQI into a second or subsequent LBs, and multiplies these LBs by the code A. The mobile terminal, in ST8905, carries out allocation of the pilot for sounding which is multiplied by the code a to the region for sounding RS, and carries out allocation of the Ack/Nack or the CQI which is multiplied by the code A to the Ack/Nack exclusive channel, and then transmits them to the base station. The base station which, in ST8906, received the signals, in ST8907, performs a correlation operation on the signal in the region for sounding by using the code a, and, when the result of the correlation operation is equal to or larger than a certain threshold, can identify the mobile terminal and judge that the base station has received an uplink scheduling request from this identified mobile terminal.

[0220]

The base station which has judged that the base station

has received an uplink scheduling request, in ST8910, handles the uplink scheduling request. The base station then, in ST8911, performs a correlation operation on the signal in the second or subsequent LBs or SBs, which is transmitted via the Ack/Nack exclusive channel, by using the code A, and, in ST8912, performs judgment of the Ack/Nack or the CQI. When, in ST8907, the result of the correlation operation with the code a is smaller than the certain threshold, the base station still cannot identify the mobile terminal and handles the signal by judging that the signal does not have an uplink scheduling request. In that case, the base station, in ST8909, performs a correlation operation on signals in all the LBs and SBs, which are transmitted via the Ack/Nack exclusive channel, by using the code A, and, when the result of the correlation operation is equal to or larger than a certain threshold, identifies the mobile terminal. After identifying the mobile terminal, the base station, in ST8912, performs judgment of the Ack/Nack or the CQI.

[0221]

With the structure as mentioned above, the mobile terminal can suppress the increase in the PAPR which appears when transmitting both an Ack/Nack signal or a CQI signal, and an uplink scheduling request signal SR simultaneously.

Furthermore, because it becomes unnecessary to ensure the region of an S-RACH for a scheduling request in advance, the waste of the time-frequency resource can be eliminated.

In addition, by transmitting an uplink scheduling request signal SR by using a reference signal for sounding, the base station is enabled to, when receiving this signal, judge whether this signal has an uplink scheduling request.

Furthermore, because the mobile terminal transmits an

uplink scheduling request signal SR by using a reference signal for sounding, the base station can evaluate the status of the uplink channel used for carrying out uplink scheduling.

[0222]

In addition, because a frequency band wider than that at the time of using an S-RACH or an Ack/Nack exclusive channel can be used, transmission further resistant to the frequency selective fading can be implemented.

Furthermore, the base station can measure the status of the frequency selective fading, and can carry out appropriate uplink scheduling.

In the above-mentioned embodiments, when a mobile terminal does not have an uplink scheduling request, the mobile terminal inserts an Ack/Nack or a CQI symbol into the first LB. As the mapping method, the method disclosed in Embodiment 2 can be applied. By doing in this way, there is provided an advantage of improving the quality of reception of an Ack/Nack or a CQI.

As shown in above-mentioned Embodiment 1, also in the case in which a mobile terminal has an uplink scheduling request, the mobile terminal can insert an Ack/Nack or a CQI symbol into each of all the LBs and SBs, like in the case in which there is no uplink scheduling request, and, only when the mobile terminal has an uplink scheduling request, can DTX only the first LB and transmit a sounding pilot in this LB by using the RS region for sounding. As a result, the complexity of the process of multiplexing symbols can be reduced.

[0223]

In the above-mentioned embodiments, the case in which an Ack/Nack and/or a CQI signal is transmitted by using an Ack/Nack exclusive channel is disclosed. In contrast, the method of this

embodiment can also be applied to a case in which an Ack/Nack or a CQI signal is not transmitted by using an Ack/Nack exclusive channel. For example, when a scheduling request occurs in a mobile terminal, the mobile terminal has only to transmit an RS for sounding by using the first LB in a region for sounding and not to transmit any other signals.

In the above-mentioned embodiments, when a scheduling request occurs in a mobile terminal, the mobile terminal inserts a pilot symbol for sounding into the first LB. The same advantage is acquired even if the mobile terminal changes an LB or SB into which the mobile terminal inserts the pilot symbol according to the region allocated to an RS for sounding.

[0224]

Hereafter, variants will be explained. In a first variant, the region for sounding RS is allocated to all the bands. Fig. 56 is a figure showing a time-frequency resource at the time of allocating the region for sounding RS to all the bands of the system. Regions A and B are regions for an Ack/Nack exclusive channel. In this example, the first LB is allocated, as the region for sounding RS, once within 2 TTIs. Each of a plurality of mobile terminals under the control of the base station transmits a reference signal for sounding by using this region for sounding RS. The plurality of mobile terminals can be divided into one or more groups. Furthermore, the region for a sounding reference signal can also be divided into one or more regions. Transmission of an RS for sounding by a mobile terminal included in a certain mobile terminal group can be carried out by using a certain divided region.

[0225]

A transmission signal of a mobile terminal in a case in

which a scheduling request occurs is shown in Fig. 61. When a necessity for transmission of uplink data occurs in a mobile terminal in a state in which the mobile terminal is receiving downlink data (Downlink data, DL data) transmitted from a base station, or in a state in which allocation of an Ack/Nack exclusive channel for transmitting an Ack/Nack signal, which is the result of reception of downlink data, and/or a CQI signal to the base station is made, and the mobile terminal then transmits an uplink scheduling request signal SR to the base station, the mobile terminal transmits the uplink scheduling request signal by using a region for sounding RS allocated to this mobile terminal, and transmits an Ack/Nack signal, a CQI signal, or a reference signal for demodulation in other LBs or SBs by using the Ack/Nack exclusive channel. In contrast, when there is no uplink scheduling request, the mobile terminal does not transmit any uplink scheduling request signal, and, furthermore, does not transmit any Ack/Nack signal or any CQI signal once with the first LB by using the Ack/Nack exclusive channel within 2 TTIs. This is because since all the bands of the system are allocated to the region for sounding RS and some other mobile terminals under the control of the base station transmit sounding RSs with this LB of the Ack/Nack exclusive channel, if the mobile transmits an Ack/Nack signal or a CQI signal with this LB, the base station cannot discriminate this Ack/Nack or CQI signal from any other signals.

In the mapping of transmission symbols in the mobile terminal, a pilot for sounding is inserted when there is an uplink scheduling request, like in the mapping shown in Fig. 59, whereas when there is no uplink scheduling request, it is preferable to insert either nothing or dummy data into the

first LB and not to carry out any transmission with this LB.

[0226]

With the above-mentioned structure, this embodiment offers the same advantages as those provided by Embodiment 9. Furthermore, the base station can make an evaluation of uplink channel conditions with a wider band.

In addition, because the base station can make an evaluation of the channel conditions of an Ack/Nack exclusive channel, there is provided an advantage of performing scheduling of an Ack/Nack signal or a CQI signal of a mobile terminal to an Ack/Nack exclusive channel with a high degree of precision.

Furthermore, by dividing the plurality of mobile terminals into one or more groups, and/or by dividing the region for sounding reference signals into one or more regions, there is provided an advantage of bringing greater efficiency to the use of the code resources allocated to each mobile terminal.

[0227]

In a second variant, the region for sounding RS is divided into parts having the same frequency bandwidth as the Ack/Nack exclusive channel, and a divided part is allocated to a certain mobile terminal group.

Fig. 57 shows a figure of a time-frequency resource. Regions A and B are regions for an Ack/Nack exclusive channel. In this example, the first LB is allocated, as the region for sounding RS, once within 2 TTIs. The region for sounding RS is divided into parts having the same frequency bandwidth as the Ack/Nack exclusive channel, and a divided part is allocated to a certain mobile terminal group. Each of a plurality of mobile terminals in the certain mobile terminal group transmits

a reference signal for sounding by using this divided part of the region for sounding RS.

[0228]

Because the region with which a certain mobile terminal transmits a sounding RS has the same frequency bandwidth as the Ack/Nack exclusive channel, the length of a code for sounding pilot symbols can be made to be equal to that of a code for an Ack/Nack and/or CQI symbols. Therefore, the necessity to separately provide two codes specific to each mobile terminal for sounding pilot symbols and for an Ack/Nack or CQI symbols can be eliminated. In other words, the required number of types of spread codes can be reduced to one.

Therefore, with this structure, there is provided an advantage of being able to reduce the amount of codes specific to each mobile terminal, and hence to increase the number of mobile terminals allocated from the base station.

[0229]

In a third variant, a region for sounding RS is disposed also in an Ack/Nack exclusive channel.

Fig. 58 shows a figure of a time-frequency resource. Regions A and B are regions for the Ack/Nack exclusive channel. In this example, also in the Ack/Nack exclusive channel region, the first LB is allocated, as the region for sounding RS, once within 2 TTIs.

Because the region for sounding RS is disposed in the Ack/Nack exclusive channel, the necessity to separately provide two codes specific to each mobile terminal for sounding pilot symbols and for an Ack/Nack or CQI symbols can be eliminated. That is, the frequency band which is multiplied by the spread code becomes equal. Therefore, with this structure, there is

provided an advantage of being able to reduce the amount of codes specific to each mobile terminal, and hence to increase the number of mobile terminals allocated from the base station.

Furthermore, there is provided an advantage of eliminating the necessity to separately carry out allocation to the time-frequency resources for sounding pilot symbols and for an Ack/Nack and/or CQI symbols at the time of transmission of a signal, thereby being able to simplify the control of each mobile terminal.

[0230]

Since Embodiment 9 uses a sounding reference signal for transmitting a scheduling request signal, when combined with above-mentioned Embodiment 7, Embodiment 9 can be applied to a mobile terminal regardless of whether or not an Ack/Nack exclusive channel is allocated to the mobile terminal. More specifically, what is necessary is just to apply Embodiment 7 in a case in which any Ack/Nack exclusive channel is not allocated to the mobile terminal, and to apply Embodiment 9 in a case in which an Ack/Nack exclusive channel is allocated to the mobile terminal.

[0231]

This Embodiment 9 discloses the case in which a mobile terminal does not transmit any sounding RS for uplink timing synchronization at certain periodicity. Furthermore, when combined with Embodiment 8, Embodiment 9 can also be applied to a case in which a mobile terminal transmits a sounding RS for uplink timing synchronization at certain periodicity. That is, in Embodiment 9, when receiving transmission of a sounding RS from a mobile terminal, the base station can recognize that the mobile terminal has made a scheduling request,

though when the mobile terminal has originally transmitted a sounding RS for uplink timing synchronization, the base station cannot discriminate the sounding RS for uplink timing synchronization which the mobile terminal has originally transmitted from any scheduling request. In order to solve this problem, what is necessary is just to use the method disclosed in Embodiment 8.

Furthermore, also in the case in which a mobile terminal transmits a sounding RS for uplink timing synchronization at certain periodicity, Embodiment 9 can be applied to the mobile terminal regardless of whether or not an Ack/Nack exclusive channel is allocated to the mobile terminal, when combined with the method disclosed in Embodiment 7.

[0232]

Embodiment 10.

A method of enabling a mobile terminal to transmit an uplink scheduling request by using a sounding RS regardless of whether the mobile terminal transmits a sounding RS for uplink timing synchronization at certain periodicity will be disclosed.

A time-frequency region for sounding RS is allocated as shown in Fig. 42 or 55. Fig. 42 shows a case in which no allocation of resources of an Ack/Nack exclusive channel is made, and Fig. 55 shows a case in which allocation of resources of an Ack/Nack exclusive channel is made. In either of the cases, a sounding RS from a mobile terminal is transmitted with an allocated region for sounding RS. It is assumed that the length of time intervals at which a sounding RS for uplink timing synchronization is transmitted is n×TTI (n>=2).

[0233]

Fig. 63 shows a transmission signal of a mobile terminal when an uplink scheduling request has occurred. Hereafter, it is assumed that the length of time intervals at which a sounding RS for uplink timing synchronization is transmitted is 10TTI. In a case in which a necessity for transmission of uplink data occurs in a mobile terminal, when the timing at which the mobile terminal transmits an uplink scheduling request is the same as that at which the mobile terminal transmits a sounding RS for uplink timing synchronization, the mobile terminal transmits this sounding RS for synchronization while forming the sounding RS in such a way that the sounding RS have the functions of the scheduling request.

As a method of forming a sounding RS for synchronization in such a way that the sounding RS have the functions of a scheduling request, the method disclosed in above-mentioned Embodiment 8 can be used. For example, a method of providing two types of sounding pilot patterns corresponding to the presence and absence of an uplink scheduling request can be used. In a case in which a necessity for transmission of uplink data occurs in a mobile terminal, when the timing at which the mobile terminal transmits an uplink scheduling request differs from that at which the mobile terminal transmits a sounding RS for uplink timing synchronization, the mobile terminal transmits the sounding RS as an uplink scheduling request.

[0234]

Fig. 64 shows a diagram of sequences between the mobile terminal and the base station. The mobile terminal, in ST9101, judges whether an uplink data transmission request has occurred. When no uplink data transmission request has occurred, the mobile terminal carries out ST9104. In contrast, when an uplink

data transmission request has occurred, the mobile terminal, in ST9102, judges whether the transmission timing of an uplink scheduling request is the same as that of a sounding RS for uplink timing synchronization. If those transmission timings are the same as each other, the mobile terminal carries out ST9103. The mobile terminal, in ST9103, selects a pattern 2 as a pilot for sounding. The mobile terminal then carries out ST9105. When, in ST9102, judging that the transmission timing of the uplink scheduling request differs from that of a sounding RS for uplink timing synchronization, the mobile terminal carries out ST9104. The mobile terminal, in ST9104, selects a pattern 1 as a pilot for sounding. The mobile terminal then carries out ST9105. The mobile terminal, in ST9105, multiplies the transmission signal by a code A specific to each mobile terminal. The mobile terminal, in ST9106, transmits the transmission signal to the base station with the region for sounding (RB). The base station which, in ST9107, has received the transmission signal with the region for sounding (RB), in ST9108, judges whether or not the received signal has the timing of a sounding RS for uplink timing synchronization.

[0235]

Because the base station carries out scheduling of the timing of a sounding RS for uplink timing synchronization and notifies the timing to the mobile terminal in advance, or the timing is predetermined, the base station can make the judgment. When, in ST9108, judging that the received signal has the same timing, the base station carries out ST9110. The base station, in ST9110, performs a correlation operation on the received signal by using the code A. When the result of the correlation operation is equal to or larger than a certain threshold, the

base station identifies the mobile terminal. The base station then carries out ST9111. The base station, in ST9111, judges whether the pilot for sounding is the pattern 1 or the pattern 2. As a method of judging whether the pilot for sounding is the pattern 1 or the pattern 2, a method disclosed in Embodiment 8 can be used. When judging that the pilot for sounding is the pattern 1, the base station handles the signal by judging that the signal does not include an uplink scheduling request. When, in ST9111, judging that the pilot for sounding is the pattern 2, the base station carries out ST9112. When, in ST9108, judging that the received signal has a timing different from that of a sounding RS for uplink timing synchronization, the base station carries out ST9109. The base station, in ST9109, performs a correlation operation on the received signal by using the code A, and, when the result of the correlation operation is equal to or larger than a certain threshold, the base station identifies the mobile terminal, and, in ST9112, handles the signal by judging that the signal includes an uplink scheduling request.

[0236]

With the above-mentioned structure, the same advantages as those provided by Embodiment 8 can be offered. Furthermore, there is provided an advantage of enabling a mobile terminal to transmit an uplink scheduling request regardless of whether the mobile terminal transmits a sounding RS for uplink timing synchronization at certain periodicity.

[0237]

Hereafter, variants will be explained.

In a first variant, when the transmission timing of an uplink scheduling request coincides with that of a sounding RS

for uplink timing synchronization, the timing at which an uplink scheduling request is transmitted is delayed by 2 TTIs.

Fig. 65 shows a transmission signal of a mobile terminal when an uplink scheduling request occurs in the mobile terminal. In this case, the transmission time during which a sounding RS for uplink timing synchronization is transmitted is 10TTI. In a case in which a request for transmission of uplink data occurs in a mobile terminal, when the timing at which the mobile terminal transmits an uplink scheduling request is the same as that at which the mobile terminal transmits a sounding RS for uplink timing synchronization, the mobile terminal transmits the scheduling request by delaying its transmission timing by 2TTI. In contrast, when the timing at which the mobile terminal transmits an uplink scheduling request differs from that at which the mobile terminal transmits a sounding RS for uplink timing synchronization, the mobile terminal transmits the scheduling request without delaying its transmission timing by 2TTI.

[0238]

Fig. 66 shows a diagram of sequences between the mobile terminal and the base station. The mobile terminal, in ST9301, judges whether an uplink data transmission request has occurred. When no uplink data transmission request has occurred, the mobile terminal carries out ST9304. In contrast, when an uplink data transmission request has occurred, the mobile terminal, in ST9302, judges whether the transmission timing of an uplink scheduling request is the same as that of a sounding RS for uplink timing synchronization. If those transmission timings are the same as each other, the mobile terminal carries out ST9303. The mobile terminal, in ST9303, carries out a process of delaying

the transmission timing of the scheduling request by 2TTI. In this case, about the sounding RS signal for uplink timing synchronization, the mobile terminal carries out a process of transmitting the sounding RS signal without delaying its transmission timing. The mobile terminal, in ST9304, multiplies the transmission signal by a code A specific to each mobile terminal. The mobile terminal, in ST9305, transmits the transmission signal to the base station with the region for sounding (RB). The base station which, in ST9306, has received the signal with the RB for sounding carries out ST9307.

[0239]

The base station, in ST9307, judges whether or not the received signal has the timing of a sounding RS for uplink timing synchronization. When judging that the received signal has the timing of a sounding RS for uplink timing synchronization, the base station, in ST9308, performs a correlation operation on the received signal by using the code A, and, when the result of the correlation operation is equal to or larger than a certain threshold, identifies the mobile terminal and then carries out ST9309. The base station, in ST9309, handles the signal by judging that the signal does not include an uplink scheduling request. More specifically, in this case, the base station handles the signal as a normal sounding RS for uplink timing synchronization. When, in ST9307, judging that the received signal has a timing different from that of a sounding RS for uplink timing synchronization, the base station, in ST9310, performs a correlation operation on the received signal by using the code A, and, when the result of the correlation operation is equal to or larger than a certain threshold, the base station identifies the mobile terminal and carries out ST9311. The base

station, in ST9311, handles the signal by judging that the signal includes an uplink scheduling request.

[0240]

With the above-mentioned structure, the same advantages as those provided by Embodiment 10 can be offered. Furthermore, there is provided an advantage of reducing the number of types of sounding pilot patterns to only one. Thereby, there is provided another advantage of reducing the processing carried out by the base station and the processing carried out by the mobile terminal. Compared with a case in which in, for example, Embodiment 10, the method of using the two types of codes (the codes A and B), as disclosed in Embodiment 8, is used in order to discriminate a sounding RS for uplink timing synchronization and an uplink scheduling request from each other, there is provided an advantage of reducing the number of codes to one-half that in the above-mentioned case, and increasing the number of mobile terminals to each of which a mobile-terminal-specific code can be allocated.

In the above-mentioned variant, an uplink scheduling request is transmitted with its transmission timing being delayed by 2TTI. As an alternative, an uplink scheduling request can be transmitted at any timing at which no sounding RS for uplink timing synchronization is transmitted. In this case, a mobile terminal is allowed to transmit a scheduling request with a time delay depending on its processing capability.

[0241]

A combination of Embodiment 10 or the first variant with Embodiment 9 can be applied regardless of whether or not resource allocation of an Ack/Nack exclusive channel is made.

Industrial Applicability

[0242]

As mentioned above, the present invention is suitable for a communication system which needs to prevent the increase in the radio resource load due to temporary increase in the physical channels.

Claims

[1] A data communication method which is implemented by a communication system provided with a base station which transmits data by using an OFDM (Orthogonal Frequency Division Multiplexing) method as a downlink access method, and a mobile terminal which transmits a control signal including a response signal corresponding to a result of reception of the data transmitted from said base station to said base station, and which transmits a scheduling request signal with which to make a request for allocation of radio resources to said base station before transmitting transmission data to said base station, characterized in that said mobile terminal carries out a response signal transmission process of transmitting said response signal to said base station by using an uplink control channel in an uplink direction from said mobile terminal to said base station, a scheduling request signal transmission process of transmitting said scheduling request signal to said base station by using a physical channel different from said uplink control channel when transmission data to be transmitted to said base station occur, and a control process of, when a processing timing of said response signal transmission process coincides with that of said scheduling request signal transmission process, stopping said response signal transmission process during a time interval during which said mobile terminal transmits said scheduling request signal.

Abstract

In a communications system which complies with LTE including a base station 2 which transmits data by using an OFDM (Orthogonal Frequency Division Multiplexing) method as a downlink access method, and a mobile terminal 3, in a case in which an uplink scheduling request signal SR is transmitted by using an S-RACH when an Ack/Nack signal is being transmitted by using an Ack/Nack exclusive channel, the transmission of the Ack/Nack signal is stopped while the uplink scheduling request signal SR is transmitted.

FIG.1

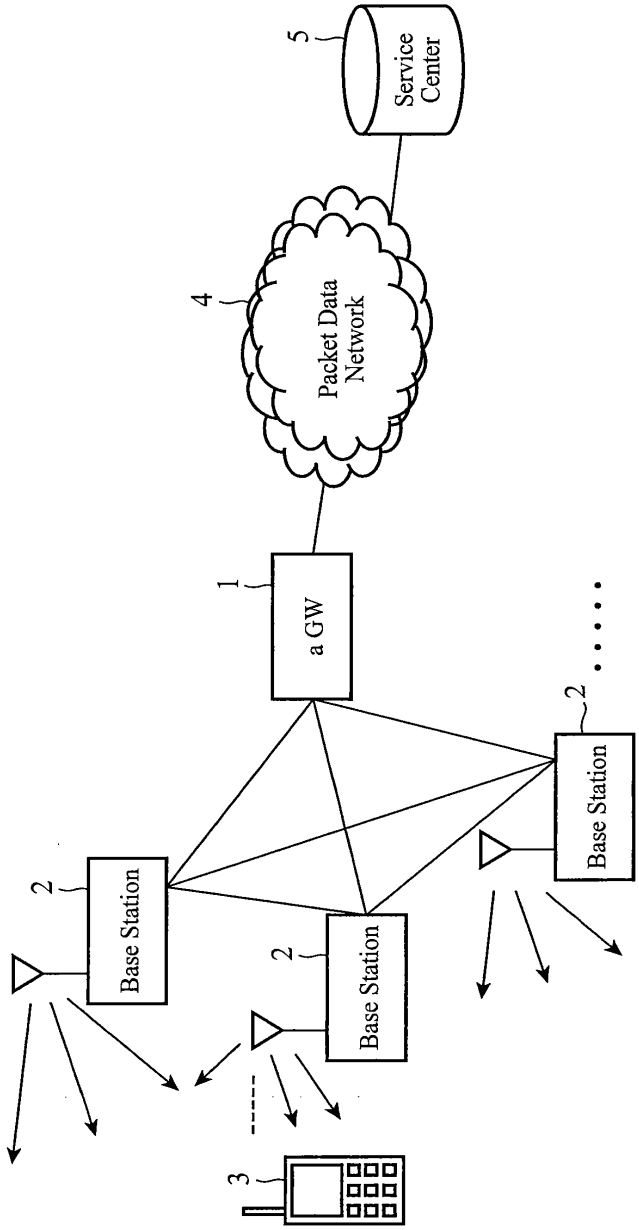

Service Center
5
Packet Data Network
4
a GW
1
Base Station
2
Base Station
2
Base Station
2
3

FIG.2

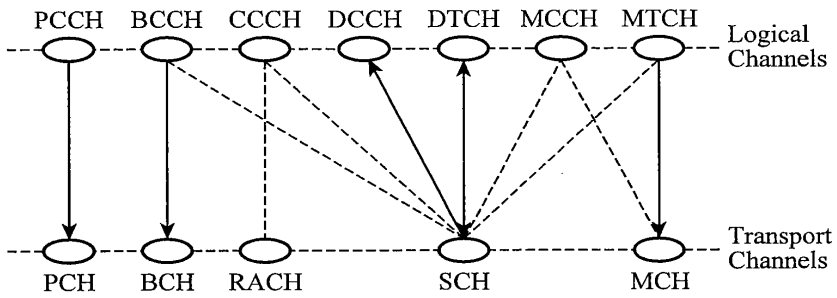

PCCH
BCCH
CCCH
DCCH
DTCH
MCCH
MTCH
Logical Channels
Transport Channels
PCH
BCH
RACH
SCH
MCH

FIG. 3

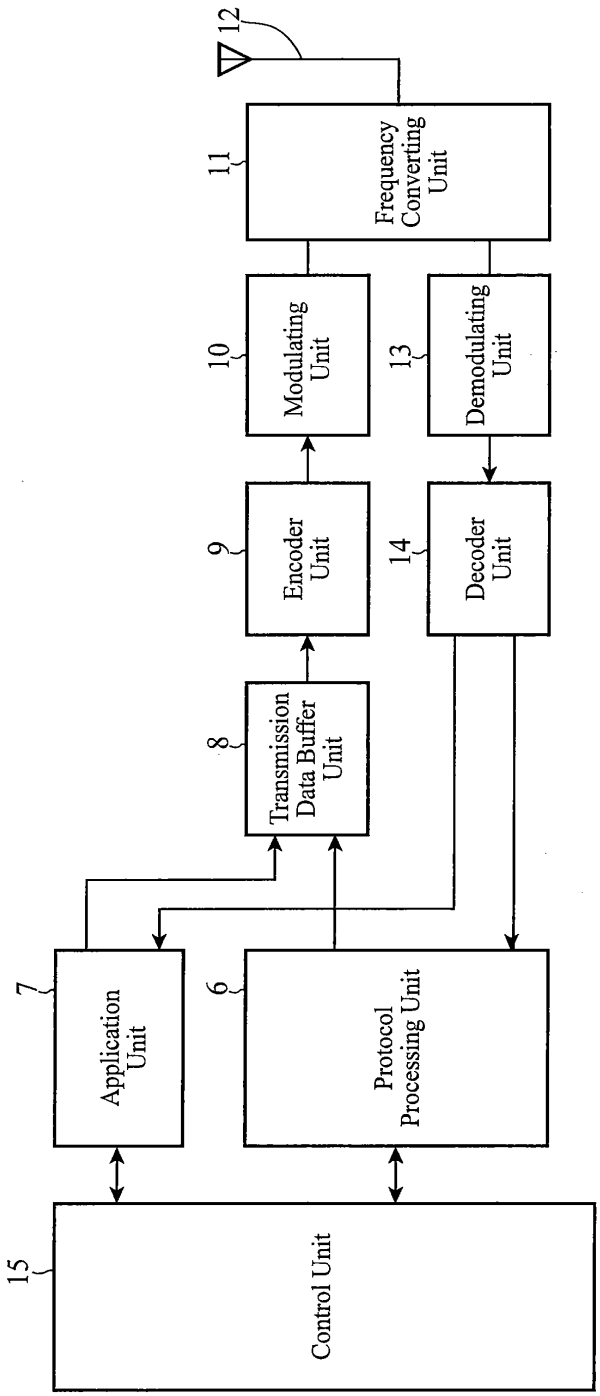

12
11
Frequency Converting Unit
10
Modulating Unit
13
Demodulating Unit
9
Encoder Unit
14
Decoder Unit
8
Transmission Data Buffer Unit
7
Application Unit
6
Protocol Processing Unit
15
Control Unit

FIG.4

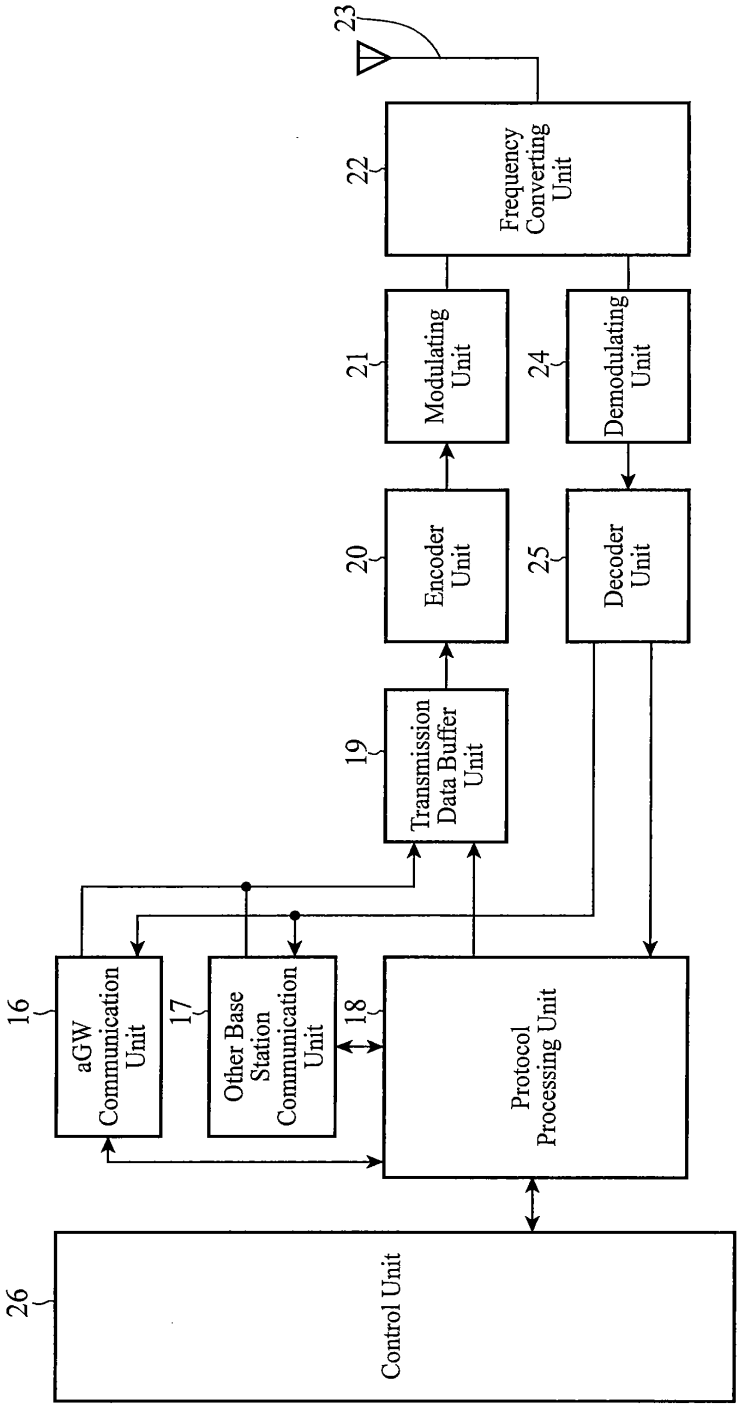

23
22
Frequency Converting Unit
21
Modulating Unit
24
Demodulating Unit
20
Encoder Unit
25
Decoder Unit
19
Transmission Data Buffer Unit
16
aGW Communication Unit
17
Other Base Station Communication Unit
18
Protocol Processing Unit
26
Control Unit

FIG.5

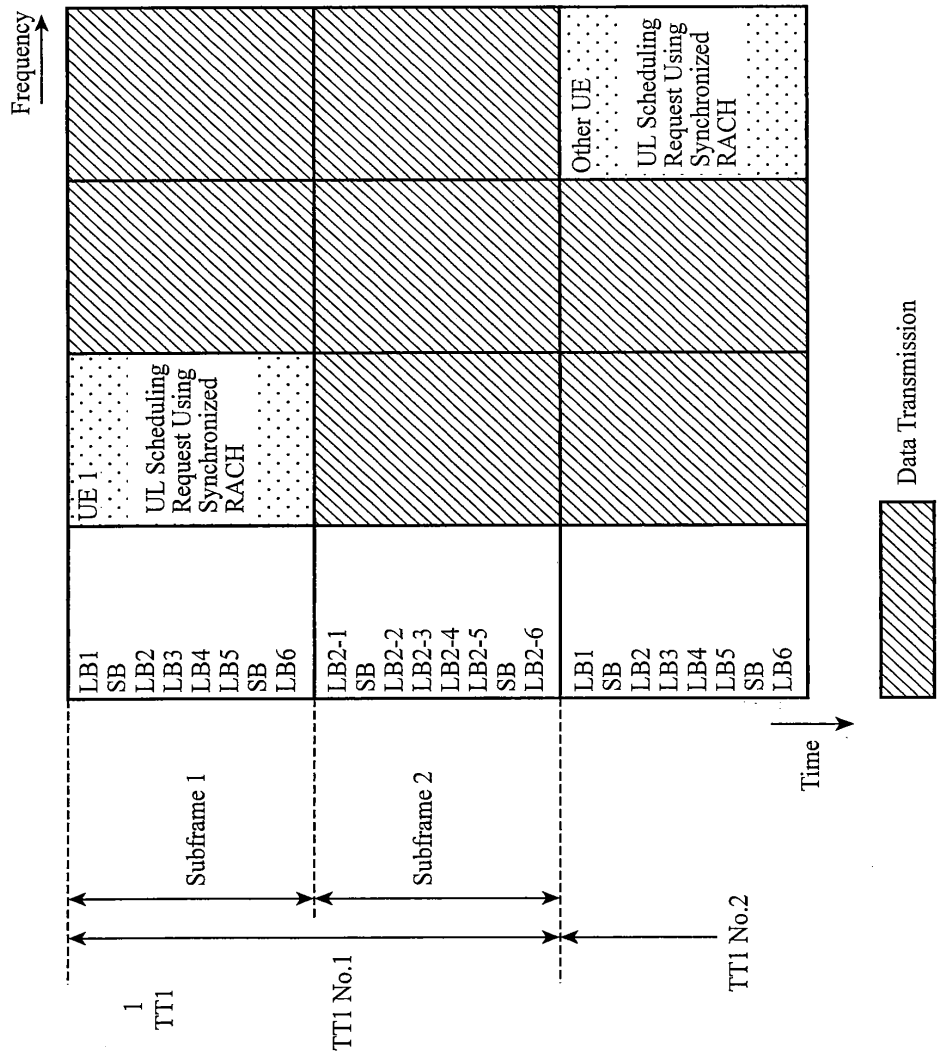

Frequency
UE 1
UL Scheduling Request Using Synchronized RACH
LB1
SB
LB2
LB3
LB4
LB5
SB
LB6
LB2-1
SB
LB2-2
LB2-3
LB2-4
LB2-5
SB
LB2-6
LB1
SB
LB2
LB3
LB4
LB5
SB
LB6
Other UE
UL Scheduling Request Using Synchronized RACH
Subframe 1
Subframe 2
1 TT1
TT1 No.1
TT1 No.2
Time
Data Transmission

FIG. 6

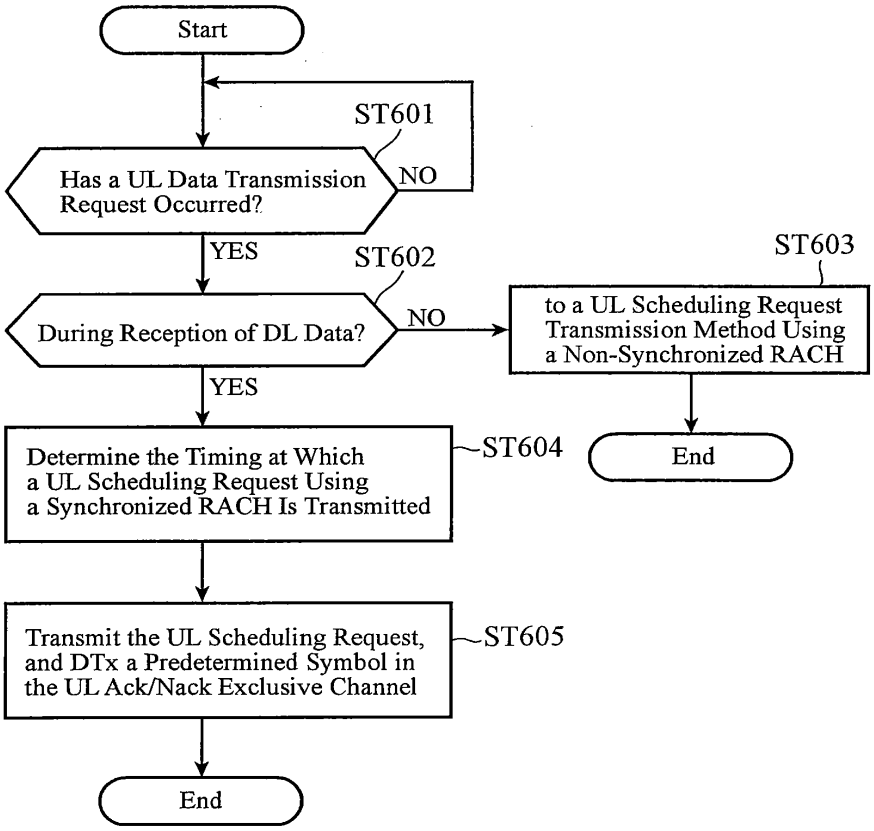

Start
ST601
Has a UL Data Transmission Request Occurred?
NO
YES
ST602
During Reception of DL Data?
NO
ST603
to a UL Scheduling Request Transmission Method Using a Non-Synchronized RACH
End
YES
Determine the Timing at Which a UL Scheduling Request Using a Synchronized RACH Is Transmitted
ST604
Transmit the UL Scheduling Request, and DTx a Predetermined Symbol in the UL Ack/Nack Exclusive Channel
ST605
End

FIG.7

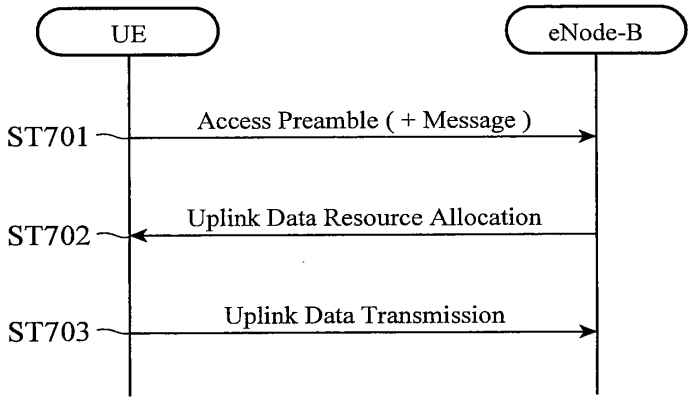

UE
eNode-B
ST701
Access Preamble (+ Message)
ST702
Uplink Data Resource Allocation
ST703
Uplink Data Transmission

FIG.8

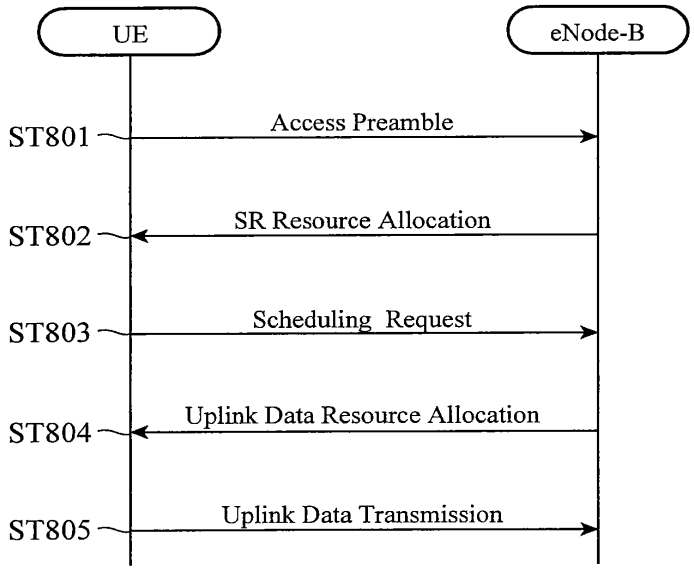

UE
eNode-B
ST801
Access Preamble
ST802
SR Resource Allocation
ST803
Scheduling Request
ST804
Uplink Data Resource Allocation
ST805
Uplink Data Transmission

FIG.9

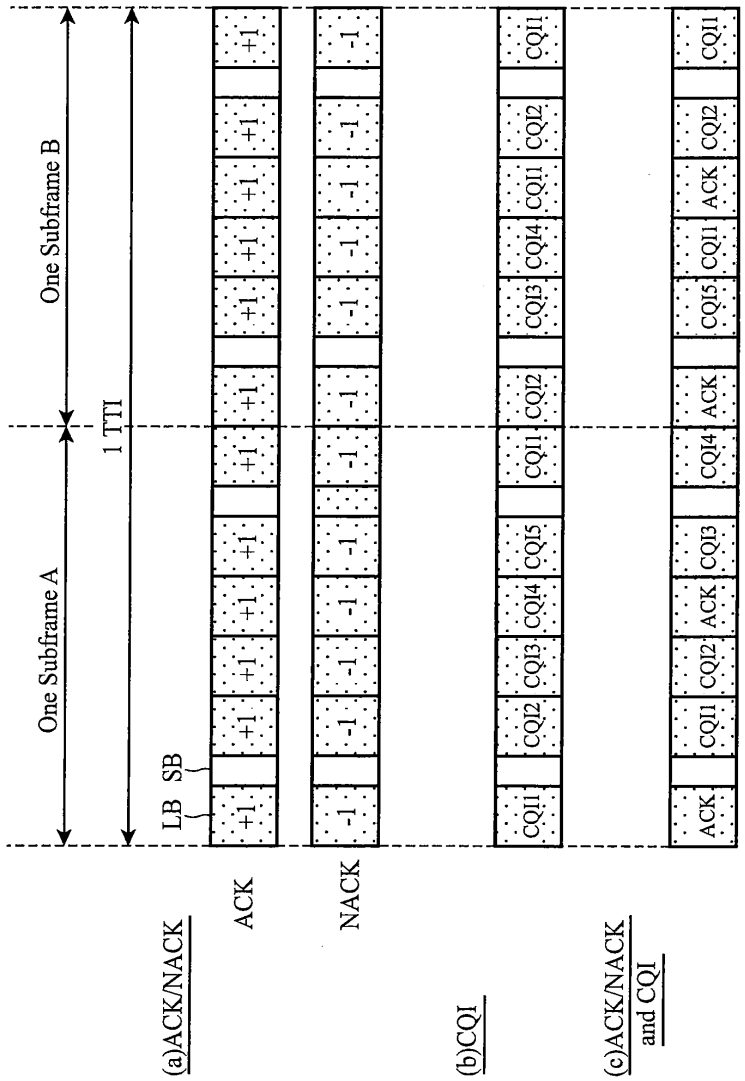

One Subframe A
One Subframe B
1 TTI
LB
SB
(a)ACK/NACK
ACK
NACK
(b)CQI
(c)ACK/NACK and CQI
+1
-1
CQI1
CQI2
CQI3
CQI4
CQI5
ACK

FIG.10

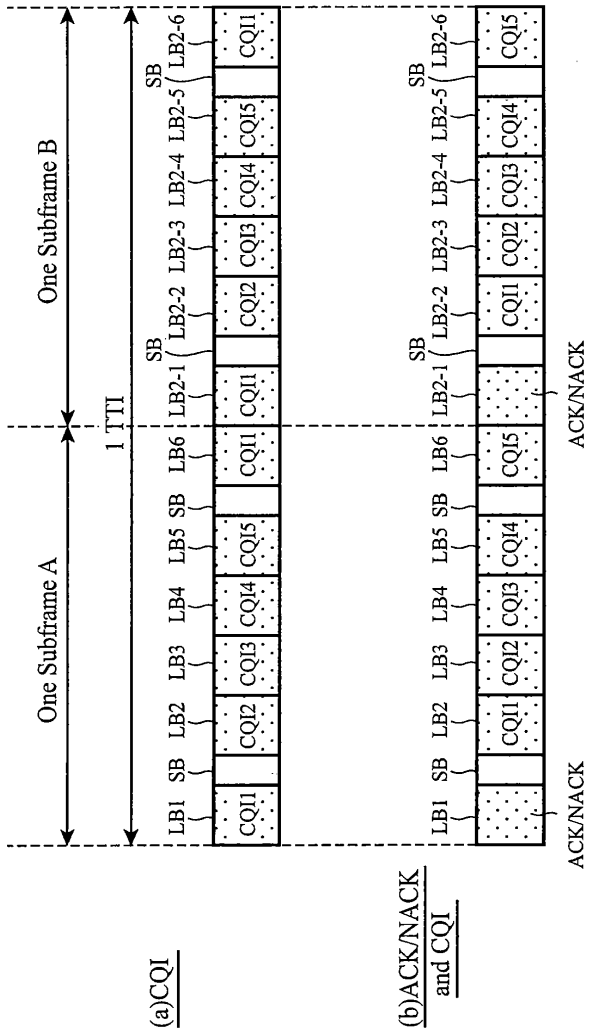

One Subframe A
One Subframe B
1 TTI
(a)CQI
(b)ACK/NACK and CQI
LB1
SB
LB2
LB3
LB4
LB5
SB
LB6
LB2-1
LB2-2
LB2-3
LB2-4
LB2-5
LB2-6
CQI1
CQI2
CQI3
CQI4
CQI5
ACK/NACK

FIG.11

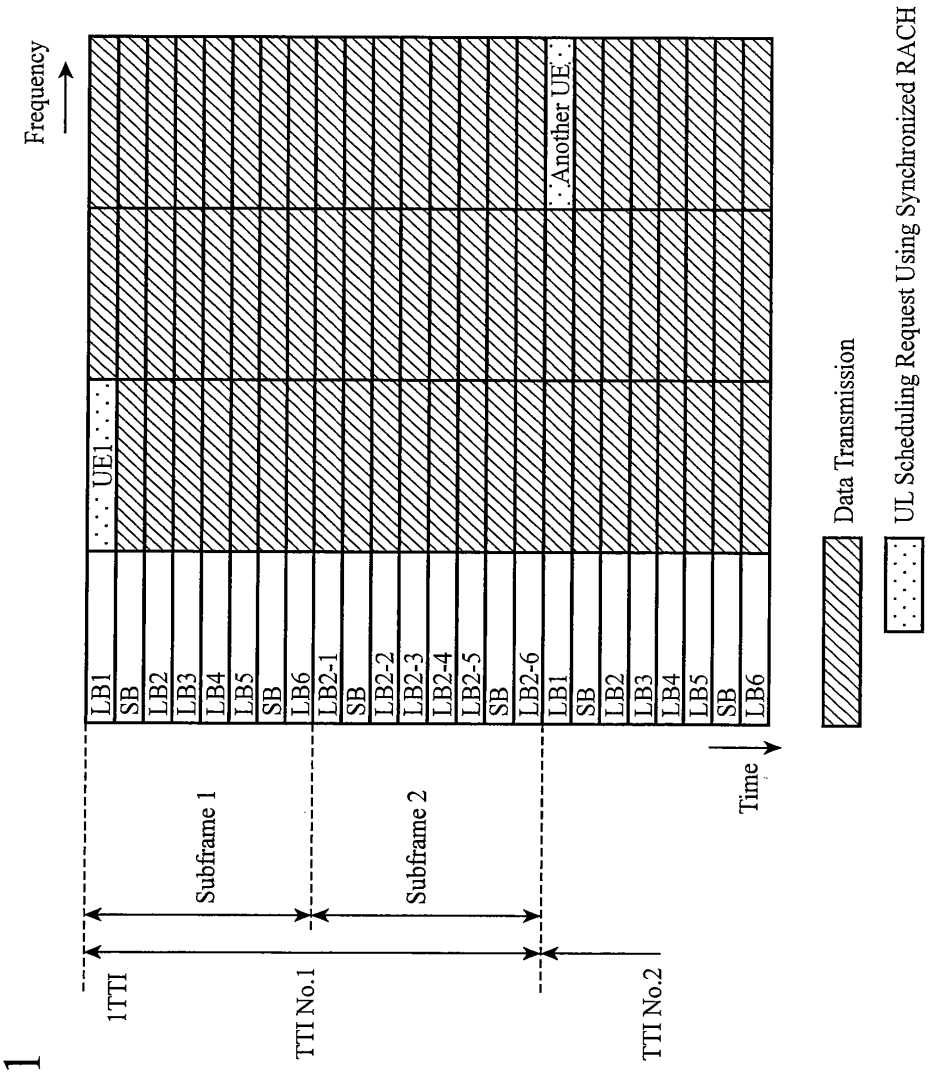

Frequency
UE1
Another UE
LB1
SB
LB2
LB3
LB4
LB5
SB
LB6
LB2-1
SB
LB2-2
LB2-3
LB2-4
LB2-5
SB
LB2-6
LB1
SB
LB2
LB3
LB4
LB5
SB
LB6
Time
Subframe 1
Subframe 2
1TTI
TTI No.1
TTI No.2
Data Transmission
UL Scheduling Request Using Synchronized RACH

FIG.12

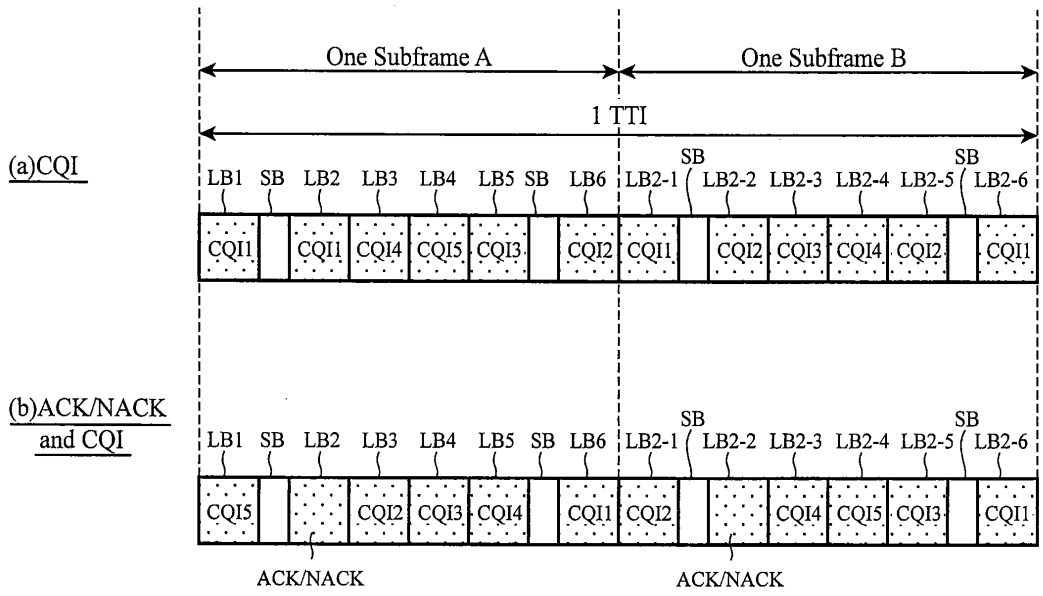

One Subframe A
One Subframe B
1 TTI
(a)CQI
LB1 SB LB2 LB3 LB4 LB5 SB LB6 LB2-1 SB LB2-2 LB2-3 LB2-4 LB2-5 SB LB2-6
CQI1 CQI1 CQI4 CQI5 CQI3 CQI2 CQI1 CQI2 CQI3 CQI4 CQI2 CQI1
(b)ACK/NACK and CQI
LB1 SB LB2 LB3 LB4 LB5 SB LB6 LB2-1 SB LB2-2 LB2-3 LB2-4 LB2-5 SB LB2-6
CQI5 CQI2 CQI3 CQI4 CQI1 CQI2 CQI4 CQI5 CQI3 CQI1
ACK/NACK
ACK/NACK

FIG. 13

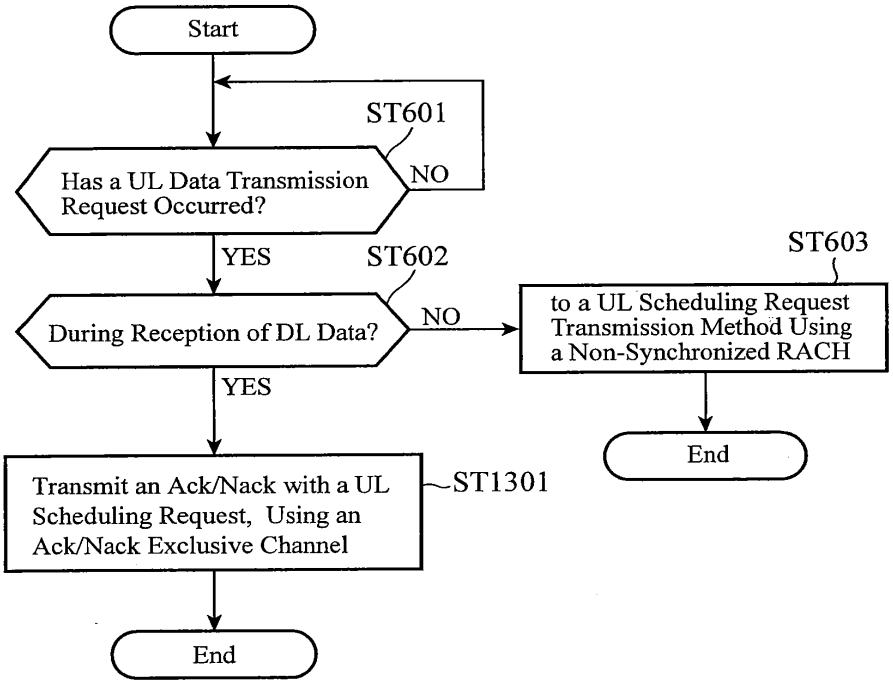
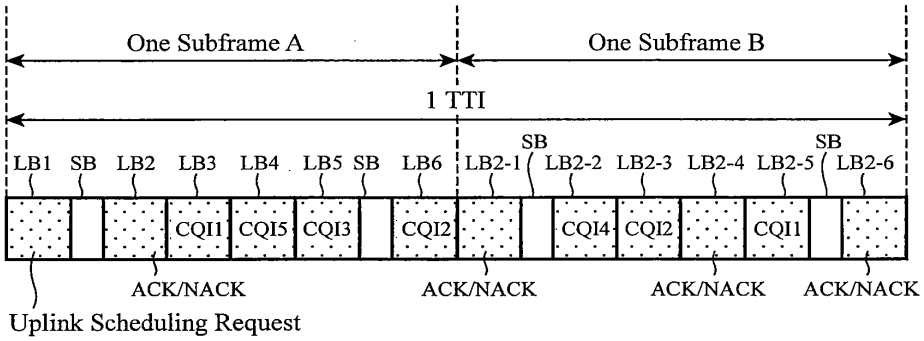

Start
ST601
Has a UL Data Transmission Request Occurred?
NO
YES
ST602
During Reception of DL Data?
NO
ST603
to a UL Scheduling Request Transmission Method Using a Non-Synchronized RACH
End
YES
Transmit an Ack/Nack with a UL Scheduling Request, Using an Ack/Nack Exclusive Channel
ST1301
End

FIG.14



Uplink Scheduling Request

1	With Request
0	Without Request

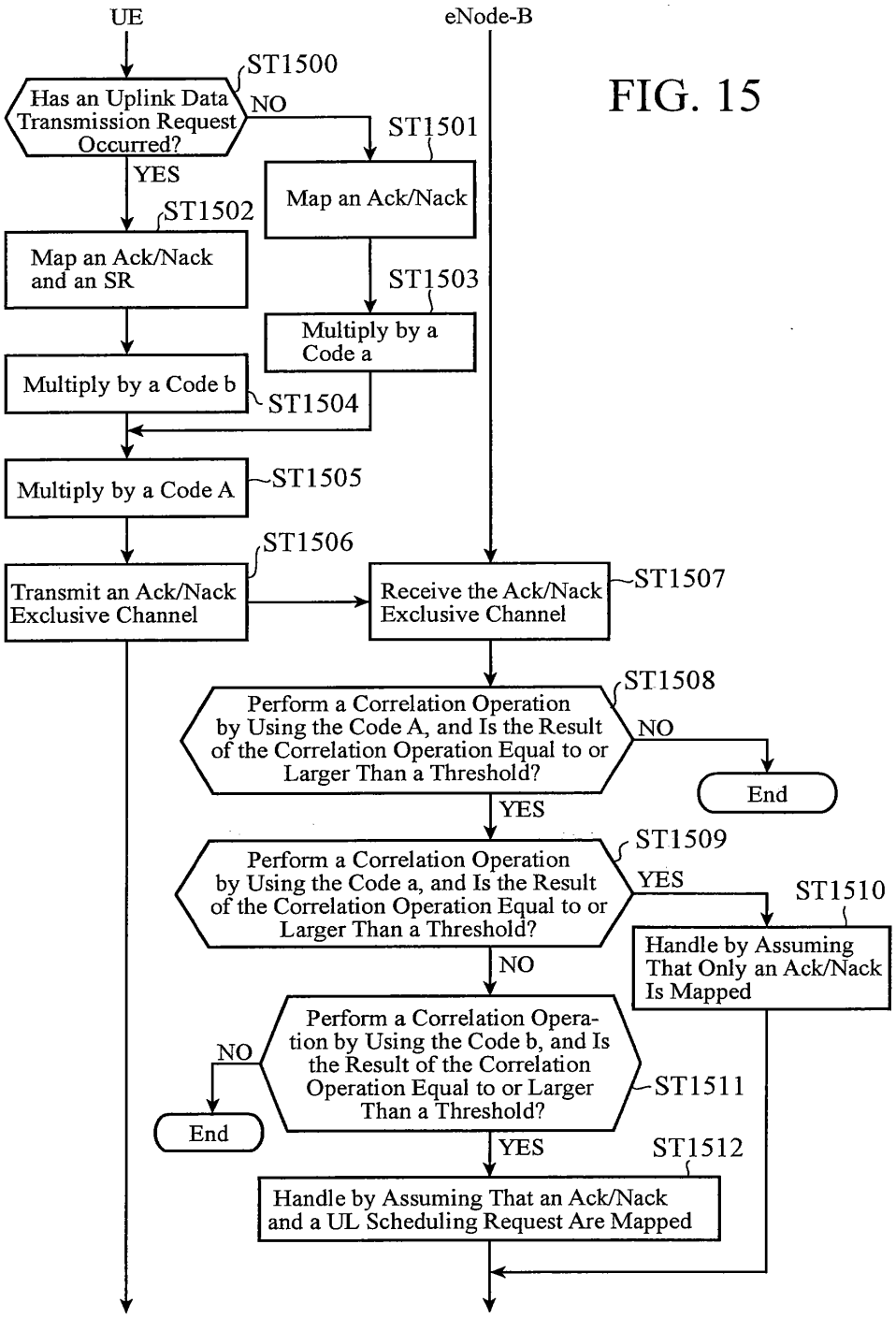

UE
eNode-B
ST1500
Has an Uplink Data Transmission Request Occurred?
NO
YES
ST1501
Map an Ack/Nack
ST1502
Map an Ack/Nack and an SR
ST1503
Multiply by a Code a
Multiply by a Code b
ST1504
Multiply by a Code A
ST1505
ST1506
Transmit an Ack/Nack Exclusive Channel
Receive the Ack/Nack Exclusive Channel
ST1507
ST1508
Perform a Correlation Operation by Using the Code A, and Is the Result of the Correlation Operation Equal to or Larger Than a Threshold?
NO
End
YES
ST1509
Perform a Correlation Operation by Using the Code a, and Is the Result of the Correlation Operation Equal to or Larger Than a Threshold?
YES
ST1510
Handle by Assuming That Only an Ack/Nack Is Mapped
NO
Perform a Correlation Operation by Using the Code b, and Is the Result of the Correlation Operation Equal to or Larger Than a Threshold?
NO
End
ST1511
YES
ST1512
Handle by Assuming That an Ack/Nack and a UL Scheduling Request Are Mapped

FIG. 15

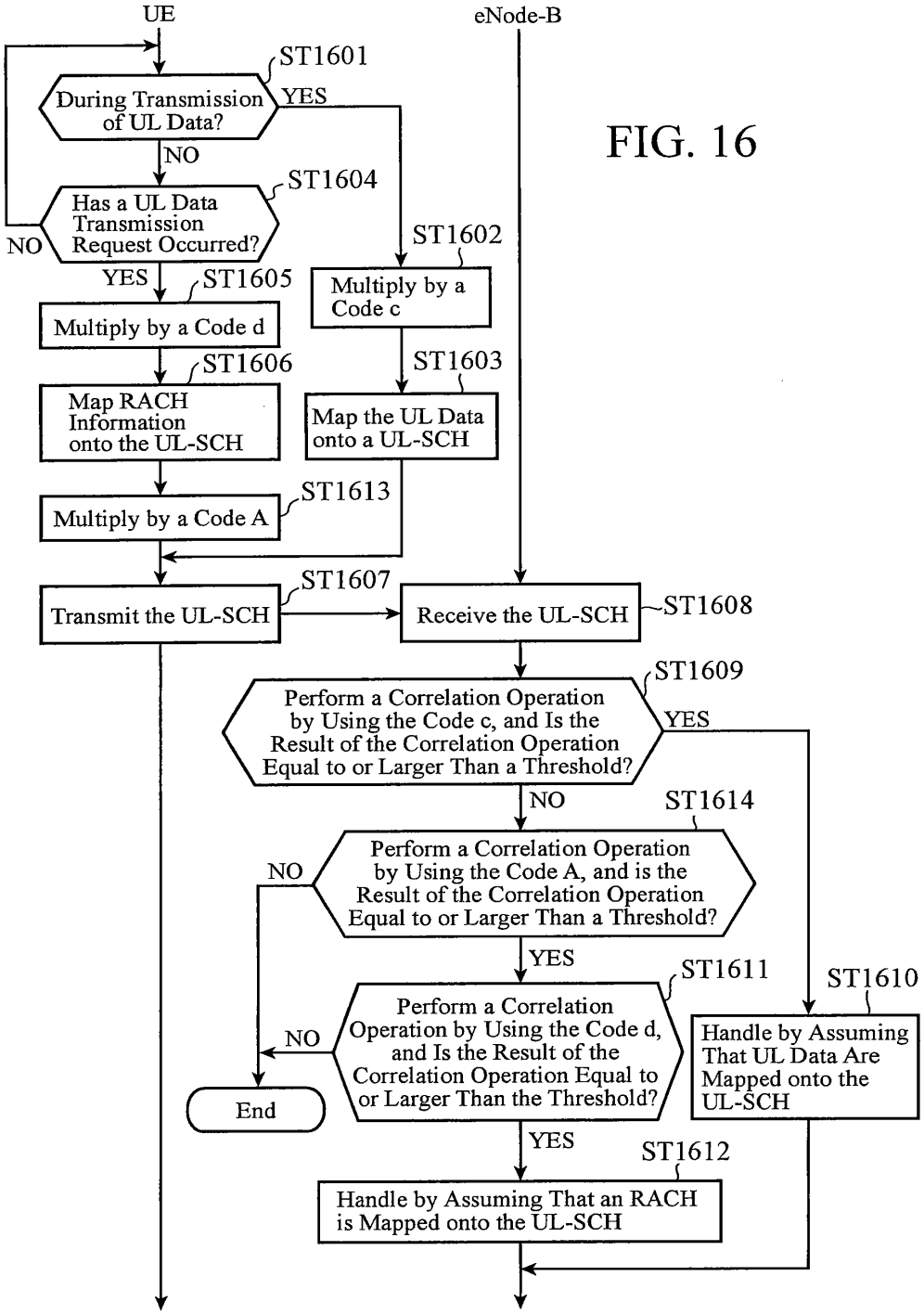

UE
eNode-B
ST1601
During Transmission of UL Data?
YES
NO
ST1604
Has a UL Data Transmission Request Occurred?
NO
YES
ST1605
Multiply by a Code d
ST1606
Map RACH Information onto the UL-SCH
ST1613
Multiply by a Code A
ST1602
Multiply by a Code c
ST1603
Map the UL Data onto a UL-SCH
ST1607
Transmit the UL-SCH
Receive the UL-SCH
ST1608
ST1609
Perform a Correlation Operation by Using the Code c, and Is the Result of the Correlation Operation Equal to or Larger Than a Threshold?
YES
NO
ST1614
Perform a Correlation Operation by Using the Code A, and is the Result of the Correlation Operation Equal to or Larger Than a Threshold?
NO
YES
ST1611
Perform a Correlation Operation by Using the Code d, and Is the Result of the Correlation Operation Equal to or Larger Than the Threshold?
NO
End
ST1610
Handle by Assuming That UL Data Are Mapped onto the UL-SCH
YES
ST1612
Handle by Assuming That an RACH is Mapped onto the UL-SCH

FIG. 16

FIG.17

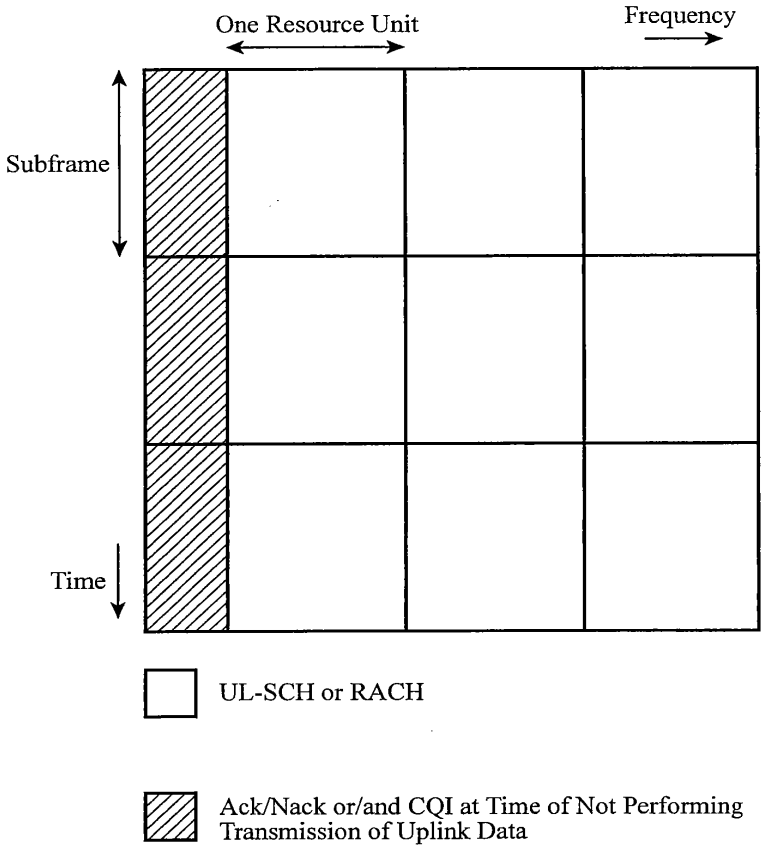

One Resource Unit
Frequency
Subframe
Time
UL-SCH or RACH
Ack/Nack or/and CQI at Time of Not Performing Transmission of Uplink Data

FIG. 18

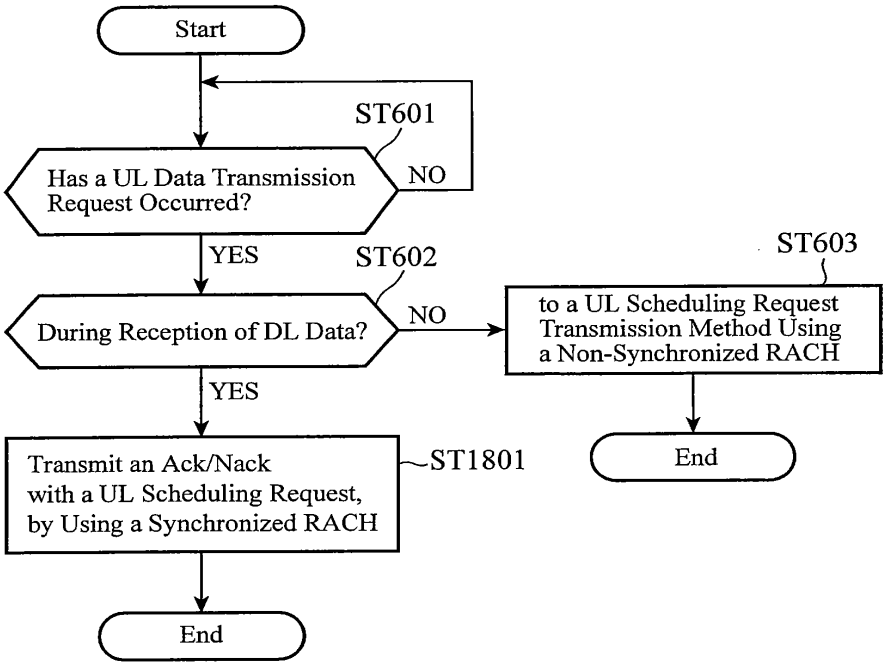

Start
ST601
Has a UL Data Transmission Request Occurred?
NO
YES
ST602
During Reception of DL Data?
NO
ST603
to a UL Scheduling Request Transmission Method Using a Non-Synchronized RACH
End
YES
Transmit an Ack/Nack with a UL Scheduling Request, by Using a Synchronized RACH
ST1801
End

FIG.19

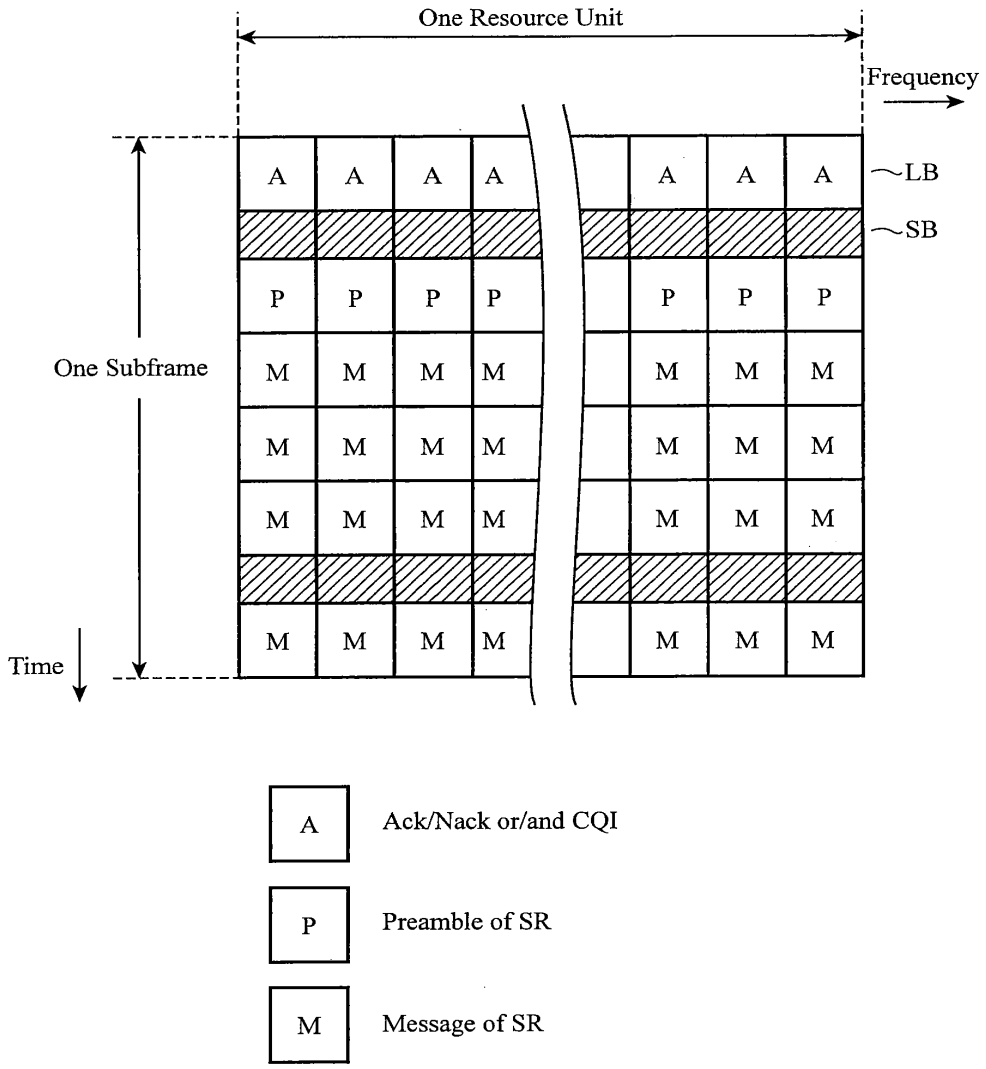

One Resource Unit
Frequency
LB
SB
One Subframe
Time
A
P
M
Ack/Nack or/and CQI
Preamble of SR
Message of SR

FIG.20

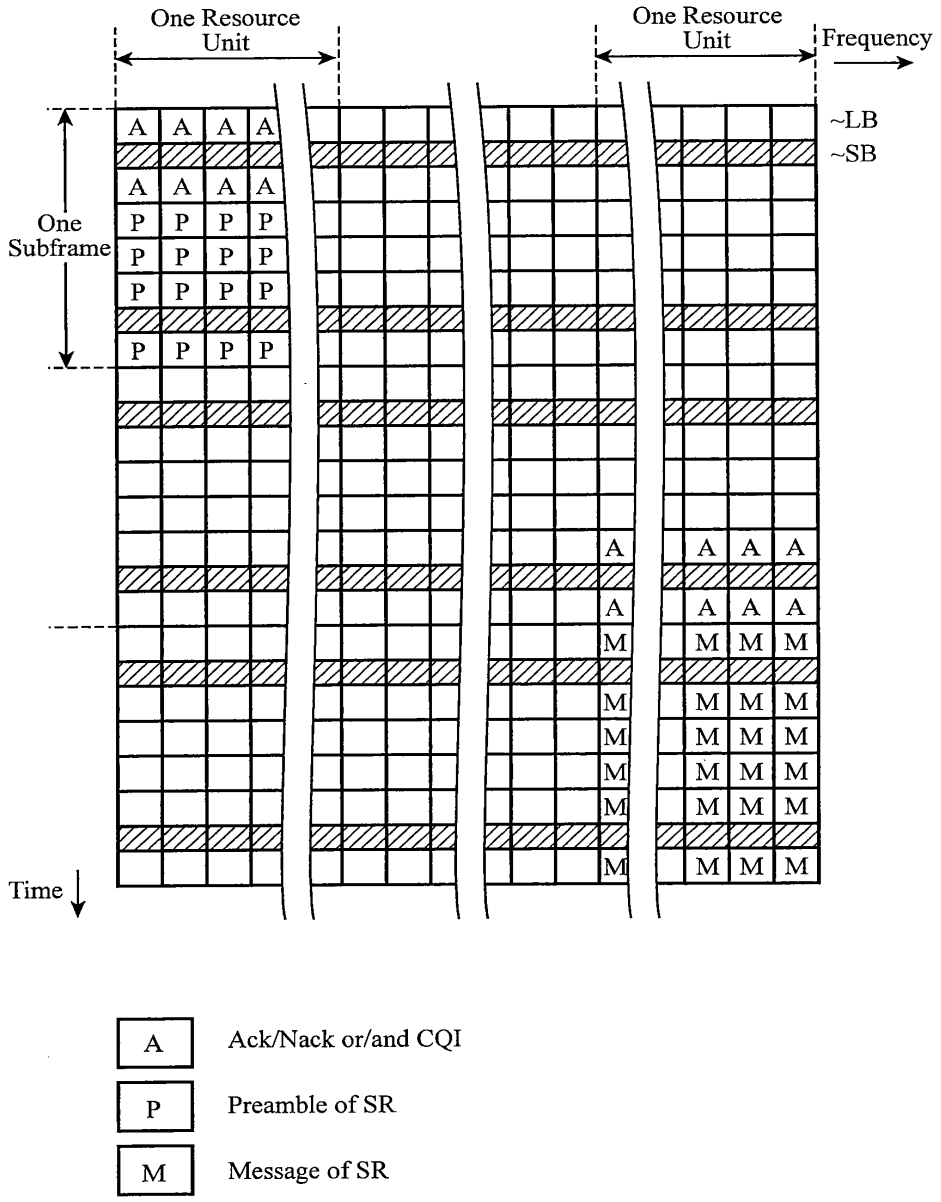

One Resource Unit
One Resource Unit
Frequency
~LB
~SB
One Subframe
Time
A
P
M
Ack/Nack or/and CQI
Preamble of SR
Message of SR

FIG.21

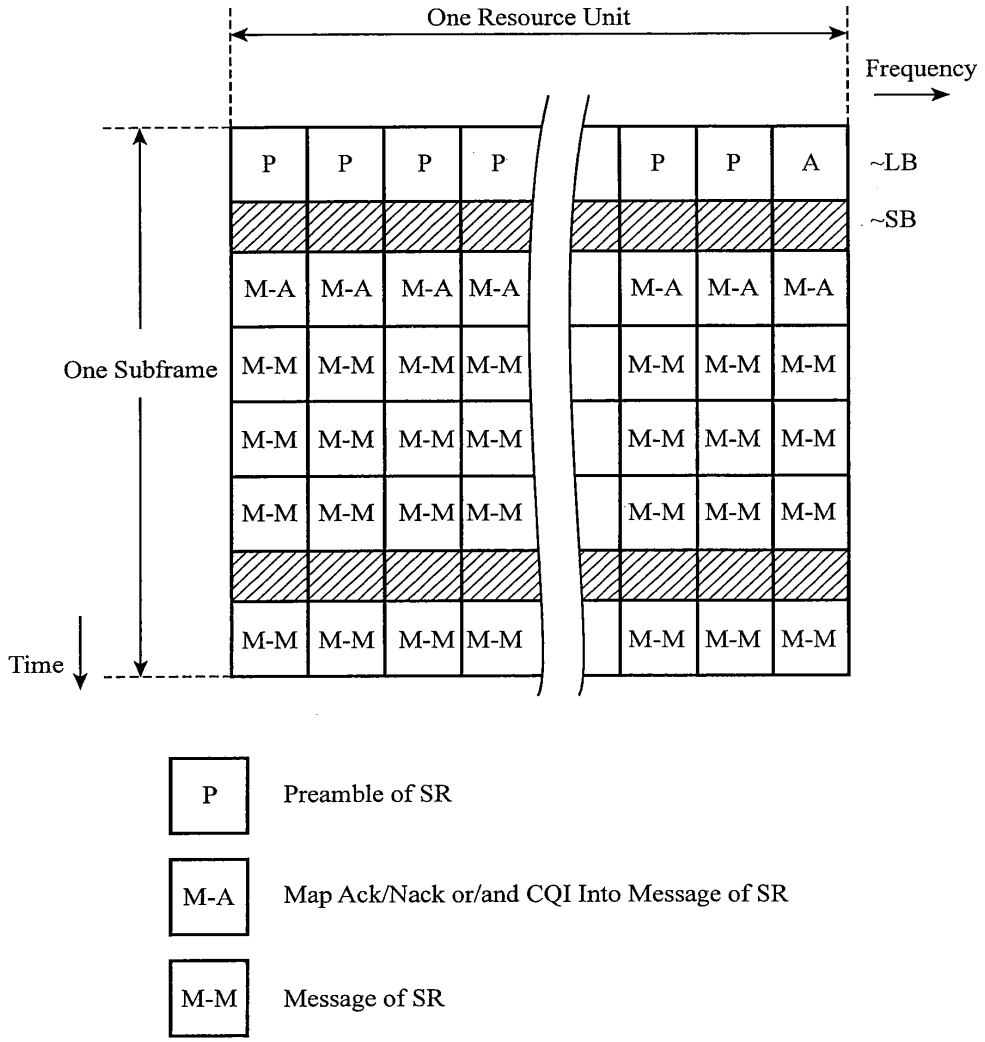

One Resource Unit
Frequency
P
P
P
P
P
P
A
~LB
~SB
M-A
M-A
M-A
M-A
M-A
M-A
M-A
One Subframe
M-M
M-M
M-M
M-M
M-M
M-M
M-M
M-M
M-M
M-M
M-M
M-M
M-M
M-M
M-M
M-M
M-M
M-M
M-M
M-M
Time
P
Preamble of SR
M-A
Map Ack/Nack or/and CQI Into Message of SR
M-M
Message of SR

FIG.22

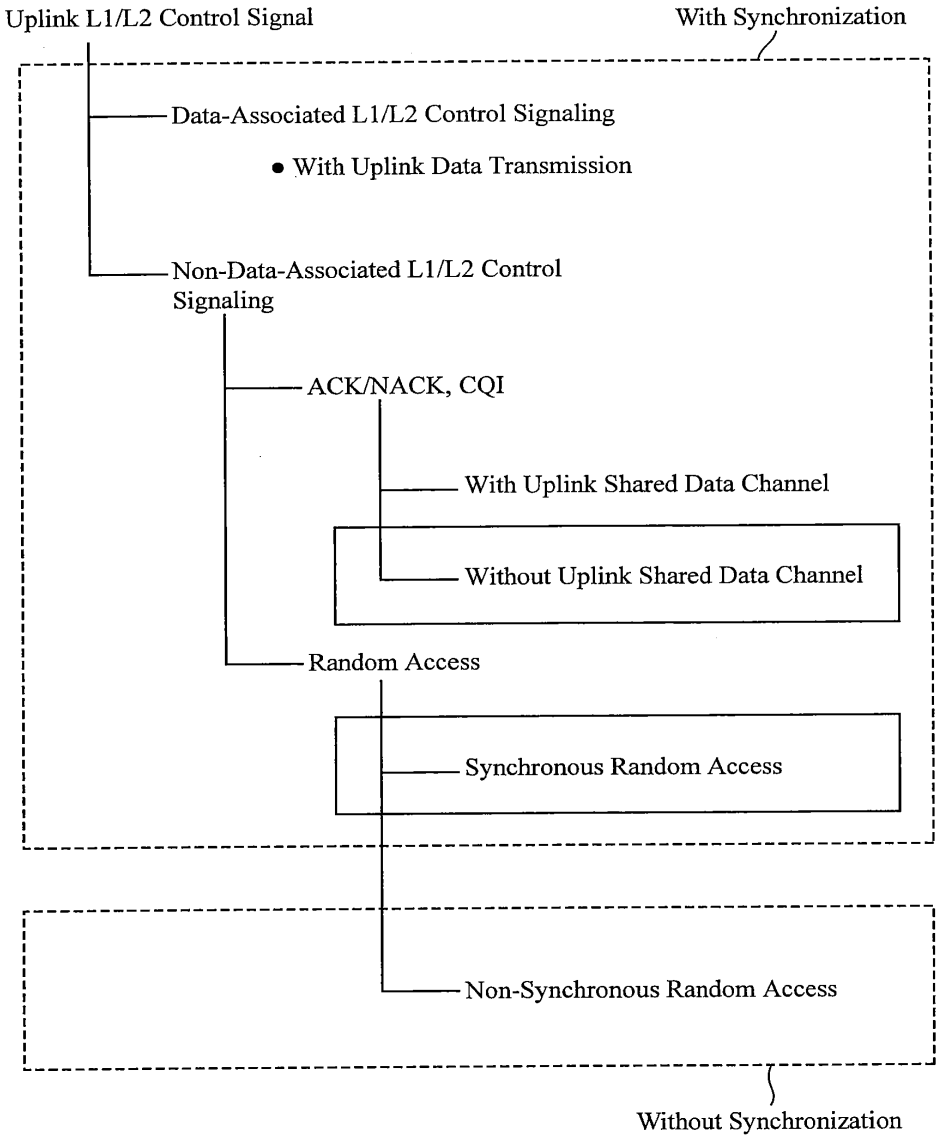

Uplink L1/L2 Control Signal
With Synchronization
Data-Associated L1/L2 Control Signaling
• With Uplink Data Transmission
Non-Data-Associated L1/L2 Control Signaling
ACK/NACK, CQI
With Uplink Shared Data Channel
Without Uplink Shared Data Channel
Random Access
Synchronous Random Access
Non-Synchronous Random Access
Without Synchronization

FIG.23

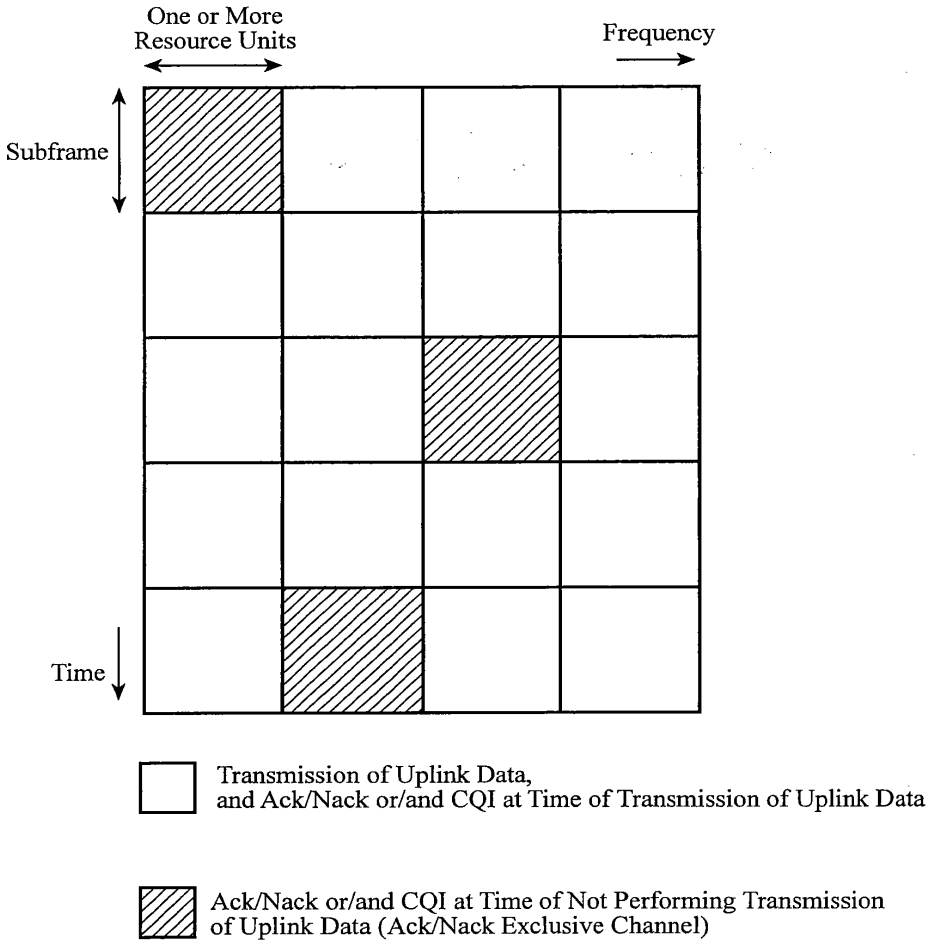

One or More
Resource Units
Frequency
Subframe
Time
Transmission of Uplink Data,
and Ack/Nack or/and CQI at Time of Transmission of Uplink Data
Ack/Nack or/and CQI at Time of Not Performing Transmission
of Uplink Data (Ack/Nack Exclusive Channel)

FIG.24

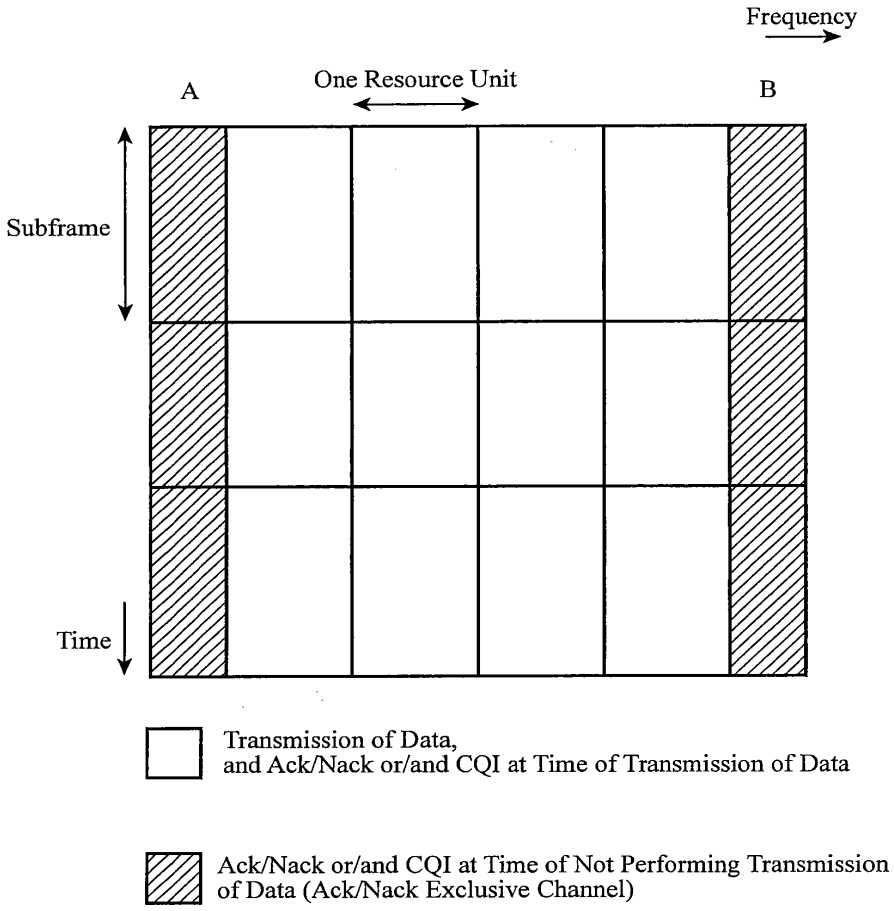

Frequency
A
One Resource Unit
B
Subframe
Time
Transmission of Data,
and Ack/Nack or/and CQI at Time of Transmission of Data
Ack/Nack or/and CQI at Time of Not Performing Transmission
of Data (Ack/Nack Exclusive Channel)

FIG.25

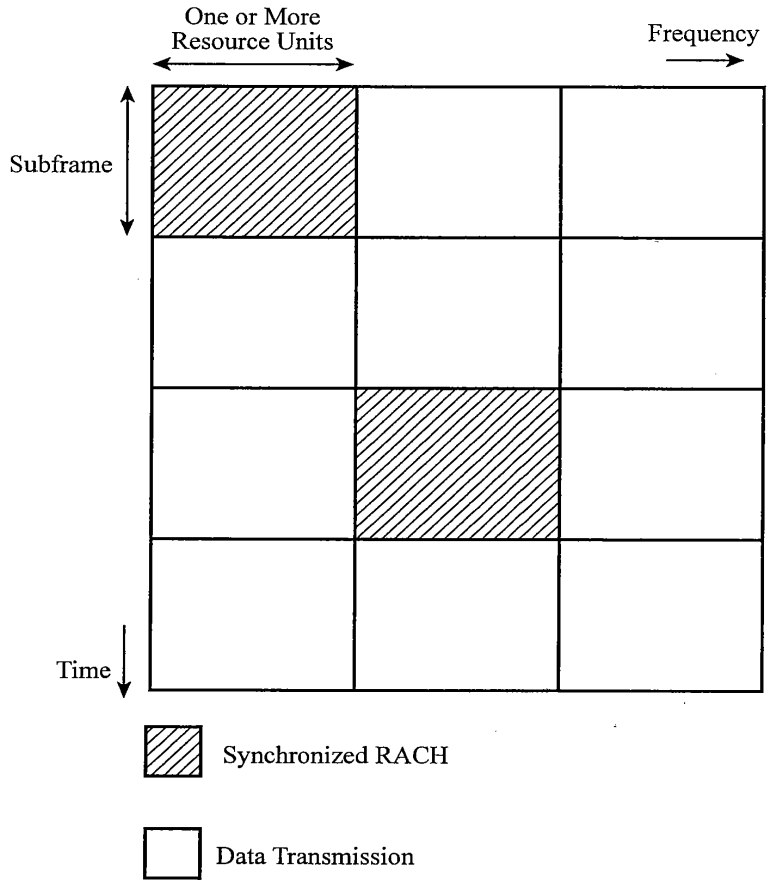

One or More
Resource Units
Frequency
Subframe
Time
Synchronized RACH
Data Transmission

FIG.26

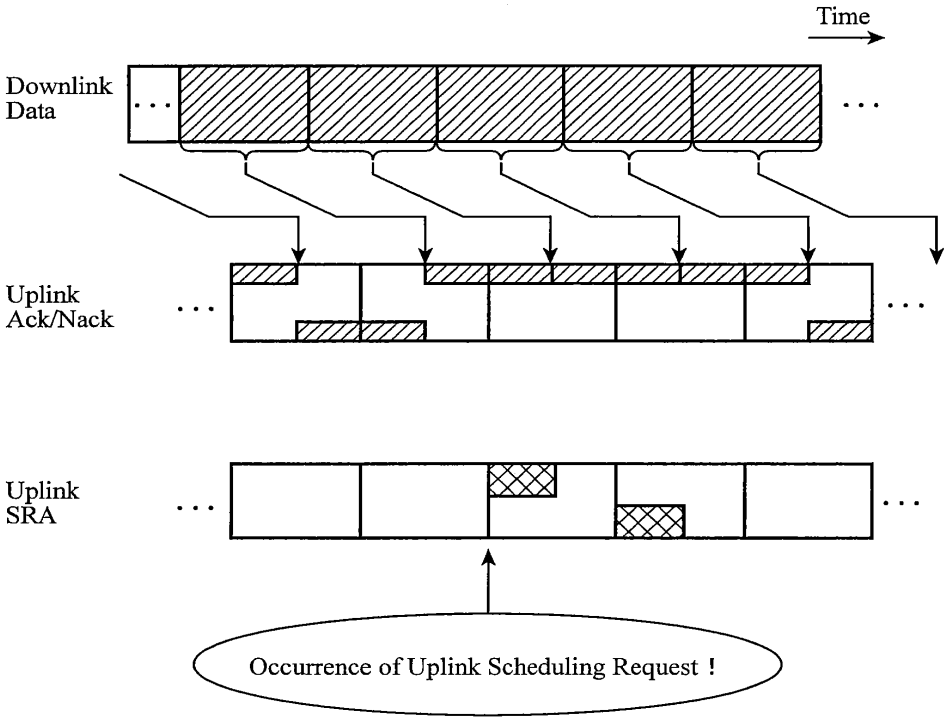
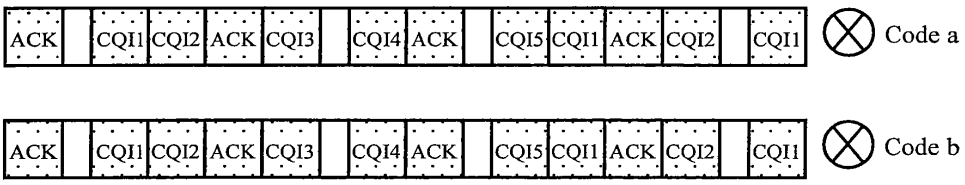


FIG.27

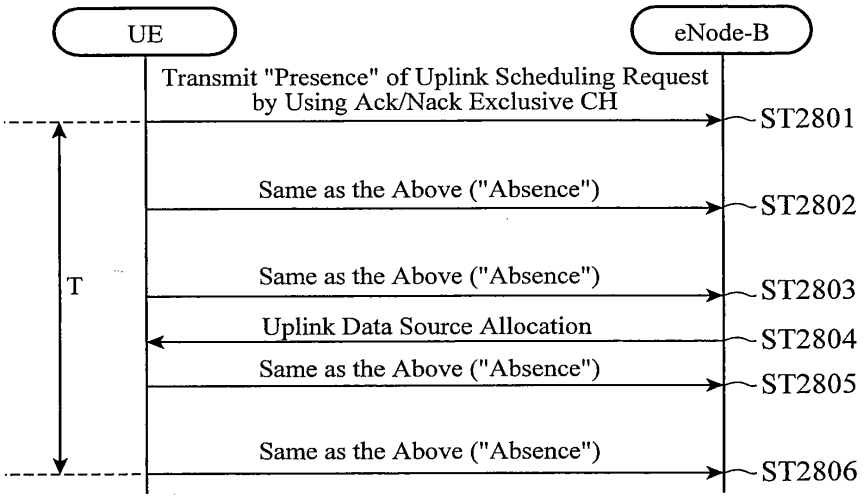


Uplink Scheduling Request

Code b	With Request
Code a	Without Request

FIG. 28

(i) In the Case of Non-Occurrence of Receiving Error



(ii) In the Case of Occurrence of Receiving Error

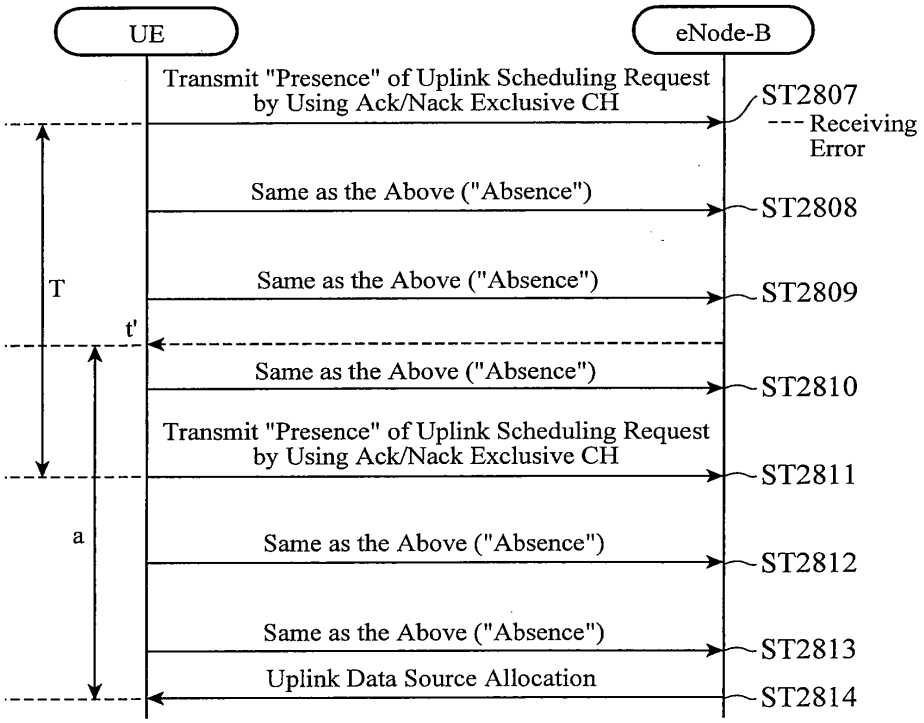


FIG. 29

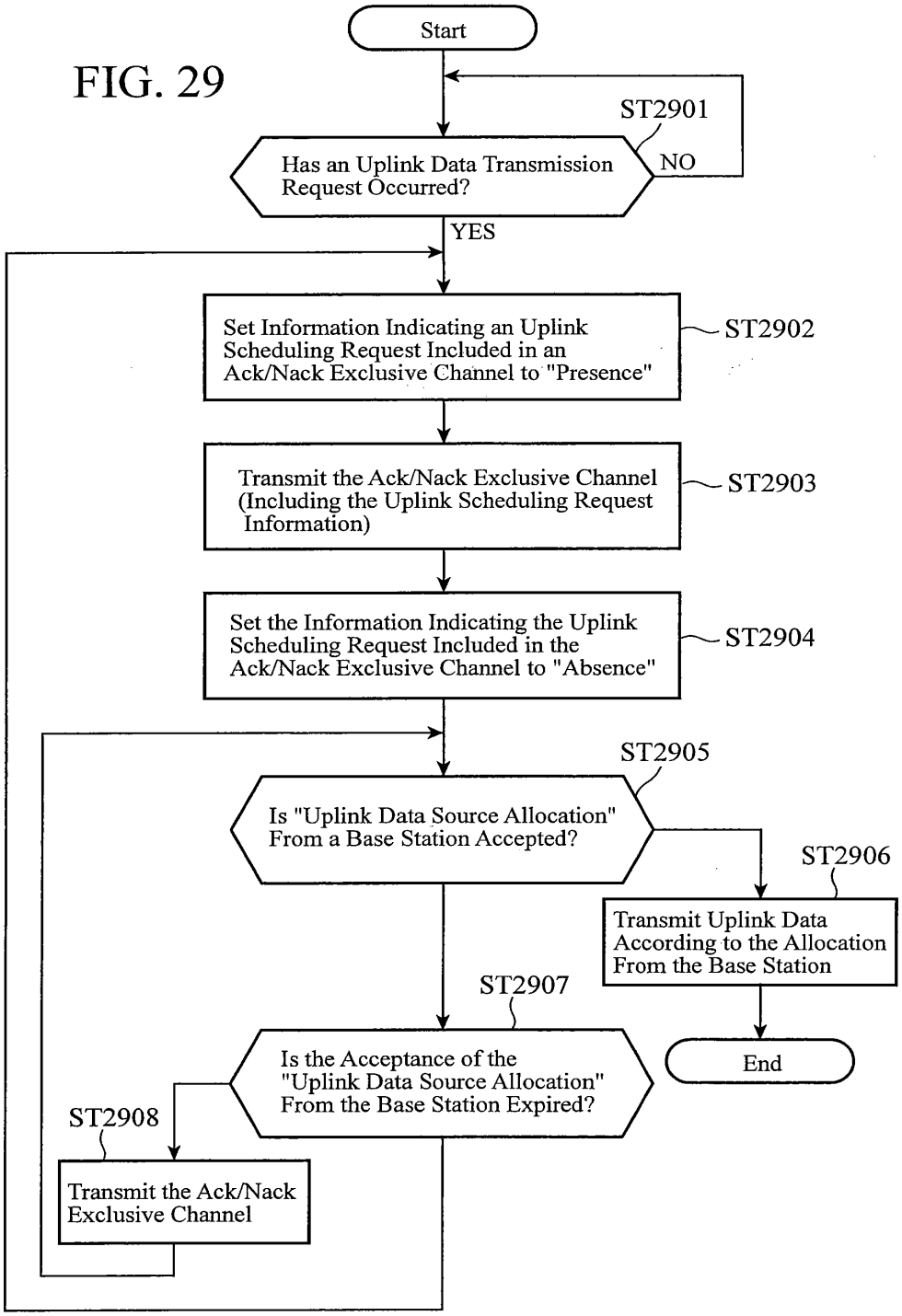

Start
ST2901
Has an Uplink Data Transmission Request Occurred?
NO
YES
Set Information Indicating an Uplink Scheduling Request Included in an Ack/Nack Exclusive Channel to "Presence"
ST2902
Transmit the Ack/Nack Exclusive Channel (Including the Uplink Scheduling Request Information)
ST2903
Set the Information Indicating the Uplink Scheduling Request Included in the Ack/Nack Exclusive Channel to "Absence"
ST2904
ST2905
Is "Uplink Data Source Allocation" From a Base Station Accepted?
ST2906
Transmit Uplink Data According to the Allocation From the Base Station
End
ST2907
Is the Acceptance of the "Uplink Data Source Allocation" From the Base Station Expired?
ST2908
Transmit the Ack/Nack Exclusive Channel

FIG. 30

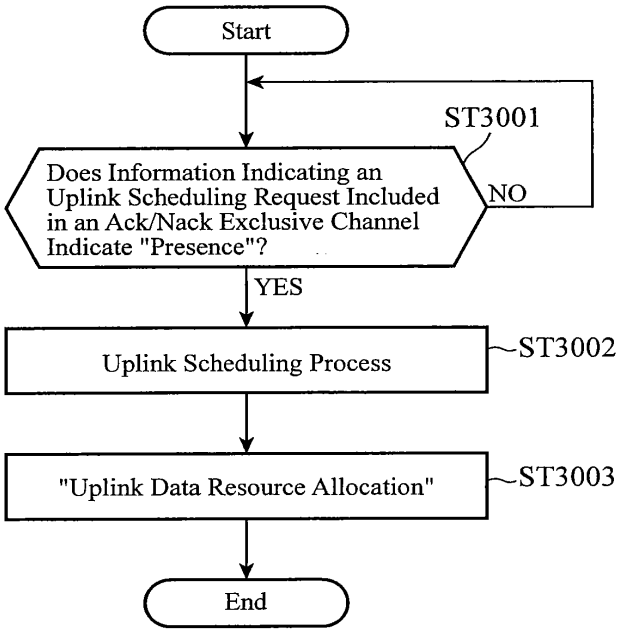
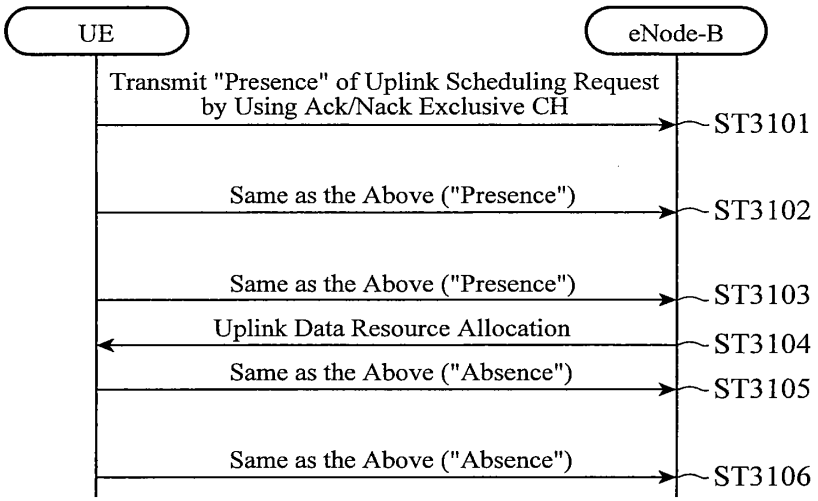

Start
ST3001
Does Information Indicating an Uplink Scheduling Request Included in an Ack/Nack Exclusive Channel Indicate "Presence"?
NO
YES
Uplink Scheduling Process
ST3002
"Uplink Data Resource Allocation"
ST3003
End

FIG. 31

(i) In the Case of Non-Occurrence of Receiving Error



(ii) In the Case of Occurrence of Receiving Error

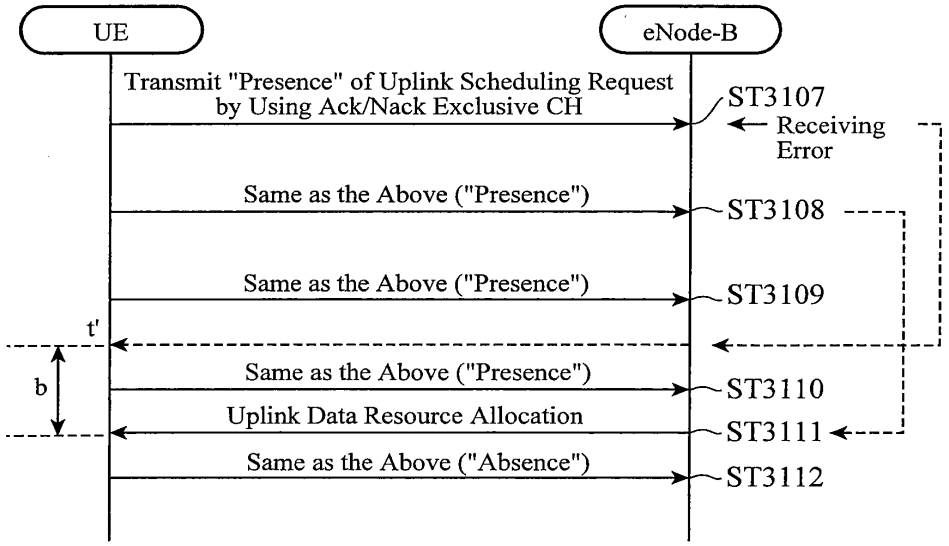


FIG. 32

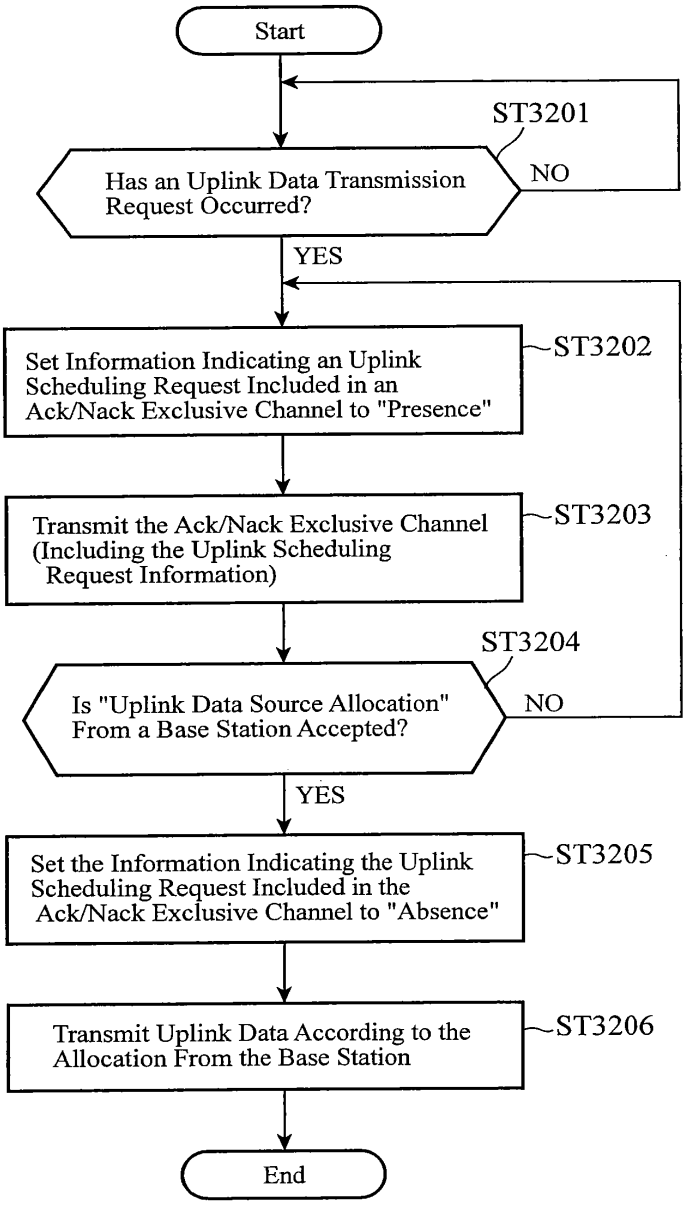

Start
ST3201
Has an Uplink Data Transmission Request Occurred?
NO
YES
Set Information Indicating an Uplink Scheduling Request Included in an Ack/Nack Exclusive Channel to "Presence"
ST3202
Transmit the Ack/Nack Exclusive Channel (Including the Uplink Scheduling Request Information)
ST3203
ST3204
Is "Uplink Data Source Allocation" From a Base Station Accepted?
NO
YES
Set the Information Indicating the Uplink Scheduling Request Included in the Ack/Nack Exclusive Channel to "Absence"
ST3205
Transmit Uplink Data According to the Allocation From the Base Station
ST3206
End

FIG. 33

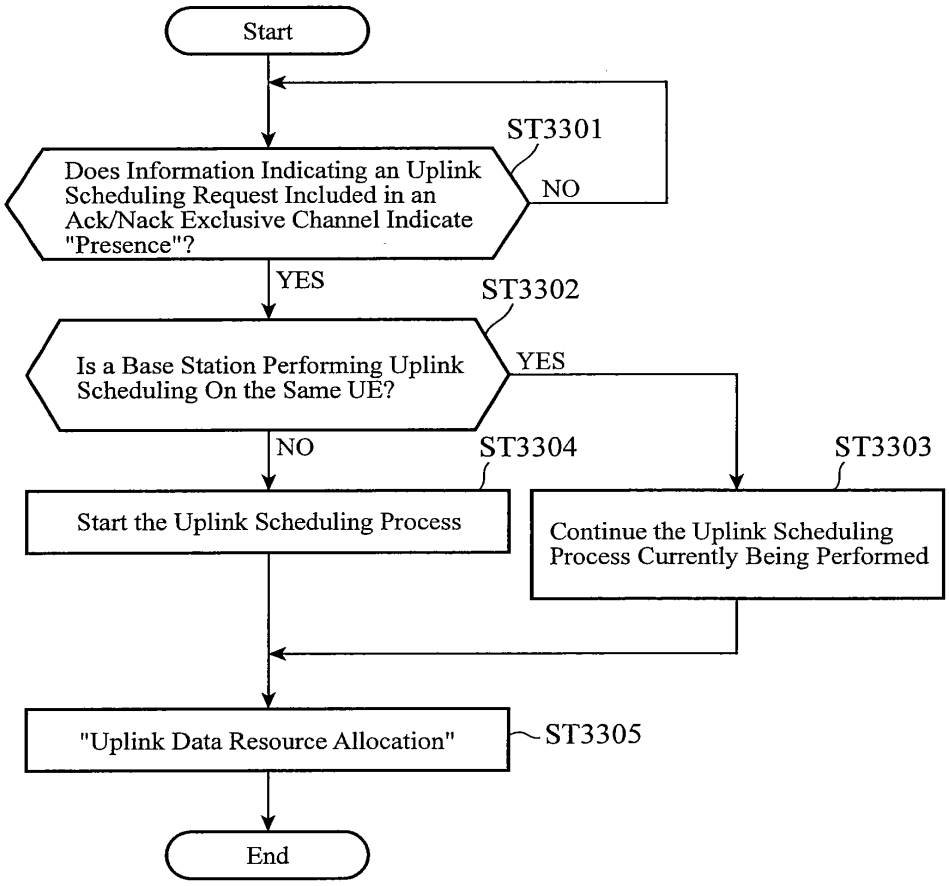
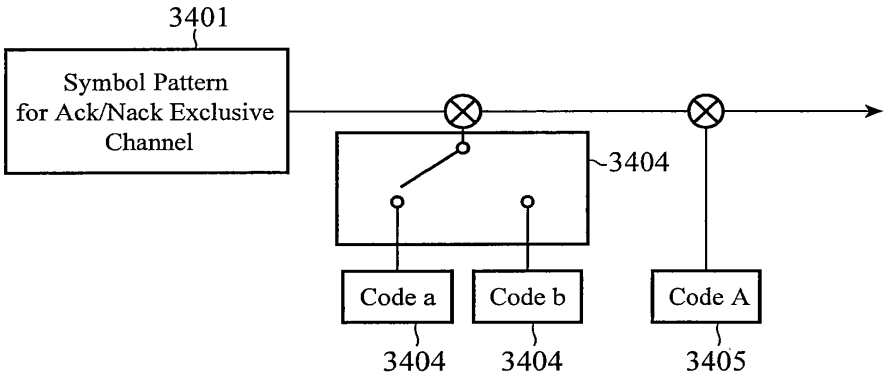

Start
ST3301
Does Information Indicating an Uplink Scheduling Request Included in an Ack/Nack Exclusive Channel Indicate "Presence"?
NO
YES
ST3302
Is a Base Station Performing Uplink Scheduling On the Same UE?
YES
NO
ST3304
ST3303
Start the Uplink Scheduling Process
Continue the Uplink Scheduling Process Currently Being Performed
"Uplink Data Resource Allocation"
ST3305
End

FIG. 34

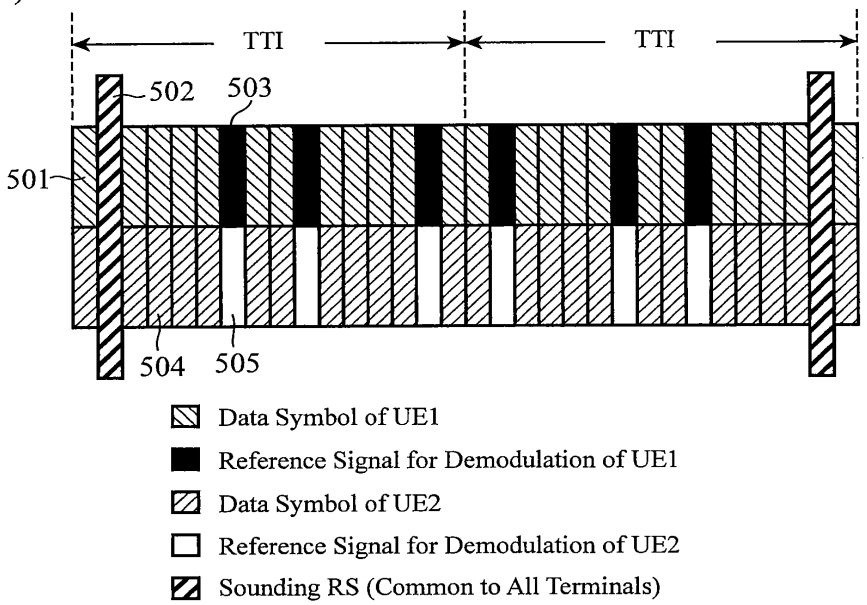


Switching Condition of Switch 3404

In the Case of Presence of Uplink Scheduling Request	Code b
In the Case of Absence of Uplink Scheduling Request	Code a

FIG.35

(a)


TTI
TTI
502
503
501
504
505
Data Symbol of UE1
Reference Signal for Demodulation of UE1
Data Symbol of UE2
Reference Signal for Demodulation of UE2
Sounding RS (Common to All Terminals)

(b)

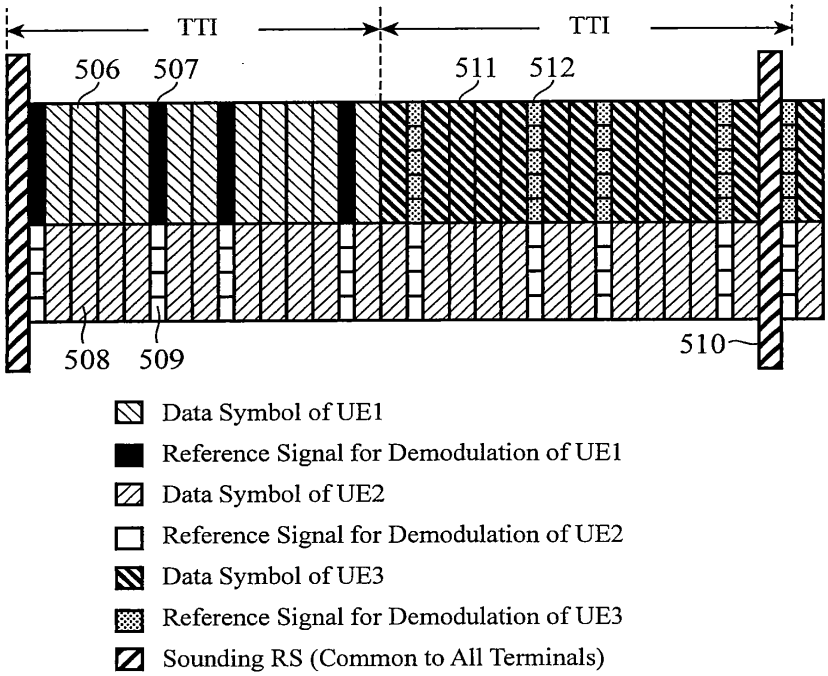

TTI
TTI
506
507
511
512
508
509
510
Data Symbol of UE1
Reference Signal for Demodulation of UE1
Data Symbol of UE2
Reference Signal for Demodulation of UE2
Data Symbol of UE3
Reference Signal for Demodulation of UE3
Sounding RS (Common to All Terminals)

FIG. 36

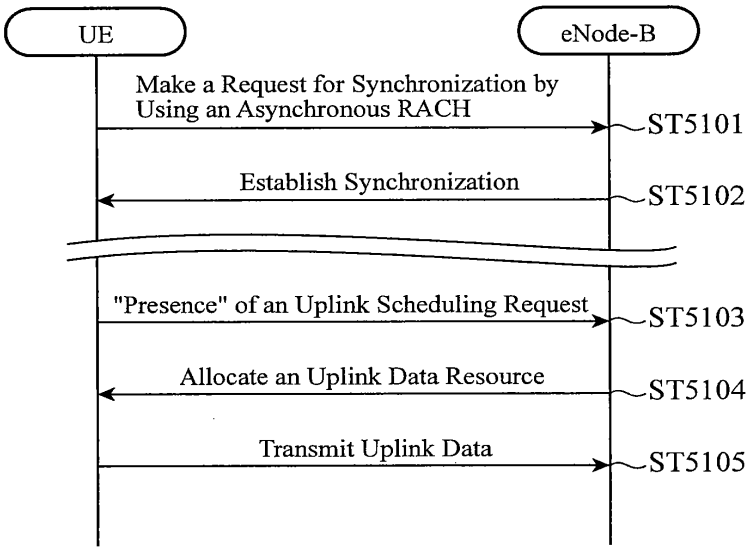

UE
eNode-B
Make a Request for Synchronization by Using an Asynchronous RACH
ST5101
Establish Synchronization
ST5102
"Presence" of an Uplink Scheduling Request
ST5103
Allocate an Uplink Data Resource
ST5104
Transmit Uplink Data
ST5105

FIG. 37

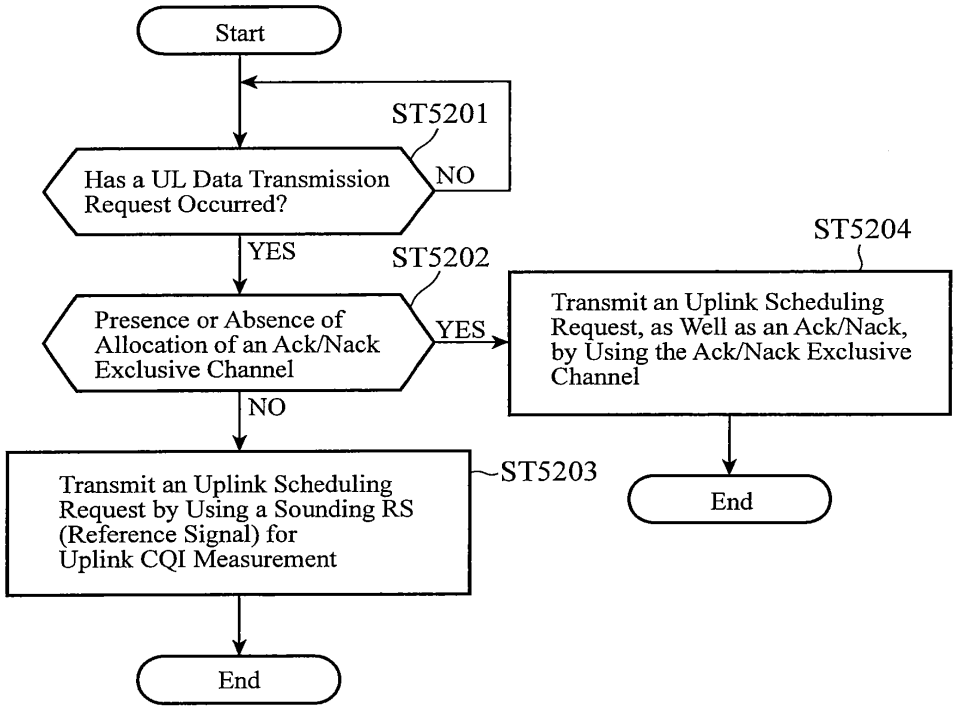

Start
ST5201
Has a UL Data Transmission Request Occurred?
NO
YES
ST5202
Presence or Absence of Allocation of an Ack/Nack Exclusive Channel
YES
NO
ST5204
Transmit an Uplink Scheduling Request, as Well as an Ack/Nack, by Using the Ack/Nack Exclusive Channel
ST5203
Transmit an Uplink Scheduling Request by Using a Sounding RS (Reference Signal) for Uplink CQI Measurement
End
End

FIG.38

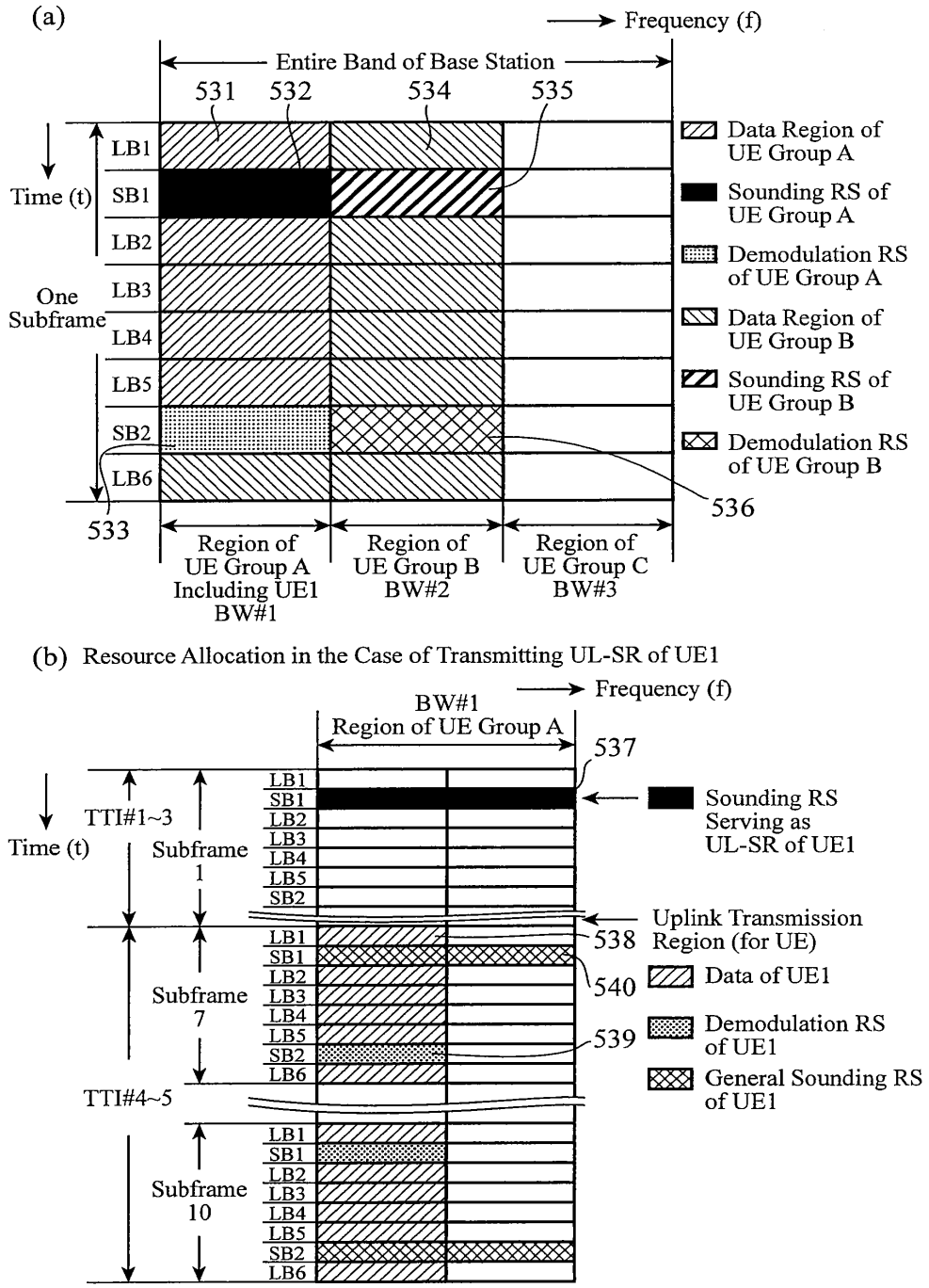

(a)
Frequency (f)
Entire Band of Base Station
531
532
534
535
Time (t)
One Subframe
LB1
SB1
LB2
LB3
LB4
LB5
SB2
LB6
533
536
Data Region of UE Group A
Sounding RS of UE Group A
Demodulation RS of UE Group A
Data Region of UE Group B
Sounding RS of UE Group B
Demodulation RS of UE Group B
Region of UE Group A Including UE1 BW#1
Region of UE Group B BW#2
Region of UE Group C BW#3
(b) Resource Allocation in the Case of Transmitting UL-SR of UE1
Frequency (f)
BW#1 Region of UE Group A
537
Time (t)
TTI#1~3
Subframe 1
Sounding RS Serving as UL-SR of UE1
Uplink Transmission Region (for UE)
538
540
539
Subframe 7
Data of UE1
Demodulation RS of UE1
General Sounding RS of UE1
TTI#4~5
Subframe 10

FIG. 39

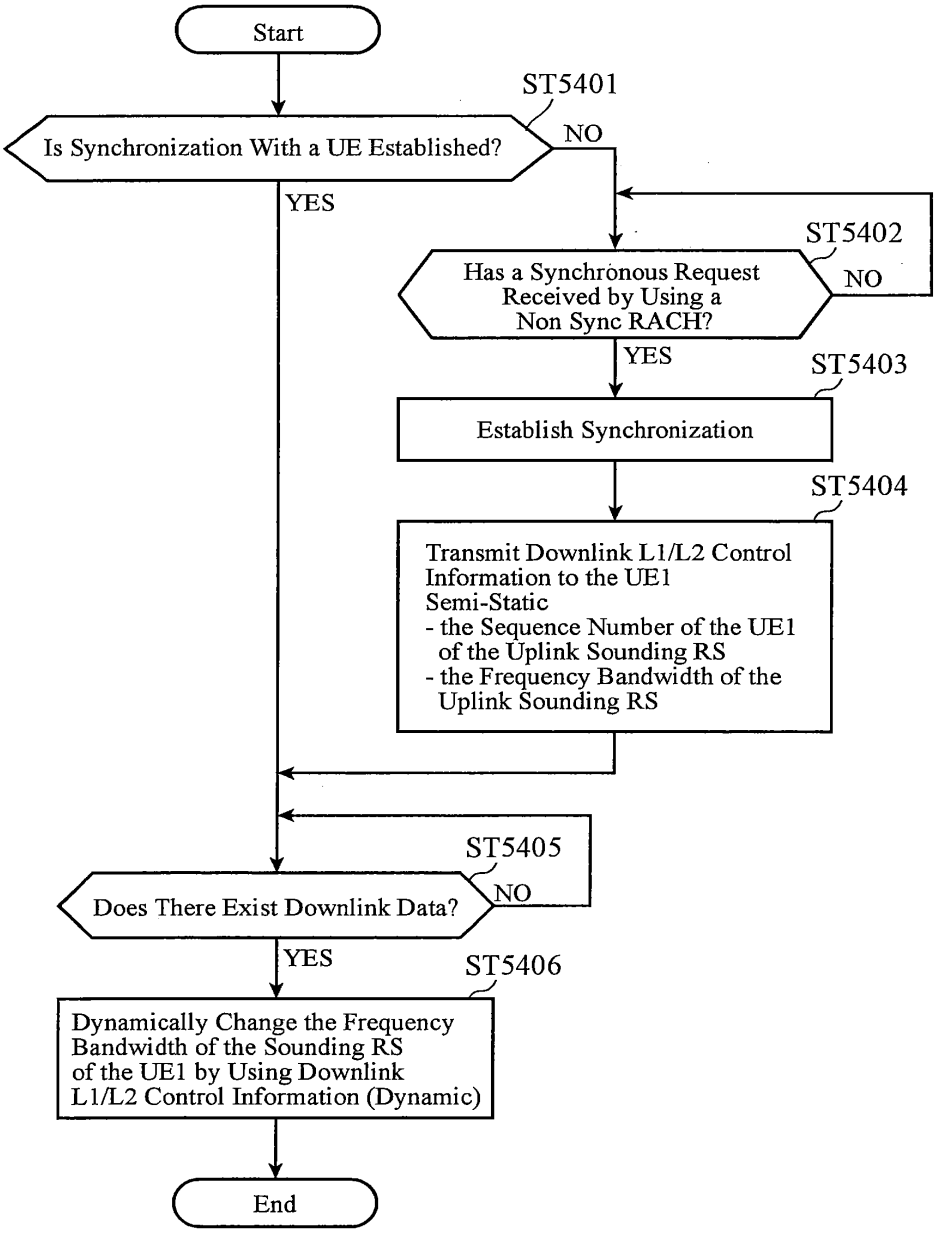

Start
ST5401
Is Synchronization With a UE Established?
NO
YES
ST5402
Has a Synchronous Request Received by Using a Non Sync RACH?
NO
YES
ST5403
Establish Synchronization
ST5404
Transmit Downlink L1/L2 Control Information to the UE1
Semi-Static
- the Sequence Number of the UE1 of the Uplink Sounding RS
- the Frequency Bandwidth of the Uplink Sounding RS
ST5405
Does There Exist Downlink Data?
NO
YES
ST5406
Dynamically Change the Frequency Bandwidth of the Sounding RS of the UE1 by Using Downlink L1/L2 Control Information (Dynamic)
End

FIG. 40

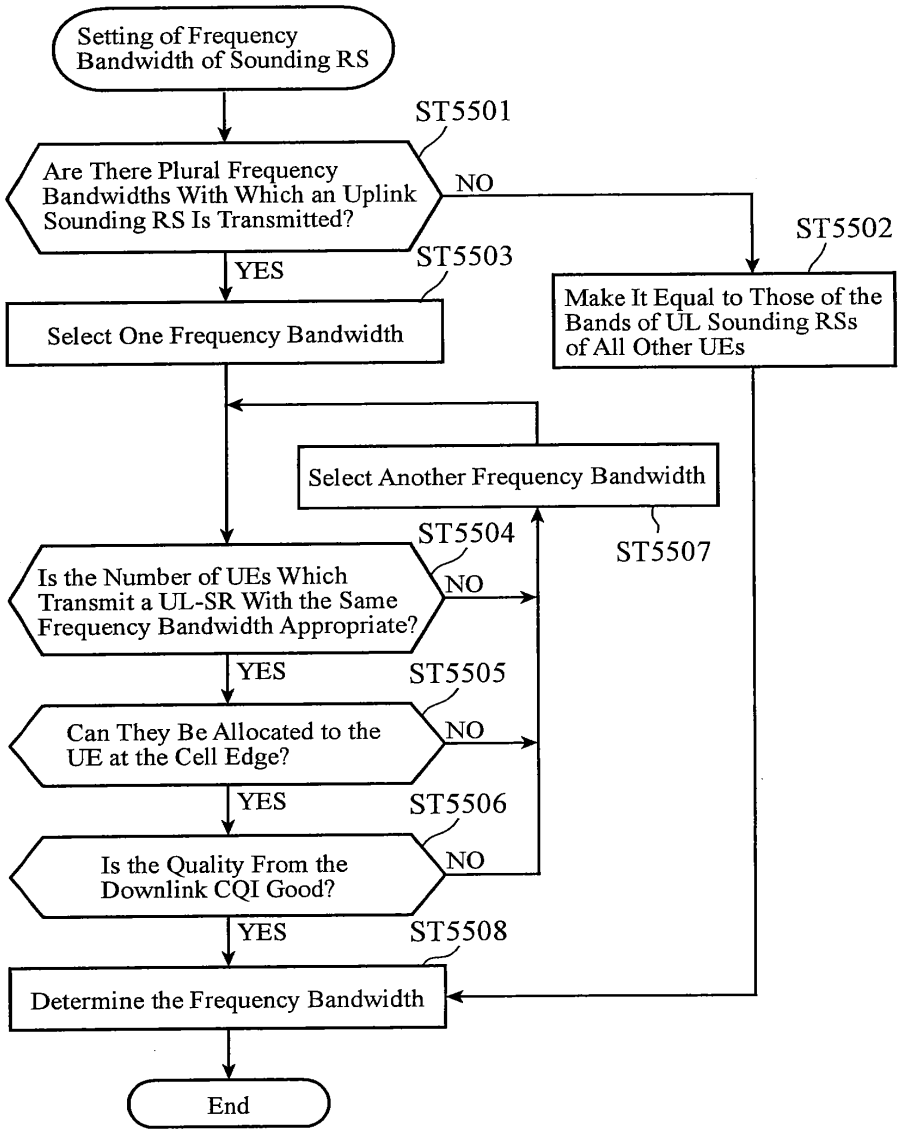

Setting of Frequency Bandwidth of Sounding RS
ST5501
Are There Plural Frequency Bandwidths With Which an Uplink Sounding RS Is Transmitted?
NO
ST5502
Make It Equal to Those of the Bands of UL Sounding RSs of All Other UEs
YES
ST5503
Select One Frequency Bandwidth
Select Another Frequency Bandwidth
ST5507
ST5504
Is the Number of UEs Which Transmit a UL-SR With the Same Frequency Bandwidth Appropriate?
NO
YES
ST5505
Can They Be Allocated to the UE at the Cell Edge?
NO
YES
ST5506
Is the Quality From the Downlink CQI Good?
NO
YES
ST5508
Determine the Frequency Bandwidth
End

FIG. 41

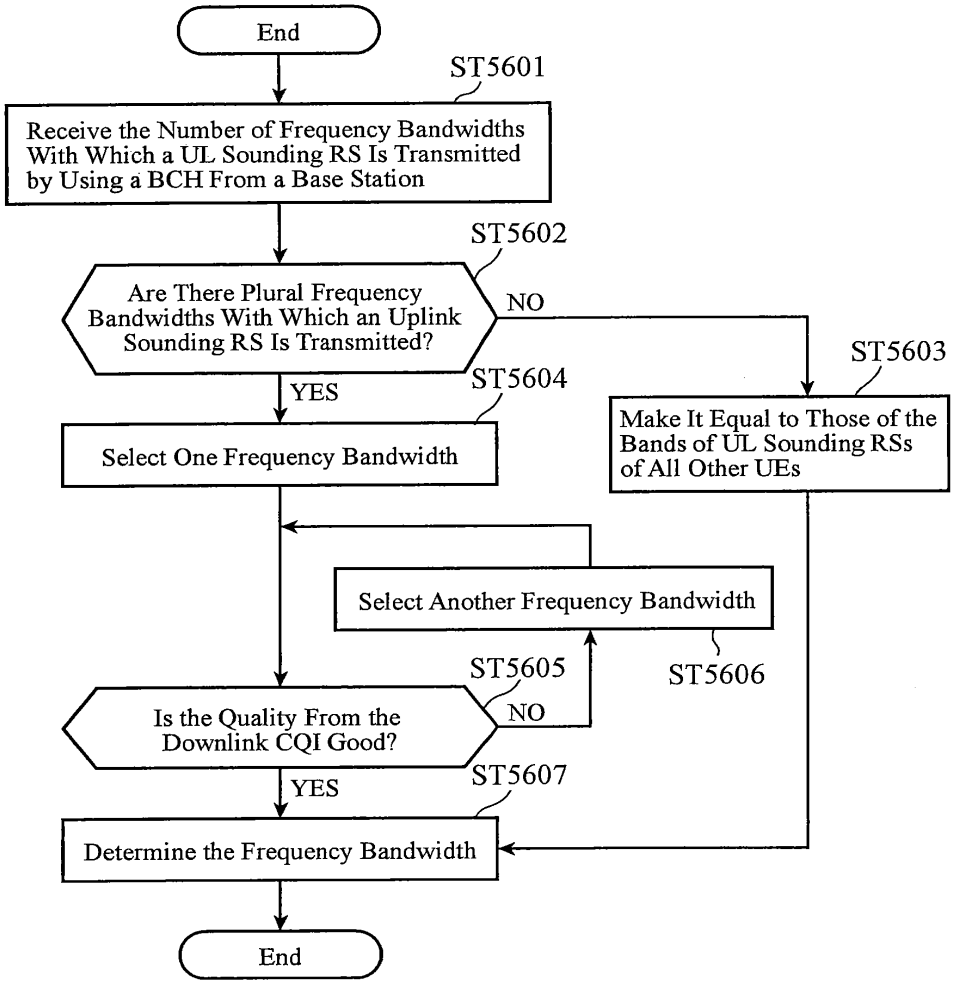

End
ST5601
Receive the Number of Frequency Bandwidths With Which a UL Sounding RS Is Transmitted by Using a BCH From a Base Station
ST5602
Are There Plural Frequency Bandwidths With Which an Uplink Sounding RS Is Transmitted?
NO
ST5603
YES
ST5604
Make It Equal to Those of the Bands of UL Sounding RSs of All Other UEs
Select One Frequency Bandwidth
Select Another Frequency Bandwidth
ST5605
ST5606
Is the Quality From the Downlink CQI Good?
NO
YES
ST5607
Determine the Frequency Bandwidth
End

FIG.42

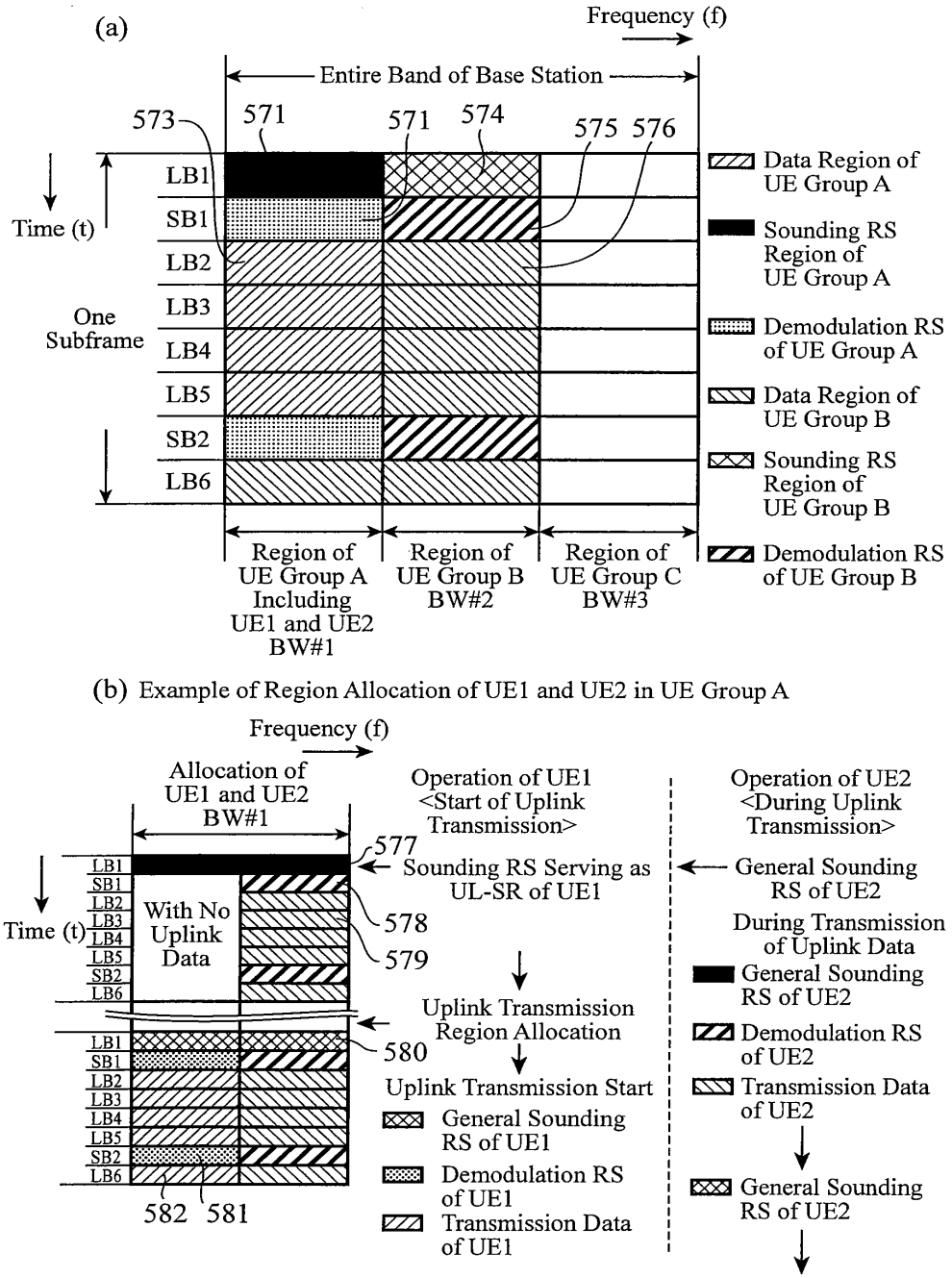

(a)
Frequency (f)
Entire Band of Base Station
573
571
571
574
575
576
Time (t)
One Subframe
LB1
SB1
LB2
LB3
LB4
LB5
SB2
LB6
Data Region of UE Group A
Sounding RS Region of UE Group A
Demodulation RS of UE Group A
Data Region of UE Group B
Sounding RS Region of UE Group B
Demodulation RS of UE Group B
Region of UE Group A Including UE1 and UE2 BW#1
Region of UE Group B BW#2
Region of UE Group C BW#3
(b) Example of Region Allocation of UE1 and UE2 in UE Group A
Frequency (f)
Allocation of UE1 and UE2 BW#1
Time (t)
With No Uplink Data
577
578
579
580
582
581
Operation of UE1 <Start of Uplink Transmission>
Sounding RS Serving as UL-SR of UE1
Uplink Transmission Region Allocation
Uplink Transmission Start
General Sounding RS of UE1
Demodulation RS of UE1
Transmission Data of UE1
Operation of UE2 <During Uplink Transmission>
General Sounding RS of UE2
During Transmission of Uplink Data
General Sounding RS of UE2
Demodulation RS of UE2
Transmission Data of UE2
General Sounding RS of UE2

FIG.43

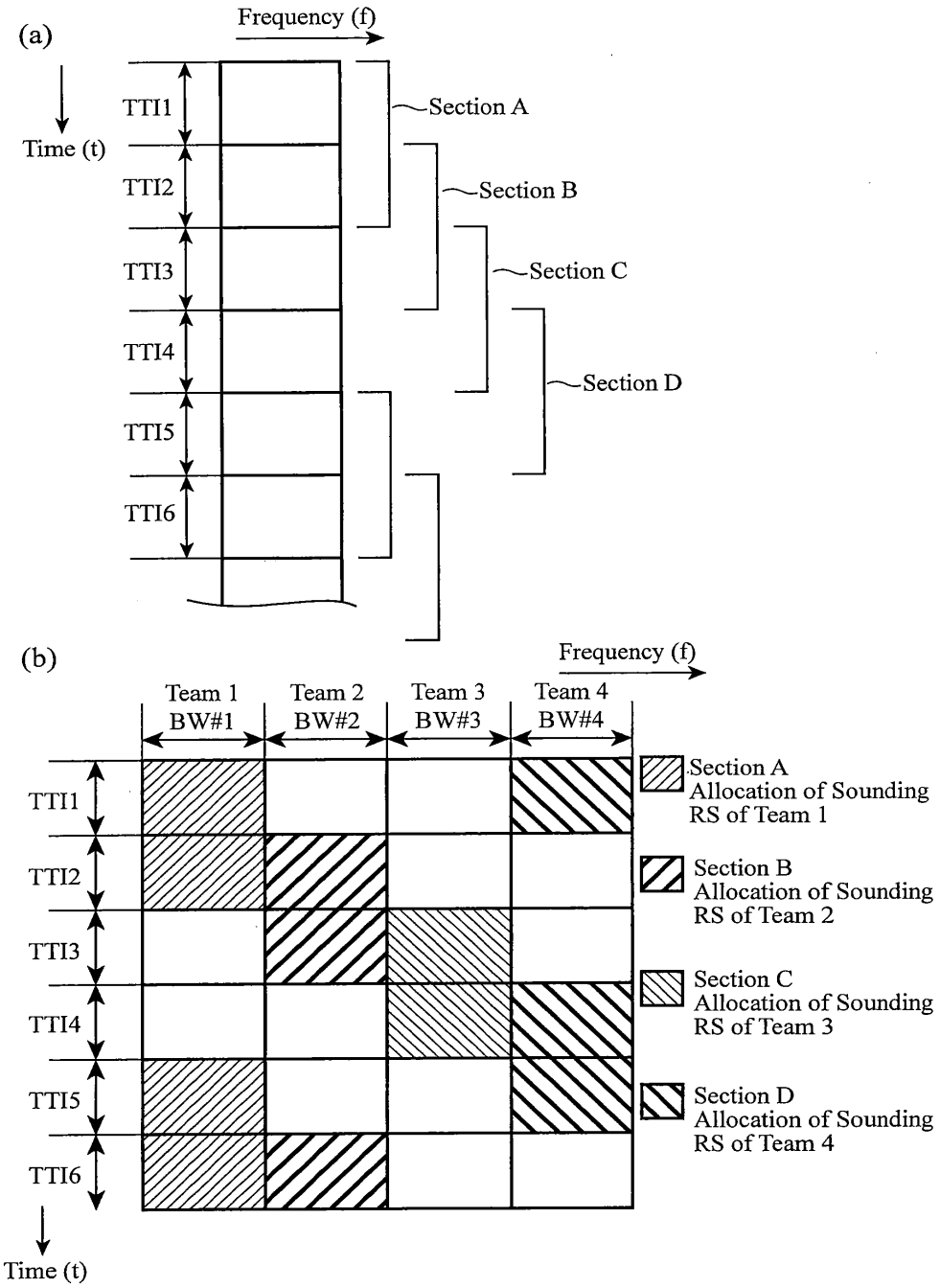
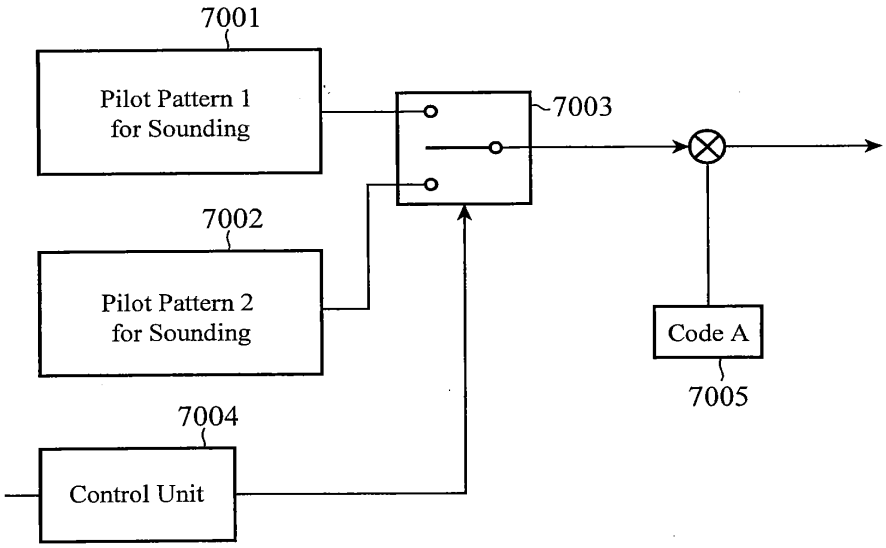

(a)
Frequency (f)
Time (t)
TTI1
TTI2
TTI3
TTI4
TTI5
TTI6
Section A
Section B
Section C
Section D
(b)
Frequency (f)
Team 1
BW#1
Team 2
BW#2
Team 3
BW#3
Team 4
BW#4
TTI1
TTI2
TTI3
TTI4
TTI5
TTI6
Time (t)
Section A
Allocation of Sounding
RS of Team 1
Section B
Allocation of Sounding
RS of Team 2
Section C
Allocation of Sounding
RS of Team 3
Section D
Allocation of Sounding
RS of Team 4

FIG. 44



Uplink Scheduling Request	Pilot Pattern for Sounding
Absence	Pattern 1
Presence	Pattern 2

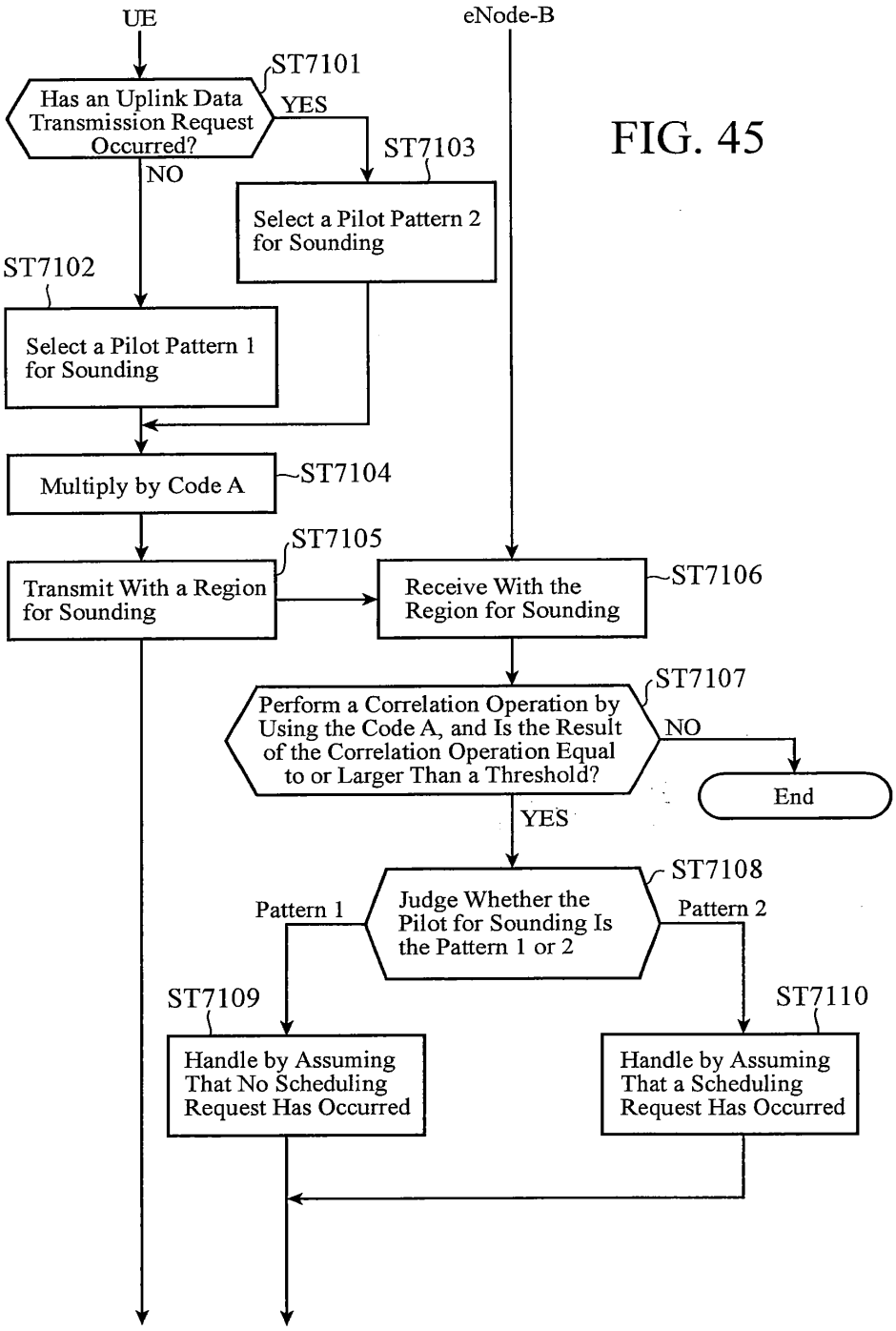

UE
eNode-B
ST7101
Has an Uplink Data Transmission Request Occurred?
YES
NO
ST7103
Select a Pilot Pattern 2 for Sounding
ST7102
Select a Pilot Pattern 1 for Sounding
Multiply by Code A
ST7104
ST7105
Transmit With a Region for Sounding
Receive With the Region for Sounding
ST7106
ST7107
Perform a Correlation Operation by Using the Code A, and Is the Result of the Correlation Operation Equal to or Larger Than a Threshold?
NO
End
YES
ST7108
Pattern 1
Judge Whether the Pilot for Sounding Is the Pattern 1 or 2
Pattern 2
ST7109
ST7110
Handle by Assuming That No Scheduling Request Has Occurred
Handle by Assuming That a Scheduling Request Has Occurred

FIG. 45

FIG. 46

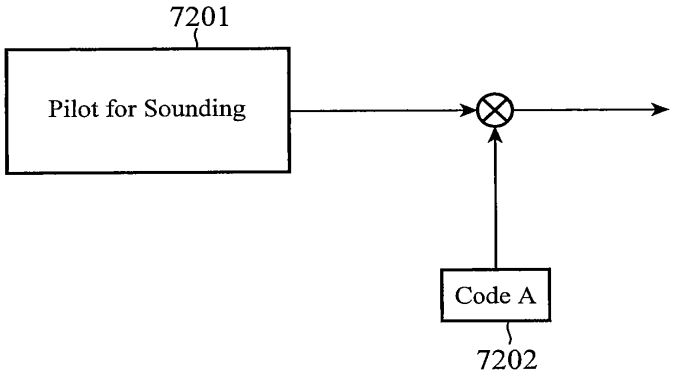
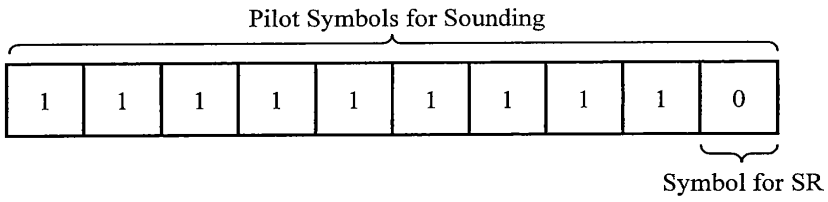


FIG. 47



Uplink Scheduling Request	Symbol for SR
Absence	1
Presence	0

FIG. 48

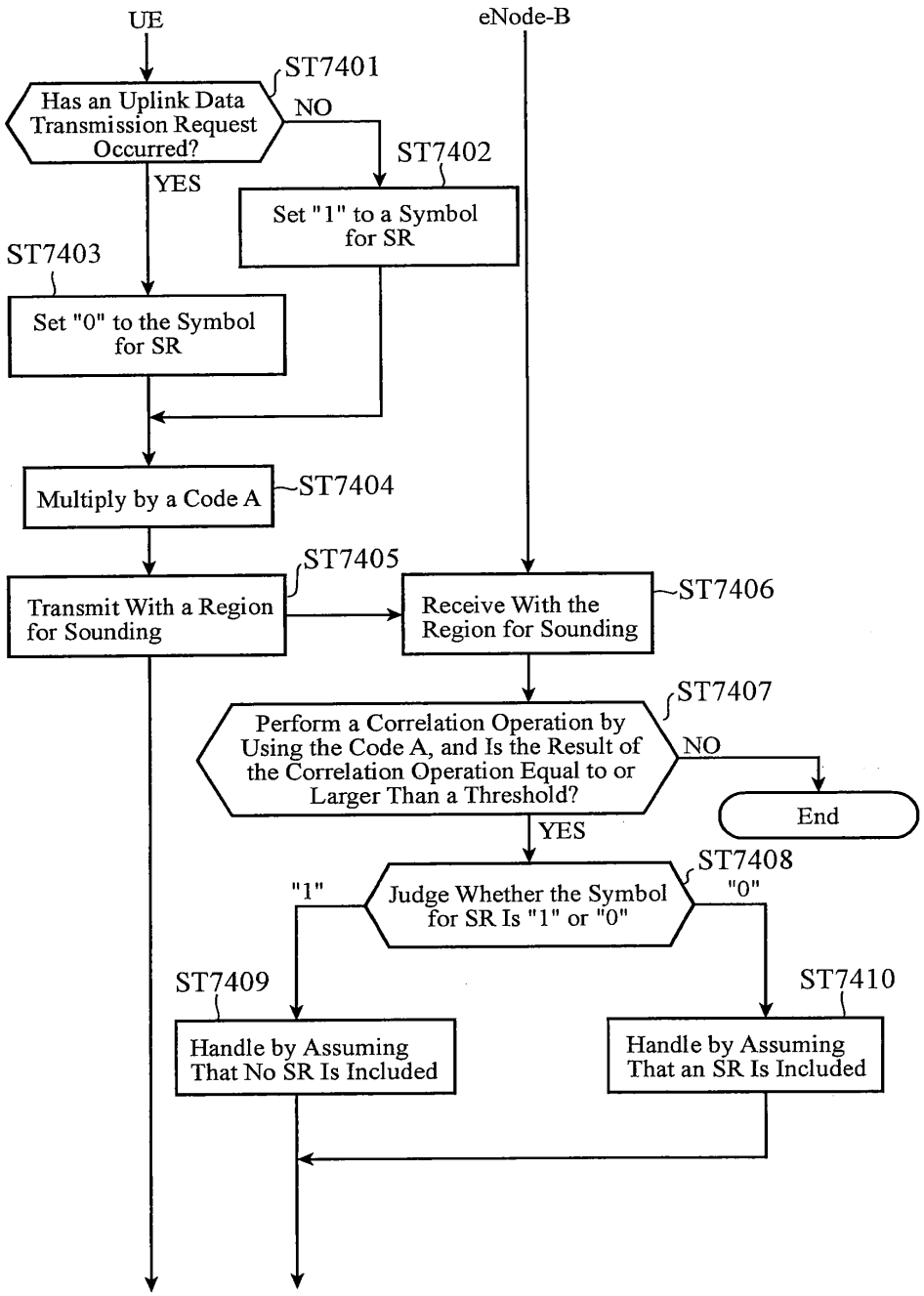
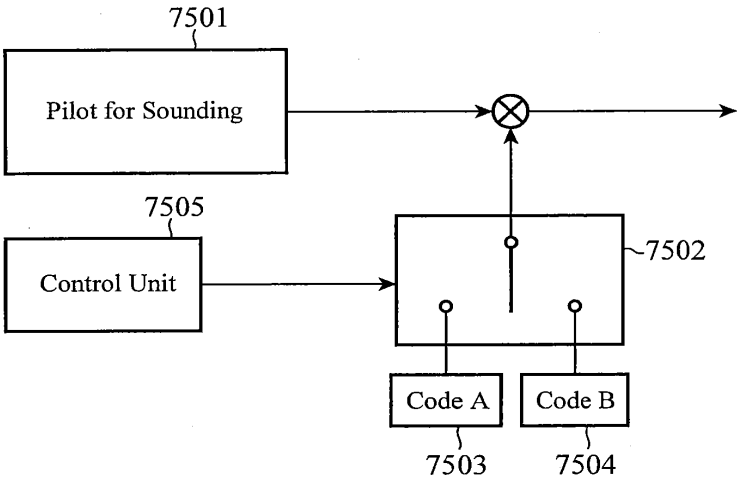

UE
eNode-B
ST7401
Has an Uplink Data Transmission Request Occurred?
NO
YES
ST7402
Set "1" to a Symbol for SR
ST7403
Set "0" to the Symbol for SR
Multiply by a Code A
ST7404
ST7405
Transmit With a Region for Sounding
Receive With the Region for Sounding
ST7406
ST7407
Perform a Correlation Operation by Using the Code A, and Is the Result of the Correlation Operation Equal to or Larger Than a Threshold?
NO
End
YES
ST7408
"1"
Judge Whether the Symbol for SR Is "1" or "0"
"0"
ST7409
ST7410
Handle by Assuming That No SR Is Included
Handle by Assuming That an SR Is Included

FIG. 49



Uplink Scheduling Request	Code for UE Identification
Absence	Code A
Presence	Code B

FIG. 50

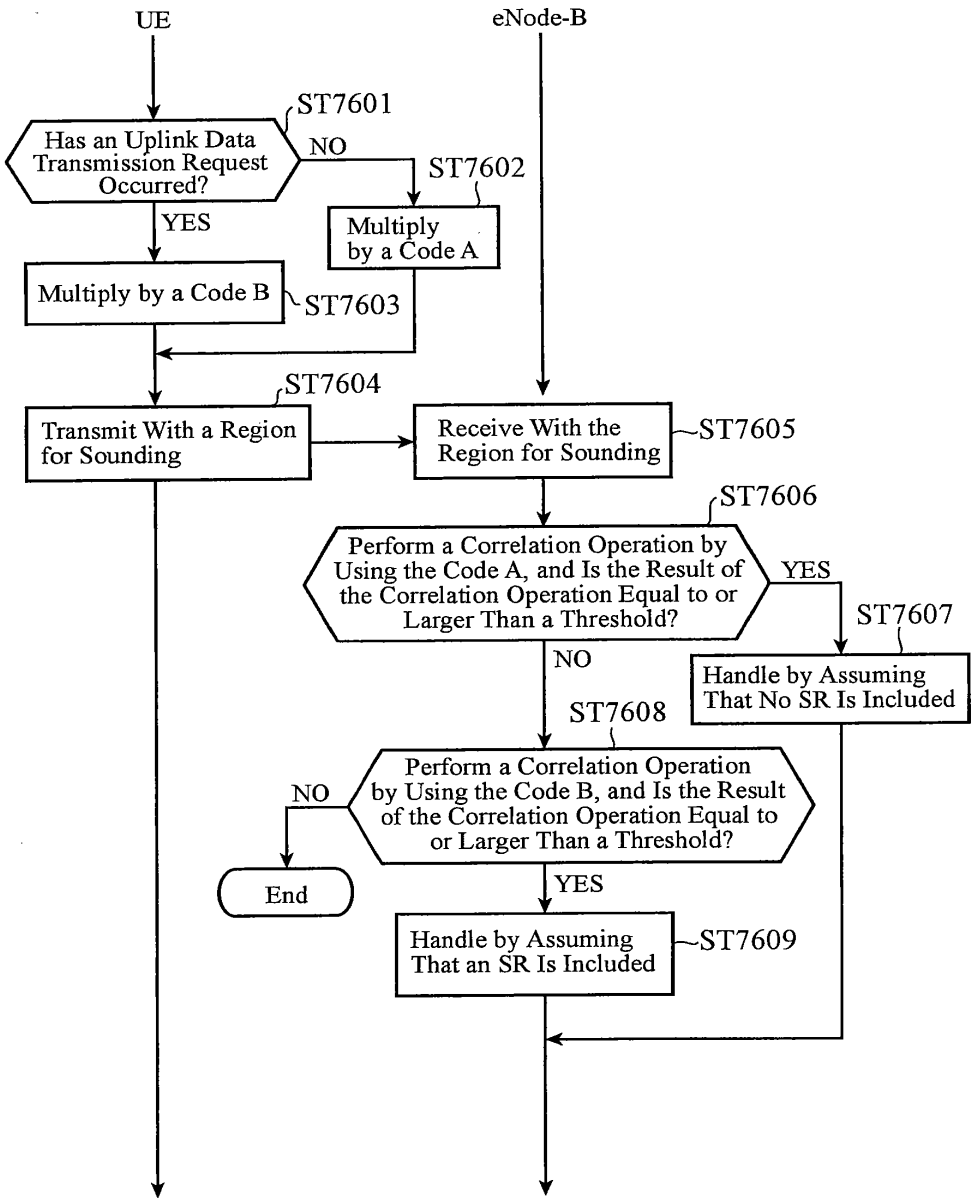
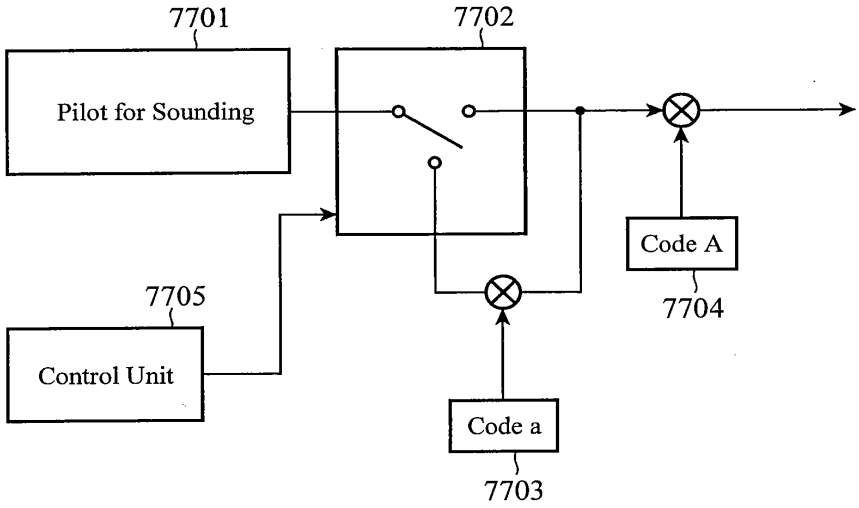

UE
eNode-B
ST7601
Has an Uplink Data Transmission Request Occurred?
NO
ST7602
Multiply by a Code A
YES
Multiply by a Code B
ST7603
ST7604
Transmit With a Region for Sounding
Receive With the Region for Sounding
ST7605
ST7606
Perform a Correlation Operation by Using the Code A, and Is the Result of the Correlation Operation Equal to or Larger Than a Threshold?
YES
ST7607
Handle by Assuming That No SR Is Included
NO
ST7608
Perform a Correlation Operation by Using the Code B, and Is the Result of the Correlation Operation Equal to or Larger Than a Threshold?
NO
End
YES
Handle by Assuming That an SR Is Included
ST7609

FIG. 51



Uplink Scheduling Request	Code for SR Presence or Absence Identification
Absence	————
Presence	Code a

FIG. 52

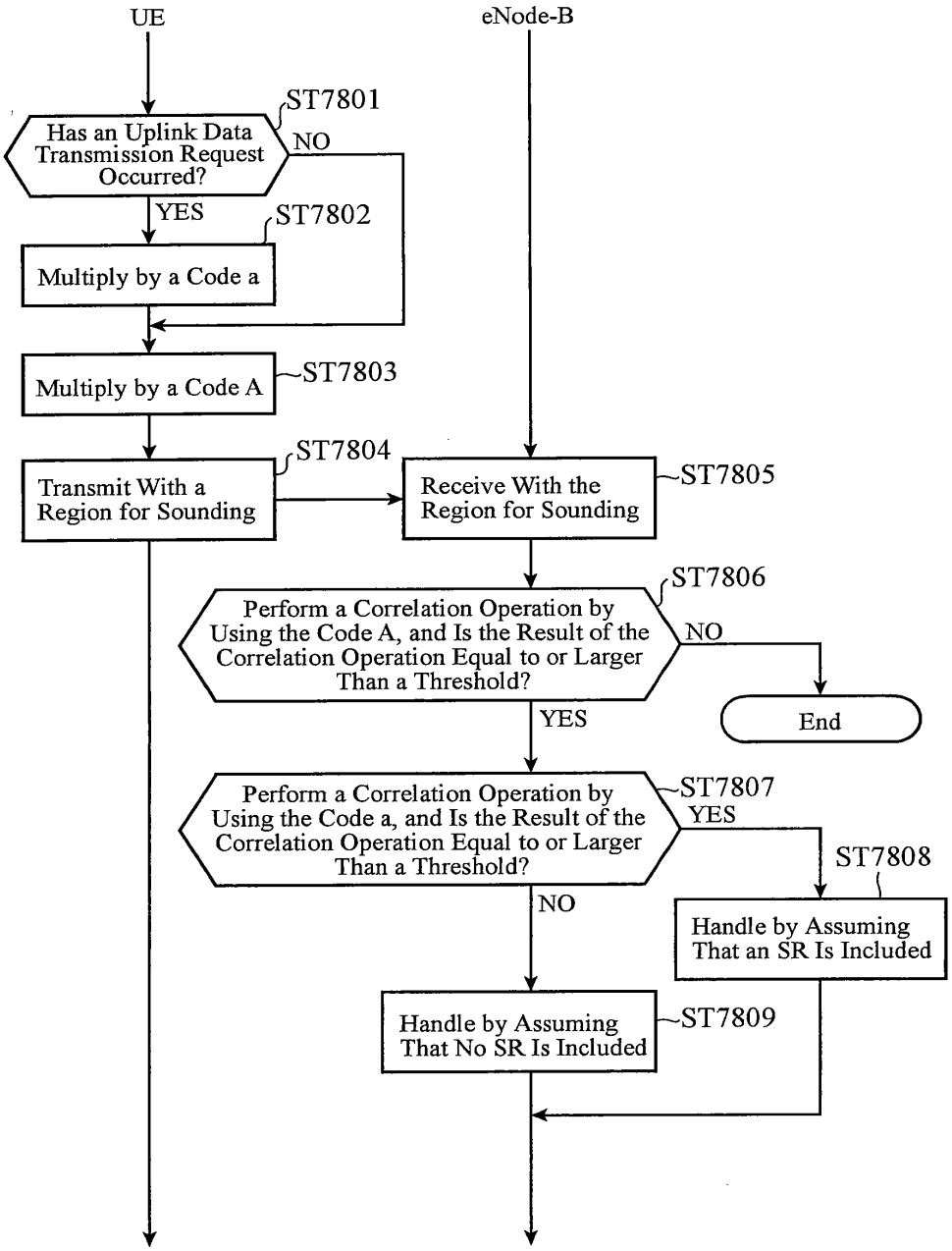

UE
eNode-B
ST7801
Has an Uplink Data Transmission Request Occurred?
NO
YES
ST7802
Multiply by a Code a
Multiply by a Code A
ST7803
ST7804
Transmit With a Region for Sounding
Receive With the Region for Sounding
ST7805
ST7806
Perform a Correlation Operation by Using the Code A, and Is the Result of the Correlation Operation Equal to or Larger Than a Threshold?
NO
End
YES
Perform a Correlation Operation by Using the Code a, and Is the Result of the Correlation Operation Equal to or Larger Than a Threshold?
ST7807
YES
ST7808
Handle by Assuming That an SR Is Included
NO
Handle by Assuming That No SR Is Included
ST7809

FIG.53

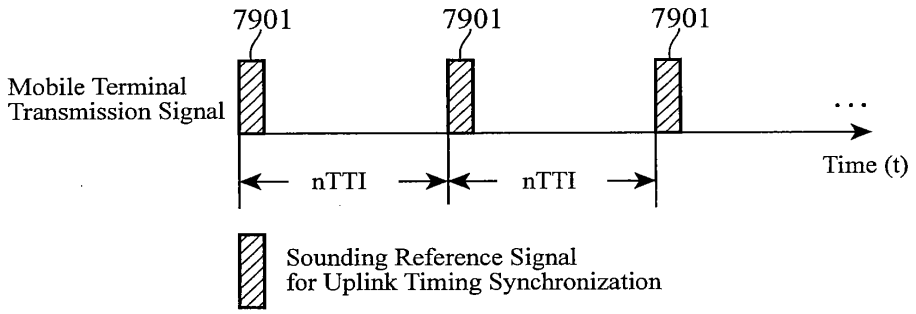

7901
7901
7901
Mobile Terminal
Transmission Signal
...
Time (t)
nTTI
nTTI
Sounding Reference Signal
for Uplink Timing Synchronization

FIG.54

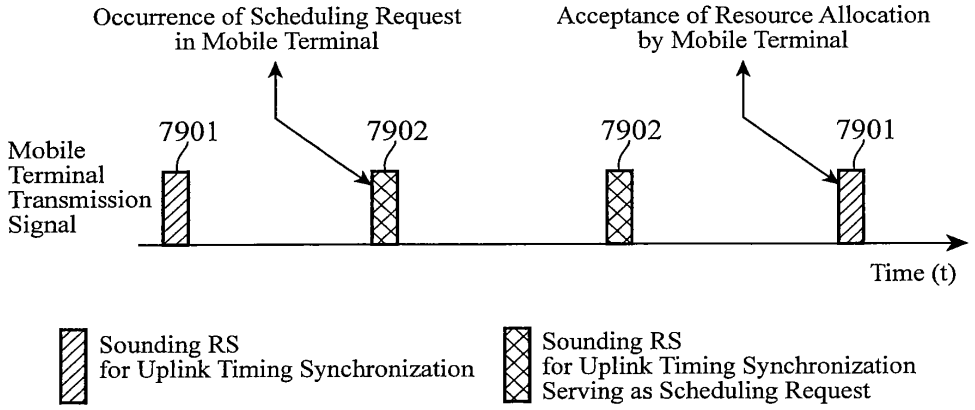

Occurrence of Scheduling Request
in Mobile Terminal
Acceptance of Resource Allocation
by Mobile Terminal
7901
7902
7902
7901
Mobile
Terminal
Transmission
Signal
Time (t)
Sounding RS
for Uplink Timing Synchronization
Sounding RS
for Uplink Timing Synchronization
Serving as Scheduling Request

FIG.55

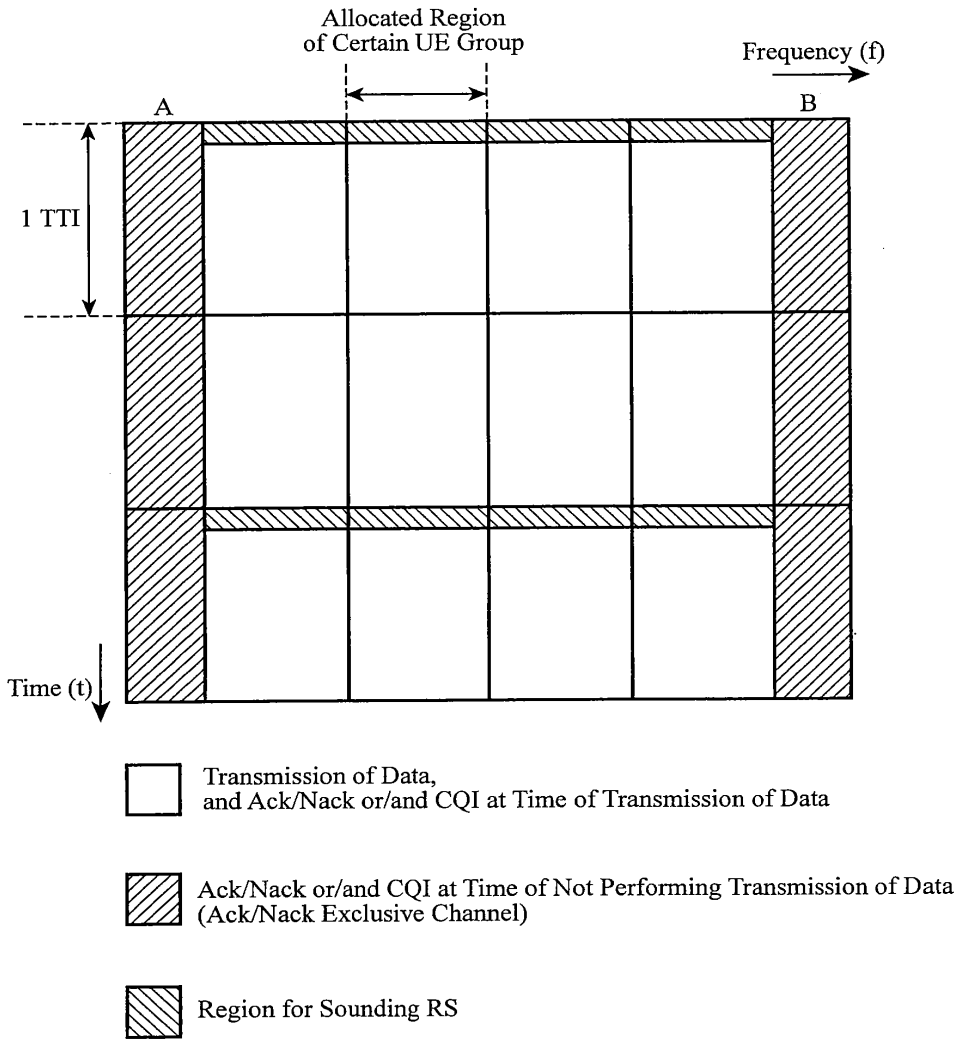

Allocated Region
of Certain UE Group
Frequency (f)
A
B
1 TTI
Time (t)
Transmission of Data,
and Ack/Nack or/and CQI at Time of Transmission of Data
Ack/Nack or/and CQI at Time of Not Performing Transmission of Data
(Ack/Nack Exclusive Channel)
Region for Sounding RS

FIG.56

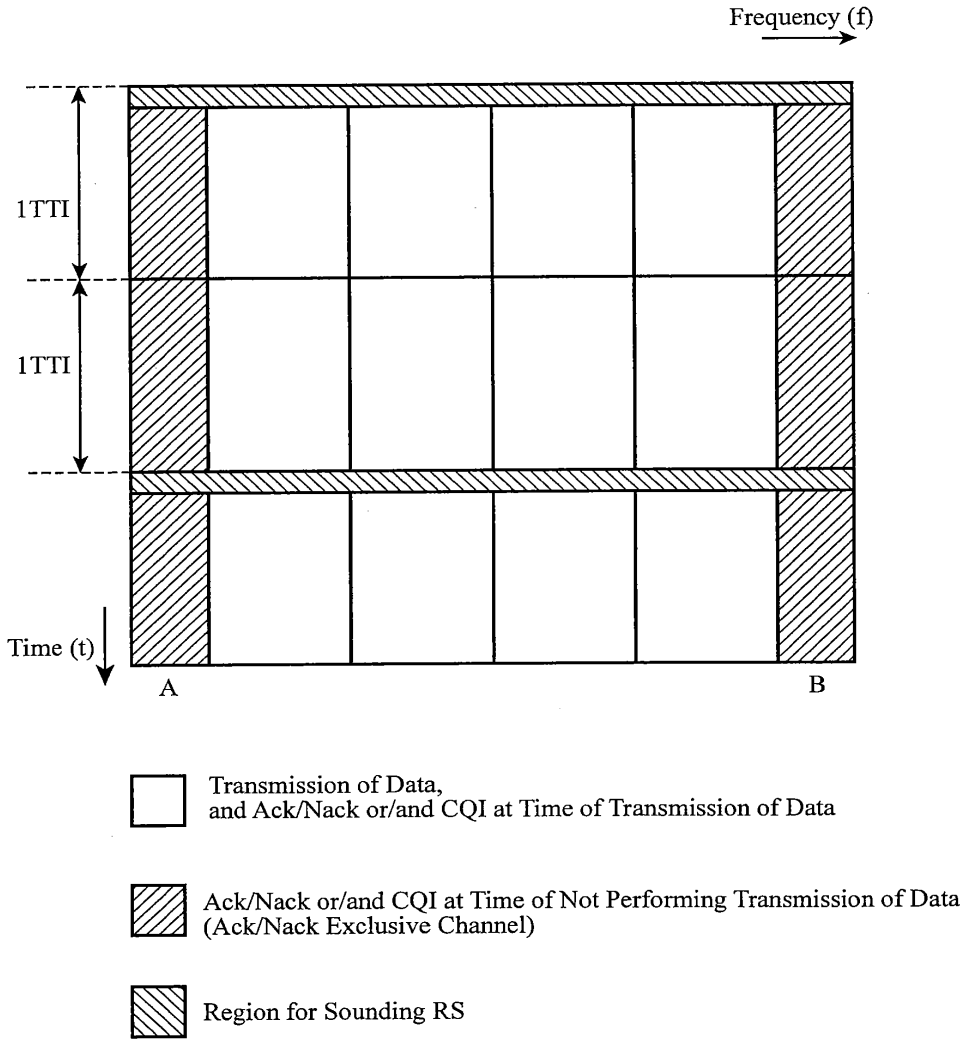

Frequency (f)
1TTI
1TTI
Time (t)
A
B
Transmission of Data,
and Ack/Nack or/and CQI at Time of Transmission of Data
Ack/Nack or/and CQI at Time of Not Performing Transmission of Data
(Ack/Nack Exclusive Channel)
Region for Sounding RS

FIG.57

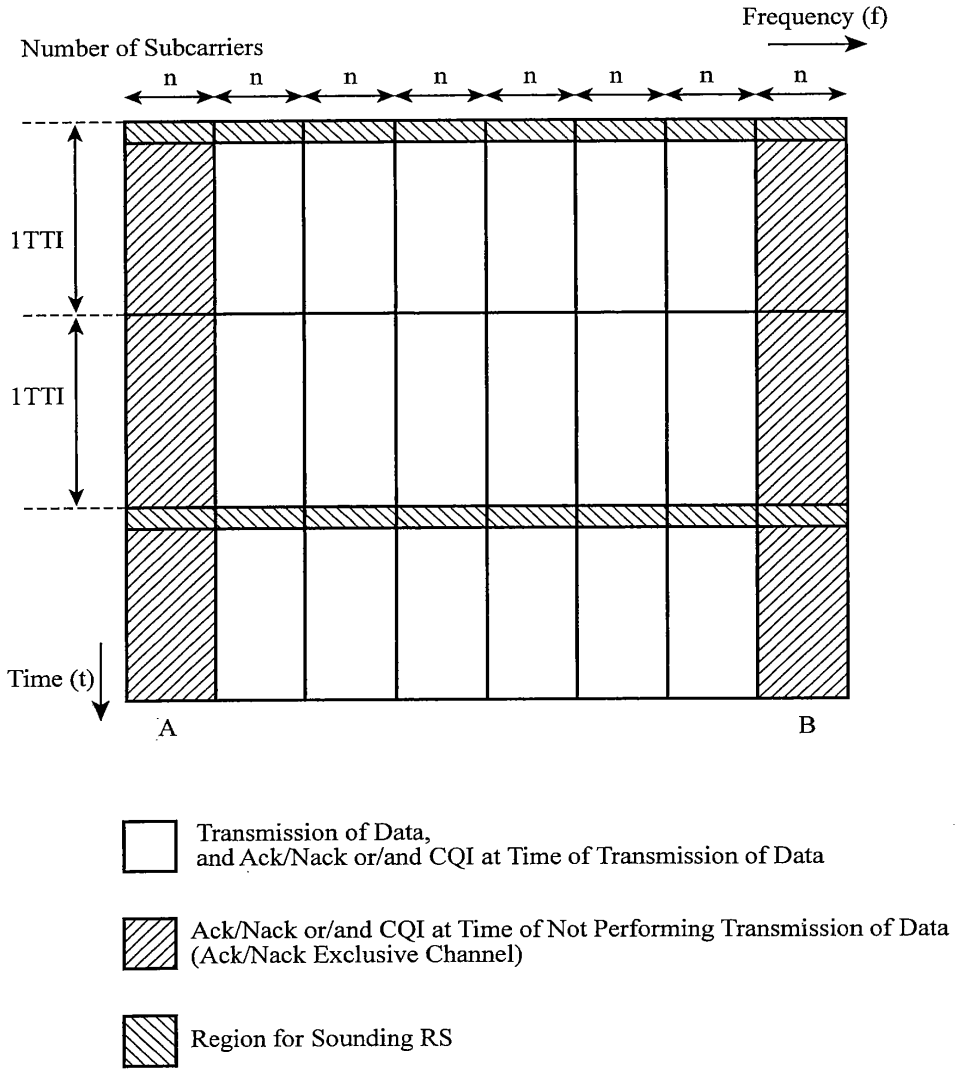

Frequency (f)
Number of Subcarriers
n
n
n
n
n
n
n
n
1TTI
1TTI
Time (t)
A
B
Transmission of Data,
and Ack/Nack or/and CQI at Time of Transmission of Data
Ack/Nack or/and CQI at Time of Not Performing Transmission of Data
(Ack/Nack Exclusive Channel)
Region for Sounding RS

FIG.58

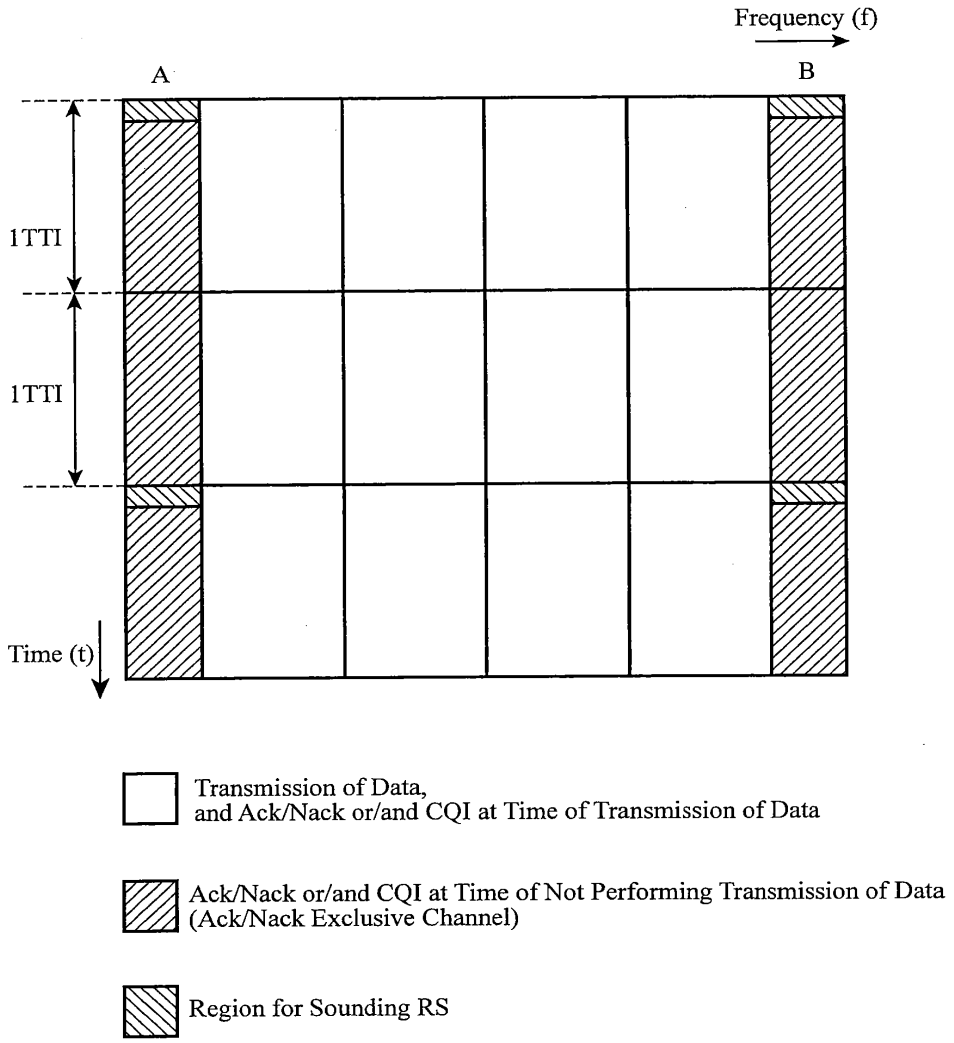

Frequency (f)
A
B
1TTI
1TTI
Time (t)
Transmission of Data,
and Ack/Nack or/and CQI at Time of Transmission of Data
Ack/Nack or/and CQI at Time of Not Performing Transmission of Data
(Ack/Nack Exclusive Channel)
Region for Sounding RS

FIG.59

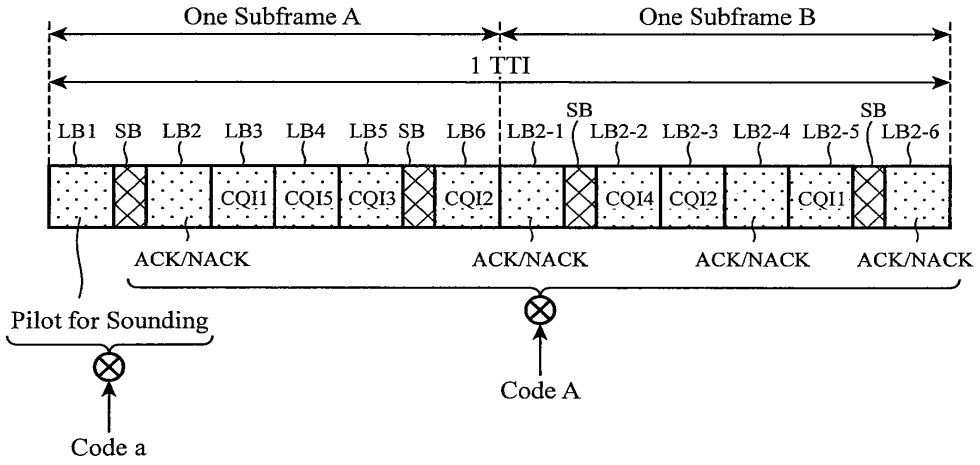

One Subframe A
One Subframe B
1 TTI
LB1
SB
LB2
LB3
LB4
LB5
SB
LB6
LB2-1
SB
LB2-2
LB2-3
LB2-4
LB2-5
SB
LB2-6
CQI1
CQI5
CQI3
CQI2
CQI4
CQI2
CQI1
ACK/NACK
ACK/NACK
ACK/NACK
ACK/NACK
Pilot for Sounding
Code a
Code A

FIG.60

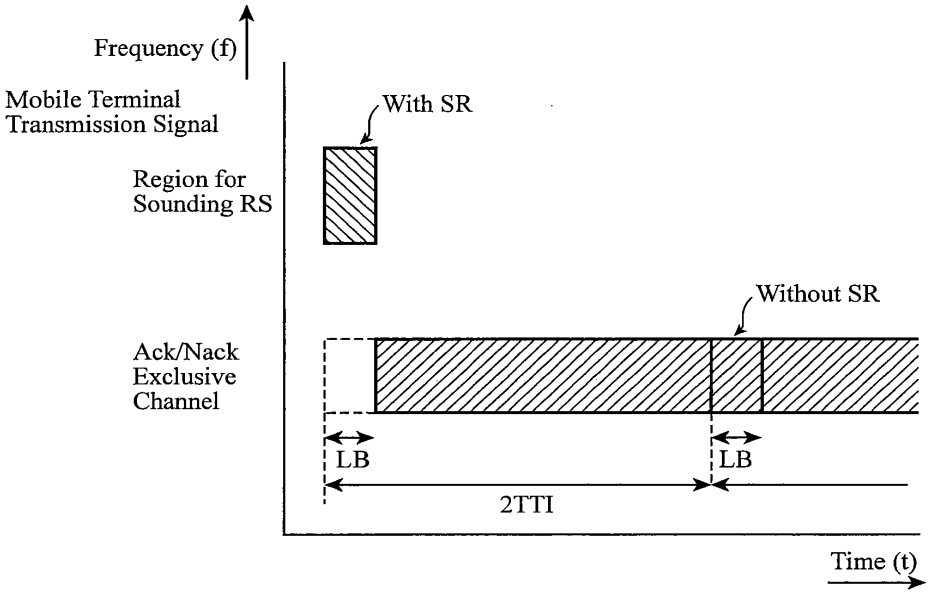

Frequency (f)
Mobile Terminal Transmission Signal
With SR
Region for Sounding RS
Without SR
Ack/Nack Exclusive Channel
LB
LB
2TTI
Time (t)

FIG.61

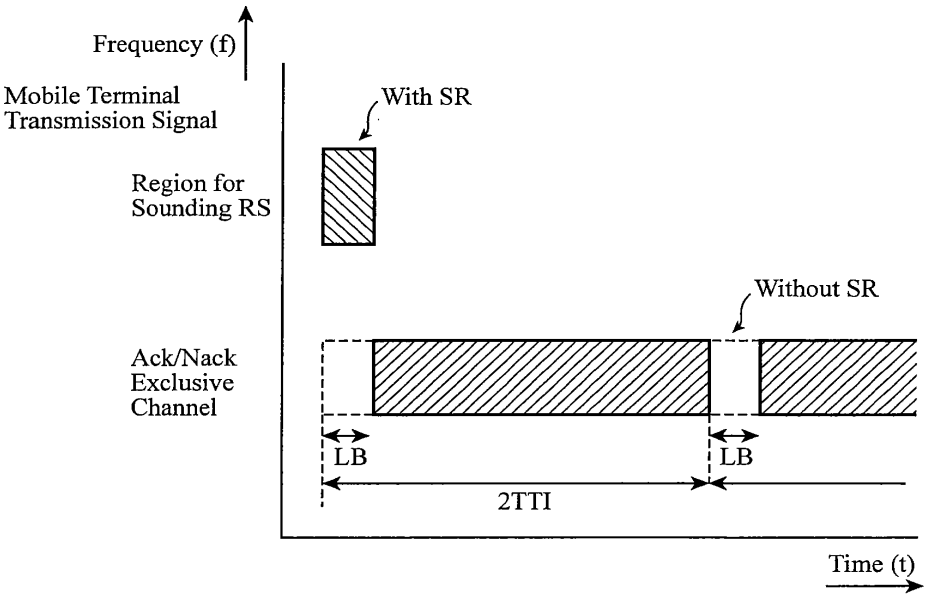

Frequency (f)
Mobile Terminal Transmission Signal
With SR
Region for Sounding RS
Without SR
Ack/Nack Exclusive Channel
LB
LB
2TTI
Time (t)

FIG. 62

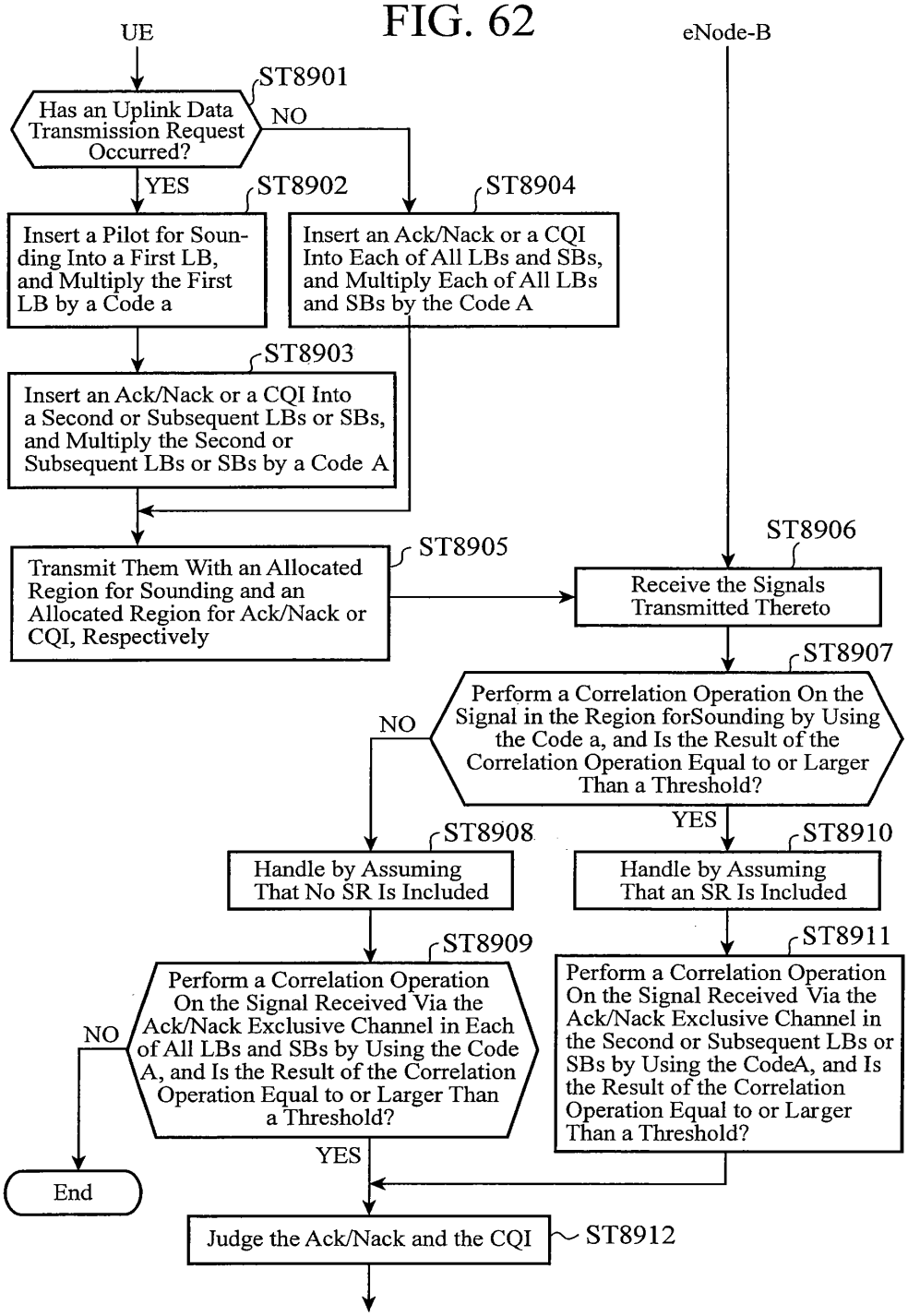

UE
eNode-B
ST8901
Has an Uplink Data Transmission Request Occurred?
NO
YES
ST8902
Insert a Pilot for Sounding Into a First LB, and Multiply the First LB by a Code a
ST8904
Insert an Ack/Nack or a CQI Into Each of All LBs and SBs, and Multiply Each of All LBs and SBs by the Code A
ST8903
Insert an Ack/Nack or a CQI Into a Second or Subsequent LBs or SBs, and Multiply the Second or Subsequent LBs or SBs by a Code A
ST8905
Transmit Them With an Allocated Region for Sounding and an Allocated Region for Ack/Nack or CQI, Respectively
ST8906
Receive the Signals Transmitted Thereto
ST8907
Perform a Correlation Operation On the Signal in the Region forSounding by Using the Code a, and Is the Result of the Correlation Operation Equal to or Larger Than a Threshold?
NO
YES
ST8908
Handle by Assuming That No SR Is Included
ST8910
Handle by Assuming That an SR Is Included
ST8909
Perform a Correlation Operation On the Signal Received Via the Ack/Nack Exclusive Channel in Each of All LBs and SBs by Using the Code A, and Is the Result of the Correlation Operation Equal to or Larger Than a Threshold?
NO
ST8911
Perform a Correlation Operation On the Signal Received Via the Ack/Nack Exclusive Channel in the Second or Subsequent LBs or SBs by Using the CodeA, and Is the Result of the Correlation Operation Equal to or Larger Than a Threshold?
YES
End
Judge the Ack/Nack and the CQI
ST8912

FIG.63

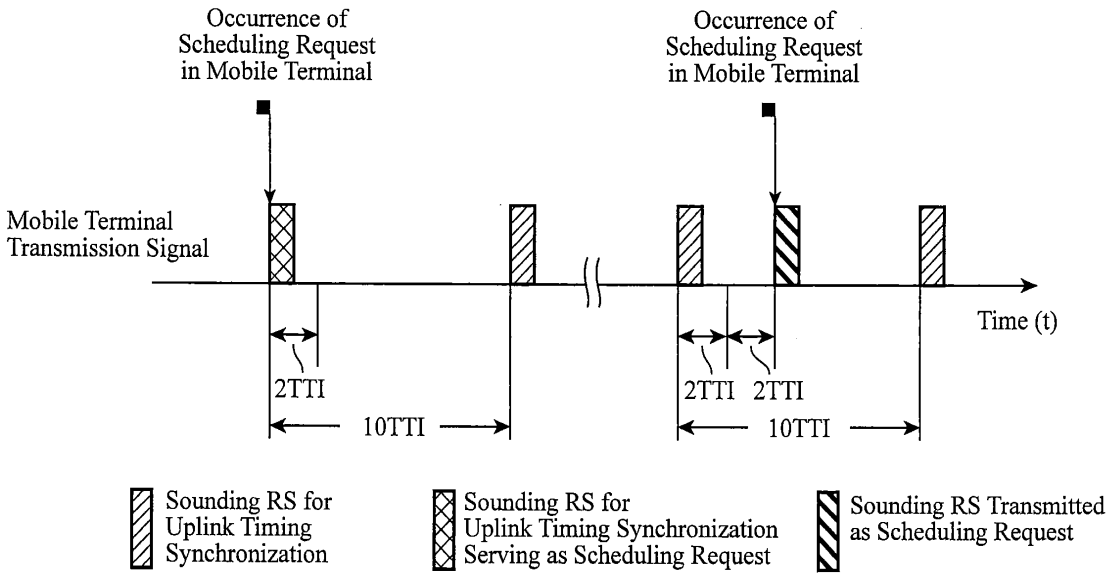

Occurrence of Scheduling Request in Mobile Terminal
Occurrence of Scheduling Request in Mobile Terminal
Mobile Terminal Transmission Signal
Time (t)
2TTI
10TTI
2TTI
2TTI
10TTI
Sounding RS for Uplink Timing Synchronization
Sounding RS for Uplink Timing Synchronization Serving as Scheduling Request
Sounding RS Transmitted as Scheduling Request

FIG. 64

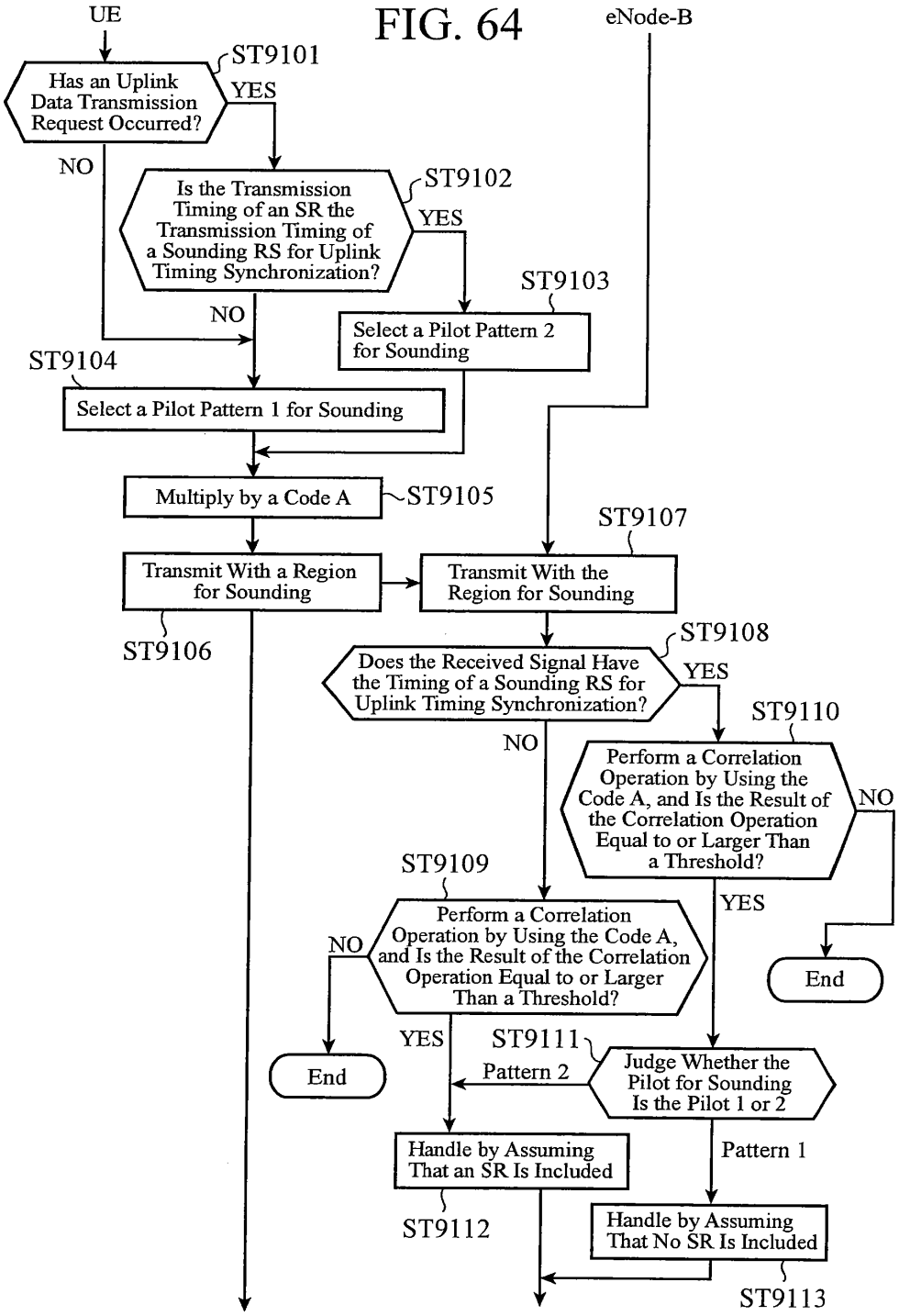

UE
eNode-B
ST9101
Has an Uplink Data Transmission Request Occurred?
YES
NO
ST9102
Is the Transmission Timing of an SR the Transmission Timing of a Sounding RS for Uplink Timing Synchronization?
YES
NO
ST9103
Select a Pilot Pattern 2 for Sounding
ST9104
Select a Pilot Pattern 1 for Sounding
Multiply by a Code A
ST9105
ST9107
Transmit With a Region for Sounding
Transmit With the Region for Sounding
ST9106
ST9108
Does the Received Signal Have the Timing of a Sounding RS for Uplink Timing Synchronization?
YES
NO
ST9110
Perform a Correlation Operation by Using the Code A, and Is the Result of the Correlation Operation Equal to or Larger Than a Threshold?
NO
YES
End
ST9109
Perform a Correlation Operation by Using the Code A, and Is the Result of the Correlation Operation Equal to or Larger Than a Threshold?
NO
End
YES
ST9111
Pattern 2
Judge Whether the Pilot for Sounding Is the Pilot 1 or 2
Handle by Assuming That an SR Is Included
Pattern 1
ST9112
Handle by Assuming That No SR Is Included
ST9113

FIG.65

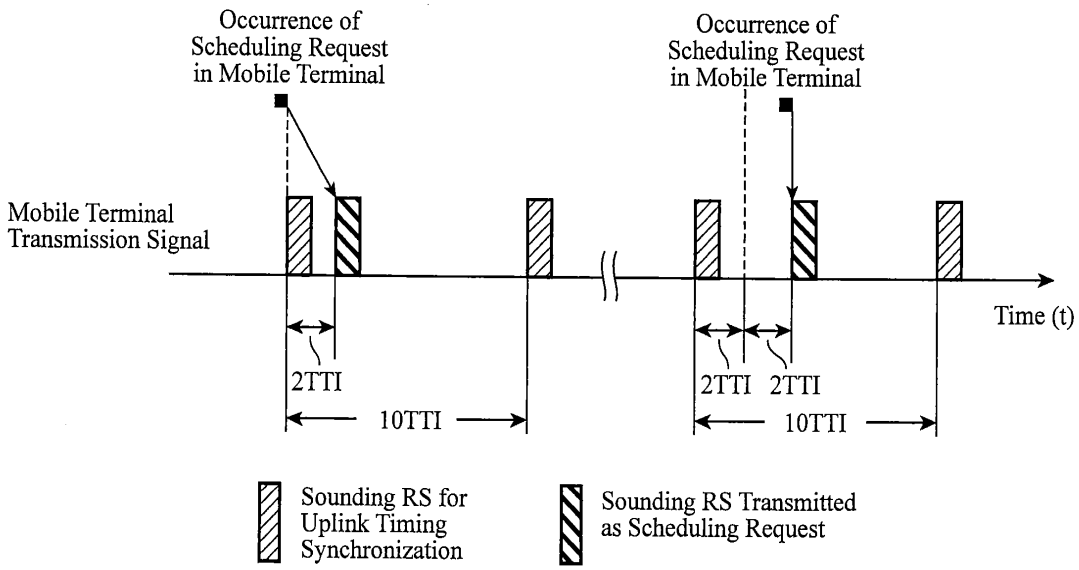
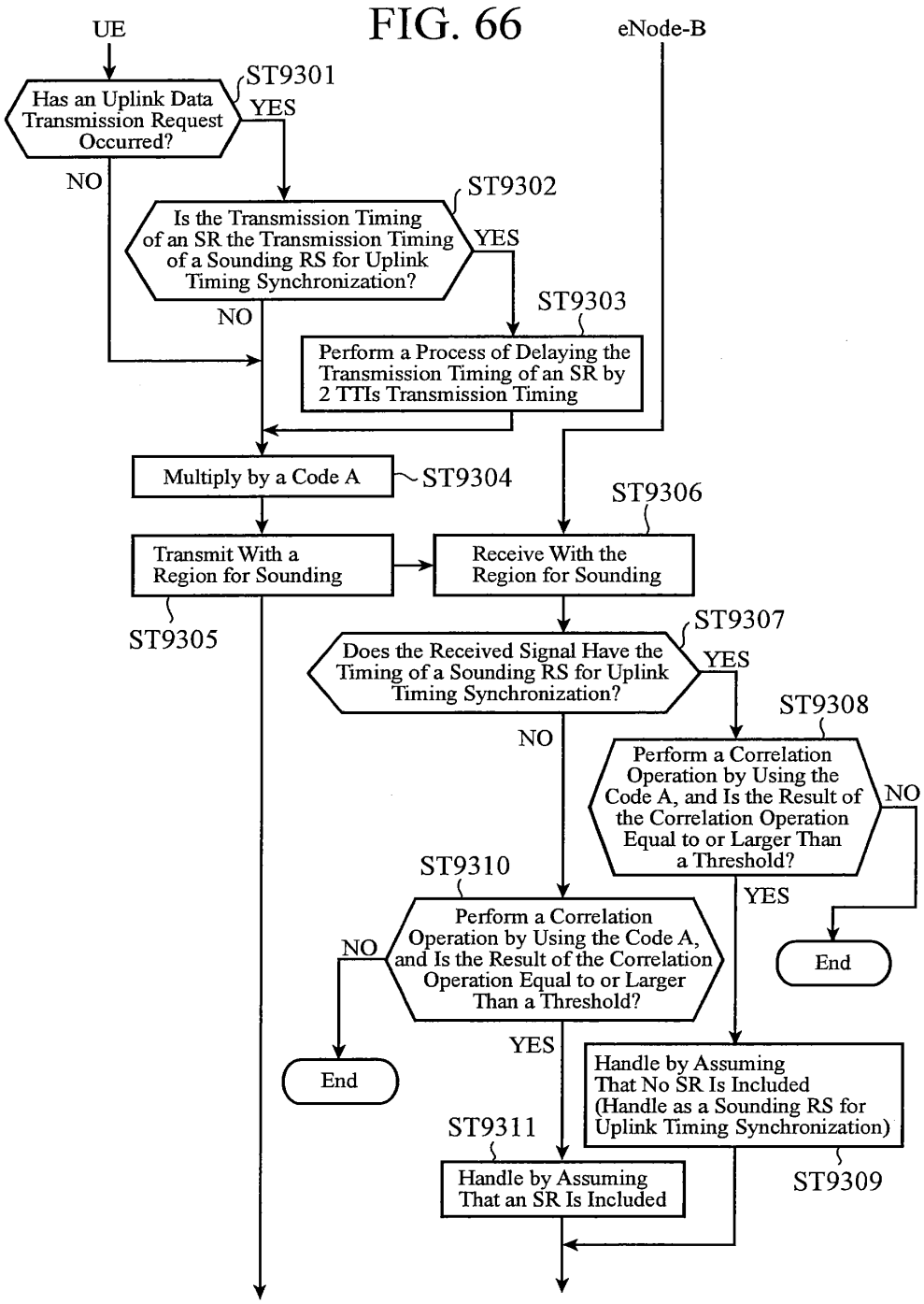

Occurrence of Scheduling Request in Mobile Terminal
Occurrence of Scheduling Request in Mobile Terminal
Mobile Terminal Transmission Signal
Time (t)
2TTI
10TTI
2TTI
2TTI
10TTI
Sounding RS for Uplink Timing Synchronization
Sounding RS Transmitted as Scheduling Request

FIG. 66


UE
eNode-B
ST9301
Has an Uplink Data Transmission Request Occurred?
YES
NO
ST9302
Is the Transmission Timing of an SR the Transmission Timing of a Sounding RS for Uplink Timing Synchronization?
YES
NO
ST9303
Perform a Process of Delaying the Transmission Timing of an SR by 2 TTIs Transmission Timing
Multiply by a Code A
ST9304
ST9306
Transmit With a Region for Sounding
Receive With the Region for Sounding
ST9305
ST9307
Does the Received Signal Have the Timing of a Sounding RS for Uplink Timing Synchronization?
YES
NO
ST9308
Perform a Correlation Operation by Using the Code A, and Is the Result of the Correlation Operation Equal to or Larger Than a Threshold?
NO
YES
End
ST9310
Perform a Correlation Operation by Using the Code A, and Is the Result of the Correlation Operation Equal to or Larger Than a Threshold?
NO
YES
End
Handle by Assuming That No SR Is Included (Handle as a Sounding RS for Uplink Timing Synchronization)
ST9311
Handle by Assuming That an SR Is Included
ST9309

Docket No. 445600US20CONT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

IN RE APPLICATION OF:	Miho MAEDA, et al.		
SERIAL NO:	New Continuation Application	GAU:	
FILED:	Herewith	EXAMINER:	
FOR:	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL		

INFORMATION DISCLOSURE STATEMENT UNDER 37 CFR 1.97

COMMISSIONER FOR PATENTS
ALEXANDRIA, VIRGINIA 22313

Commissioner:
Applicant(s) wish to disclose the following information.

REFERENCES

■ The applicant(s) wish to make of record the reference(s) listed on the attached form PTO-1449 , which were cited in parent application Serial No. 12/375,574, filed January 29, 2009. Copies of the listed reference(s) were filed in the parent application, where required, as are either statements of relevancy or any readily available partial or full English translations of pertinent portions of any non-English language reference(s).

☐ Credit card payment is being made online (if electronically filed), or is attached hereto (if paper filed), in the amount required under 37 CFR §1.17(p).

RELATED CASES

☐ Attached is a list of applicant's pending application(s), published application(s) or issued patent(s) which may be related to the present application. In accordance with the waiver of 37 CFR 1.98 dated September 21, 2004, copies of the cited pending applications are not provided. Cited published and/or issued patents, if any, are listed on the attached PTO form 1449.

☐ Credit card payment is being made online (if electronically filed), or is attached hereto (if paper filed), in the amount required under 37 CFR §1.17(p).

CERTIFICATION

☐ Each item of information contained in this 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 this statement.

☐ No item of information contained in this information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application and, to the knowledge of the undersigned, having made reasonable inquiry, was known to any individual designated in 37 CFR §1.56(c) more than three months prior to the filing of this statement.

DEPOSIT ACCOUNT

■ Please charge any additional fees for the papers being filed herewith and for which no payment is enclosed herewith, or credit any overpayment to deposit account number **15-0030**.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, L.L.P.

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Form PTO 1449 (Modified) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY DOCKET NO. 445600US20CONT	SERIAL NO. New Continuation
LIST OF REFERENCES CITED BY APPLICANT	APPLICANT Miho MAEDA, et al.	
	FILING DATE Herewith	GROUP

U.S. PATENT DOCUMENTS

EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUB CLASS	FILING DATE IF APPROPRIATE
	AA	2008/0095223	04/2008	Tong et al.			
	AB	2009/0291717	11/2009	Lee et al.			
	AC	6,980,540	12/2005	Larola et al.			
	AD	5,640,395	06/1997	Hamalainen et al.			
	AE	6,807,146	10/2004	McFarland, William			
	AF	2007/0133458	06/2007	Chandra et al.			
	AG	2007/0082620	04/2007	Zhang et al.			
	AH	7,873,023	01/2011	Ihm et al.			
	AI	2009/0196164	08/2009	Vook et al.			
	AJ	2004/0208145	10/2004	Sim et al.			
	AK	2008/0279305	11/2008	Matsumoto et al.			
	AL	2012/0307622	12/2012	Terry et al.			
	AM	2004/0213214	10/2004	Jung et al.			
	AN						

FOREIGN PATENT DOCUMENTS

		DOCUMENT NUMBER	DATE	COUNTRY	TRANSLATION YES	TRANSLATION NO
	AO	2006 33778	02/02/2006	Japan (with English Abstract)		X
	AP	2004 274432	09/30/2004	Japan (with English Abstract)		X
	AQ	2004 328498	11/18/2004	Japan (with English Abstract)		X
	AR	CN 1691820A	11/02/2005	People's Republic of China (with English Abstract and machine-generated translation)	X	
	AS					
	AT					
	AU					

OTHER REFERENCES (Including Author, Title, Date, Pertinent Pages, etc.)

	AV	"Data-non-associated L1/L2 Control Channel Structure for E-UTRA", 3GPP TSG RAN WG1 MEETING #46bis, R1 062741, NTT DOCOMO, ERICSSON, MITSUBISHI ELECTRIC, NEC, PANASONIC, SHARP, TOSHIBA CORPORATION, Pages 1-6, (2006)
	AW	"CDM-based Multiplexing Method of Multiplex ACK/NACK and CQI FOR E-UTRA Uplink", 3GPP TSG RAN WG1 MEETING #46bis, R1-062742, NTT DOCOMO, ERICSSON, MITSUBISHI ELECTRIC, NEC, PANASONIC, SHARP, TOSHIBA CORPORATION, Original R1-062742, Pages 1-6, (2006)
	AX	3GPP TR 25,814 V7.0.0, Release 7, Pages 71-74 and 78-84, (2006)
	AY	"Scheduling Request Transmission Method for E-UTRA Uplink", 3GPP TSG RAN WG1 MEETING #46bis, R1-062742, NTT DOCOMO, ERICSSON, MITSUBISHI ELECTRIC, NEC, PANASONIC, SHARP, TOSHIBA CORPORATION, Pages 1-6, (2006)
	AZ	"Uplink resource request for uplink scheduling", 3GPP TSG RAN WG1 #46bis, LG ELECTRONICS, R1-062571, Resubmission of R1-062318, Pages 1-3, (2006)

■ Additional References sheet(s) attached

Examiner		Date considered	

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

Form PTO 1449 (Modified) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE	ATTY DOCKET NO. 445600US20CONT	SERIAL NO. New Continuation
LIST OF REFERENCES CITED BY APPLICANT	APPLICANT Miho MAEDA, et al.	
	FILING DATE Herewith	GROUP

OTHER REFERENCES (Including Author, Title, Date, Pertinent Pages, etc.)

	AAA	Ericsson, "Uplink Control Signaling for E-UTRA", 3GPP Draft; R1-060111, 3rd Generation Partnership Project (3GPP), Mobile Competence Centre, vol. RAN WG1, January 19, 2006.
	AAB	Motorola, "Synchronized Random Access Channel and Scheduling Request", 3GPP Draft; R1-062664 SYNCHRACH SR, 3rd Generation Partnership Project (3GPP), Mobile Competence Centre, vol. RAN WG1, October 6, 2006.
	AAC	Nortel Networks, "Consideration on UL RACH scheme for LTE", 3GPP Draft; R1-060653 RACH, 3rd Generation Partnership Project (3GPP), Mobile Competence Centre, vol. RAN WG1, February 9, 2006.
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	AAF	Extended European Search Report issued on March 22, 2013 to European Patent Application No. 06843499.2 - 1851.
	AAG	Chinese Office Action issued April 3, 2013 to Chinese Patent Application No. 200680049892.8, with English translation
	AAH	
	AAI	
	AAJ	
	AAK	
	AAL	
	AAM	
	AAN	
	AAO	
	AAP	
	AAQ	

Examiner	Date Considered

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

Electronic Patent Application Fee Transmittal	
Application Number:	
Filing Date:	
Title of Invention:	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL
First Named Inventor/Applicant Name:	Miho MAEDA
Filer:	Marvin Jay Spivak/Yuriko Stankich
Attorney Docket Number:	445600US20CONT
Filed as Large Entity	
Filing Fees for Utility under 35 USC 111(a)	

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Utility application filing	1011	1	280	280
Utility Search Fee	1111	1	600	600
Utility Examination Fee	1311	1	720	720
Pages:				
Utility Appl Size fee per 50 sheets >100	1081	2	400	800
Claims:				
Miscellaneous-Filing:				
Late Filing Fee for Oath or Declaration	1051	1	140	140

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**2540**

Electronic Acknowledgement Receipt	
EFS ID:	21100851
Application Number:	14587726
International Application Number:	
Confirmation Number:	6371
Title of Invention:	DATA COMMUNICATION METHOD, COMMUNICATION SYSTEM AND MOBILE TERMINAL
First Named Inventor/Applicant Name:	Miho MAEDA
Customer Number:	22850
Filer:	Marvin Jay Spivak/Yuriko Stankich
Filer Authorized By:	Marvin Jay Spivak
Attorney Docket Number:	445600US20CONT
Receipt Date:	31-DEC-2014
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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		445600US-new.pdf	8113263 eec31b6acc63c3333e469f7ee707e34c7ff54265	yes	230

Multipart Description/PDF files in .zip description

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2	Fee Worksheet (SB06)	fee-info.pdf	38408 5e5bf6090ba6ad570dc9d62a65cd344966e8082b	no	2

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