UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/303,947	07/07/2010	Yeong Hyeon Kwon	7836-4-PUS

CONFIRMATION NO. 1730

POA ACCEPTANCE LETTER

62574
Jason H. Vick
Sheridan Ross, PC
Suite # 1200
1560 Broadway
Denver, CO 80202

OC000000071715188

Date Mailed: 11/07/2014

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 10/30/2014.

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.

/ttkim/

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

PTO/AIA/80 (07-12)
Approved for use through 11/30/2014. OMB 0651-0035
U.S. Patent and Trademark Office: U.S DEPARTMENT OF COMMERCE

POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

☒ Practitioners associated with Customer Number: 62574

OR

☐ Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignments documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

☒ The address associated with Customer Number: 62574

OR

☐	Firm or Individual Name			
	Address			
	City		State	Zip
	Country			
	Telephone		Email	

Assignee Name and Address: EVOLVED WIRELESS LLC
805 Las Cimas Parkway, Suite 240
Austin, TX 78746

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	Abha S Divine	Date	October 22, 2014
Name	Abha Divine	Telephone	
Title	Managing Director		

Electronic Acknowledgement Receipt

EFS ID:	20565718
Application Number:	12303947
International Application Number:	
Confirmation Number:	1730
Title of Invention:	METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yeong Hyeon Kwon
Customer Number:	62574
Filer:	Jason Vick/Joanne Vos
Filer Authorized By:	Jason Vick
Attorney Docket Number:	7836-4-PUS
Receipt Date:	30-OCT-2014
Filing Date:	07-JUL-2010
Time Stamp:	16:39:49
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		Statement_Under_373c_w_POA_EWL.pdf	2526383 87718370323572db1f4146ac00d6bd038aec64be	yes	3

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Assignee showing of ownership per 37 CFR 3.73.	1	2
	Power of Attorney	3	3
Warnings:			
Information:			
	Total Files Size (in bytes):	2526383	

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

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

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

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

PTO/AIA/96 (08-12)
Approved for use through 01/31/2013. OMB 0651-0031
U.S. Patent and Trademark Office, U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: EVOLVED WIRELESS LLC

Application No./Patent No.: 8,218,481 Filed/Issue Date: July 10, 2012

Titled: METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM

EVOLVED WIRELESS LLC, a Corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. [✓] The assignee of the entire right, title, and interest.

2. [ ] An assignee of less than the entire right, title, and interest (check applicable box):

   [ ] The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   [ ] There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. [ ] The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. [ ] The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. [ ] An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

B. [✓] A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: YEONG HYEON KWON et al. To: LG ELECTRONICS INC.

   The document was recorded in the United States Patent and Trademark Office at Reel 024647, Frame 0517, or for which a copy thereof is attached.

2. From: LG ELECTRONICS INC. To: TQ LAMBDA LLC

   The document was recorded in the United States Patent and Trademark Office at Reel 032343, Frame 0761, or for which a copy thereof is attached.

PTO/AIA/96 (08-12)
Approved for use through 01/31/2013. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

STATEMENT UNDER 37 CFR 3.73(c)

3. From: TQ LAMBDA LLC To: EVOLVED WIRELESS LLC

The document was recorded in the United States Patent and Trademark Office at
Reel 034039, Frame 0403, or for which a copy thereof is attached.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Jason H. Vick/	October 30, 2014
Signature	Date
Jason H. Vick	45,285
Printed or Typed Name	Title or Registration Number

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
12/303,947	07/07/2010	Yeong Hyeon Kwon	

CONFIRMATION NO. 1730

POA ACCEPTANCE LETTER

62574
Jason H. Vick
Sheridan Ross, PC
Suite # 1200
1560 Broadway
Denver, CO 80202

OC000000067468470

Date Mailed: 04/01/2014

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 03/11/2014.

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.

/jtfitzhugh sr/

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

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
12/303,947	07/07/2010	Yeong Hyeon Kwon	2101-3596

CONFIRMATION NO. 1730

POWER OF ATTORNEY NOTICE

35884
LEE, HONG, DEGERMAN, KANG & WAIMEY
660 S. FIGUEROA STREET
Suite 2300
LOS ANGELES, CA 90017

OC000000067468359

Date Mailed: 04/01/2014

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 03/11/2014.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

/jtfitzhugh sr/

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

PTO/AIA/80 (07-12)
Approved for use through 11/30/2014. OMB 0651-0035
U.S. Patent and Trademark Office; U.S DEPARTMENT OF COMMERCE

POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

■ Practitioners associated with Customer Number: 62574

OR

☐ Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignments documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

■ The address associated with Customer Number: 62574

OR

☐

Firm or Individual Name			
Address			
City		State	Zip
Country			
Telephone		Email	

Assignee Name and Address: TQ LAMBDA, LLC
805 Las Cimas Parkway, Suite 240
Austin, TX 78746

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	Abha S. Divine	Date	2/27/14
Name	Abha S. Divine	Telephone	(512) 609-1820
Title	Managing Director		

PTO/SB/47 (03-09)
Approved for use through 05/31/2015. OMB 0651-0016
U.S. Patent and Trademark Office; U. S. DEPARTMENT OF COMMERCE

"FEE ADDRESS" INDICATION FORM

Address to:
Mail Stop M Correspondence
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

- OR -

Fax to:
571-273-6500

INSTRUCTIONS: The issue fee must have been paid for application(s) listed on this form. In addition, only an address represented by a Customer Number can be established as the fee address for maintenance fee purposes (hereafter, fee address). A fee address should be established when correspondence related to maintenance fees should be mailed to a different address than the correspondence address for the application. **When to check the first box below**: If you have a Customer Number to represent the fee address. **When to check the second box below**: If you have no Customer Number representing the desired fee address, in which case a completed Request for Customer Number (PTO/SB/125) must be attached to this form. For more information on Customer Numbers, see the Manual of Patent Examining Procedure (MPEP) § 403.

For the following listed application(s), please recognize as the "Fee Address" under the provisions of 37 CFR 1.363 the address associated with:

☑ Customer Number: 62574

OR

☐ The attached Request for Customer Number (PTO/SB/125) form.

PATENT NUMBER (if known)	APPLICATION NUMBER
8,218,481	12/303,947

Completed by (check one):

☐ Applicant/Inventor

Signature

☑ Attorney or Agent of record 45285 (Reg. No.)

Jason H. Vick
Typed or printed name

☐ Assignee of record of the entire interest. See 37 CFR 3.71. Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96)

303-863-9700
Requester's telephone number

☐ Assignee recorded at Reel _____ Frame_____

March 11, 2014
Date

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more that one signature is required, see below*.

☑ * Total of 1 forms are submitted.

Electronic Acknowledgement Receipt

EFS ID:	18437805
Application Number:	12303947
International Application Number:	
Confirmation Number:	1730
Title of Invention:	METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yeong Hyeon Kwon
Customer Number:	35884
Filer:	Jason Vick/Joanne Vos
Filer Authorized By:	Jason Vick
Attorney Docket Number:	2101-3596
Receipt Date:	11-MAR-2014
Filing Date:	07-JUL-2010
Time Stamp:	17:43:35
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		Statement_Under_373c_w_POA.pdf	522421 fb15c26549ae785ebd7ce35ccb851a2f22cfcae9	yes	3

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Assignee showing of ownership per 37 CFR 3.73.	1	2
	Power of Attorney	3	3

Warnings:					
Information:					
2	Change of Address	Fee_Address.pdf	205392 aeb3dec5f5992513cf06fc1359b4e8e9658b503f	no	1
Warnings:					
Information:					
		Total Files Size (in bytes):	727813		

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

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

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

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

PTO/AIA/96 (08-12)
Approved for use through 01/31/2013. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: TQ LAMBDA LLC

Application No./Patent No.: 8,218,481 Filed/Issue Date: July 10, 2012

Titled: METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM

TQ LAMBDA LLC, a Corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

B. ☑ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: YEONG HYEON KWON et al. To: LG ELECTRONICS INC.

   The document was recorded in the United States Patent and Trademark Office at

   Reel 024647, Frame 0517, or for which a copy thereof is attached.

2. From: LG ELECTRONICS INC. To: TQ LAMBDA LLC

   The document was recorded in the United States Patent and Trademark Office at

   Reel 032343, Frame 0761, or for which a copy thereof is attached.

PTO/AIA/96 (08-12)
Approved for use through 01/31/2013. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

Signature	March 11, 2014 Date
Jason H. Vick Printed or Typed Name	45,285 Title or Registration Number

[Page 2 of 2]

UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/303,947	07/10/2012	8218481	2101-3596	1730

35884 7590 06/20/2012

LEE, HONG, DEGERMAN, KANG & WAIMEY
660 S. FIGUEROA STREET
Suite 2300
LOS ANGELES, CA 90017

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 135 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):

Yeong Hyeon Kwon, Gyeonggi-do, KOREA, REPUBLIC OF;
Seung Hee Han, Gyeonggi-do, KOREA, REPUBLIC OF;
Hyun Hwa Park, Gyeonggi-do, KOREA, REPUBLIC OF;
Dong Cheol Kim, Gyeonggi-do, KOREA, REPUBLIC OF;
Hyun Woo Lee, Gyeonggi-do, KOREA, REPUBLIC OF;
Min Seok Noh, Gyeonggi-do, KOREA, REPUBLIC OF;

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)

35884 7590 05/06/2012

LEE, HONG, DEGERMAN, KANG & WAIMEY
660 S. FIGUEROA STREET
Suite 2300
LOS ANGELES, CA 90017

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.
12/303,947	07/07/2010	Yeong Hyeon Kwon	2101-3596	1730

TITLE OF INVENTION: METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1740	$300	$0	$2040	06/06/2012

EXAMINER	ART UNIT	CLASS-SUBCLASS
KHAJURIA, SHRIPAL K	2478	370-328000

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 LEE, HONG, DEGERMAN, KANG & WAIMEY
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: LG ELECTRONICS INC.

(B) RESIDENCE: (CITY and STATE OR COUNTRY): SEOUL, REPUBLIC OF KOREA

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

4a. 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 credit any overpayment, to Deposit Account Number 50-2290 (enclose an extra copy of this form).

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

☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.

☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature /Ali Atefi/ Date June 5, 2012

Typed or printed name Ali Atefi Registration No. 63,960

This collection of information 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.

Electronic Patent Application Fee Transmittal	
Application Number:	12303947
Filing Date:	07-Jul-2010
Title of Invention:	METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yeong Hyeon Kwon
Filer:	Ali. Atefi/Anna Tounian
Attorney Docket Number:	2101-3596
Filed as Large Entity	

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

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	1740	1740
Publ. Fee- early, voluntary, or normal	1504	1	300	300

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**2040**

Electronic Acknowledgement Receipt	
EFS ID:	12943035
Application Number:	12303947
International Application Number:	
Confirmation Number:	1730
Title of Invention:	METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yeong Hyeon Kwon
Customer Number:	35884
Filer:	Ali. Atefi/Anna Tounian
Filer Authorized By:	Ali. Atefi
Attorney Docket Number:	2101-3596
Receipt Date:	05-JUN-2012
Filing Date:	07-JUL-2010
Time Stamp:	21:43:17
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$2040
RAM confirmation Number	7133
Deposit Account	502290
Authorized User	LEE, HONG, DEGERMAN, KANG & WAIMEY
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	2101-3596-Transmittal-IssueFee.pdf	71729 9d19c73a415a8c2b0c626b2d5fae41f2cbd317d7	no	1
Warnings:					
Information:					
2	Issue Fee Payment (PTO-85B)	2101-3596-IssueFeeForm.pdf	340824 2c05cdaff912f14d9e01bf499ce687525dc6a2ac	no	1
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	32110 d9b4c521d5b0c937c5d9da11ea1f4ac40511ba14	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	444663		

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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.

Customer No. 035884 **Docket No. 2101-3596**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Yeong Hyeon KWON et al.		Art Unit:	2478
Serial No.:	12/303,947	Examiner:	Khajuria, Shripal K.
Filed:	July 7, 2010	Conf. No.	1730
For:	METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM		

TRANSMITTAL OF ISSUE FEE

Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In response to the Notice of Allowance dated March 6, 2012, enclosed are the following:

☒ Form Part B - Issue Fee Transmittal.

☒ Inventor(s) or Assignee(s) is entitled to **LARGE** entity.

☒ The Commissioner is hereby authorized to charge the Issue Fee in the amount of $2,040 to the credit card and any deficiency in payment or credit any overpayment to **Deposit Account No. 502290.**

Respectfully submitted,

Lee, Hong, Degerman, Kang & Waimey

Date: June 5, 2012

By: /Ali Atefi/
Ali Atefi
Registration No. 63,960
Attorney for Applicant(s)

Customer No. 035884 Docket No. 2101-3596

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Yeong Hyeon KWON et al.	Art Unit: 2478
Serial No.: 12/303,947	Examiner: Khajuria, Shripal K.
Filed: July 7, 2010	Conf. No. 1730
For: METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM	

AMENDMENT AFTER NOTICE OF ALLOWANCE (NOA) PURSUANT TO 37 CFR 1.312

Mail Stop Issue Fee
Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In response to the Notice of Allowance dated March 6, 2012, for which the Issue Fee is due June 6, 2012, this paper is submitted prior to payment of the Issue Fee. Applicant respectfully requests that the Examiner amend the above-identified application as follows prior to issuance:

IN THE SPECIFICATION:

Please amend the first paragraph at line 1 on page 1 as follows:

This application is the National Stage filing under 35 U.S.C. § 371 of International Application No. PCT/KR07/02784, filed on ~~January~~ June 8, 2007, which claims the benefit of earlier filing date and right of priority to Korean Application Nos. 10-2006-0052167, filed on June 9, 2006, and 10-2006-0057488, filed on June 26, 2006.

REMARKS

Claims 31-46, which are all the claims in the application, have been allowed. Applicant respectfully submits that the amendments to the specification are intended to correct formal matters and do not change the scope of the claims.

The foregoing amendment to the specification corrects a typographical error in the filing date of PCT Application No. PCT/KR07/02784. It is respectfully noted that the filing date of June 8, 2007 was correctly listed on PCT Publication No. WO 2007/042492, and on the Declaration/Power of Attorney filed on July 7, 2010.

The specification has been amended to reflect the issued status of the parent application. No new matter has been added to the specification. In view of the allowance of claims 31-46, which have not been amended with this paper, it is respectfully submitted that claims 31-46 are still in condition for allowance. The Examiner is requested to issue a Response to Rule 312 Communication (PTO-271) as soon as possible.

If for any reason the Examiner finds the proposed amendments not in condition for entry or if further changes are deemed necessary, the Examiner is requested to call the undersigned attorney at the Los Angeles, California, telephone number (213) 623-2221.

Respectfully Submitted,
LEE, HONG, DEGERMAN, KANG & WAIMEY

Date: May 3, 2012

By: /Ali Atefi/
Ali Atefi
Registration No. 63,960
Attorney for Applicant(s)

Customer No. 035884

Electronic Acknowledgement Receipt	
EFS ID:	12700958
Application Number:	12303947
International Application Number:	
Confirmation Number:	1730
Title of Invention:	METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yeong Hyeon Kwon
Customer Number:	35884
Filer:	Ali. Atefi/Anna Tounian
Filer Authorized By:	Ali. Atefi
Attorney Docket Number:	2101-3596
Receipt Date:	03-MAY-2012
Filing Date:	07-JUL-2010
Time Stamp:	19:13:05
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2101-3596-312Amendment.pdf	82611 32c07c3c8627f173b08d1939ff6f909c084e280a	yes	3

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment after Notice of Allowance (Rule 312)	1	1
	Specification	2	2
	Applicant Arguments/Remarks Made in an Amendment	3	3
Warnings:			
Information:			
	Total Files Size (in bytes):	82611	

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PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	12303947
Filing Date	2010-07-07
First Named Inventor	Yeong Hyeon Kwon
Art Unit	2478
Examiner Name	KHAJURIA, SHRIPAL K
Attorney Docket Number	2101-3596

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
/S.K./	1	2000102067	JP		2000-04-07	MITSUBISHI ELECTRIC CORP		☐
/S.K./	2	2001268051	JP		2001-09-28	NTT DOCOMO INC		☐
/S.K./	3	2003179576	JP		2003-06-27	SONY CORP		☐

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	12303947
	Filing Date	2010-07-07
	First Named Inventor	Yeong Hyeon Kwon
	Art Unit	2478
	Examiner Name	KHAJURIA, SHRIPAL K
	Attorney Docket Number	2101-3596

/S.K./	4	2005/055527	WO		2005-06-16	QUALCOMM INC		☐

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NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		☐

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EXAMINER SIGNATURE

Examiner Signature	/Shripal Khajuria/	Date Considered	04/24/2012

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

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

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	12303947
	Filing Date	2010-07-07
	First Named Inventor	Yeong Hyeon Kwon
	Art Unit	2478
	Examiner Name	KHAJURIA, SHRIPAL K
	Attorney Docket Number	2101-3596

CERTIFICATION STATEMENT

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

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

OR

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

☐ See attached certification statement.

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

☐ A certification statement is not submitted herewith.

SIGNATURE

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

Signature	/David Majdali/	Date (YYYY-MM-DD)	2012-04-18
Name/Print	David Majdali	Registration Number	53,257

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

Privacy Act Statement

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

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

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

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

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	12303947
	Filing Date	2010-07-07
	First Named Inventor	Yeong Hyeon Kwon
	Art Unit	2478
	Examiner Name	KHAJURIA, SHRIPAL K
	Attorney Docket Number	2101-3596

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] ¡	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2000102067	JP		2000-04-07	MITSUBISHI ELECTRIC CORP		☐
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	Attorney Docket Number	2101-3596

	4	2005/055527	WO		2005-06-16	QUALCOMM INC		☐

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NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		☐

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

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

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	Application Number	12303947
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	First Named Inventor	Yeong Hyeon Kwon
	Art Unit	2478
	Examiner Name	KHAJURIA, SHRIPAL K
	Attorney Docket Number	2101-3596

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OR

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☐ A certification statement is not submitted herewith.

SIGNATURE

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Signature	/David Majdali/	Date (YYYY-MM-DD)	2012-04-18
Name/Print	David Majdali	Registration Number	53,257

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

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

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

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

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal	
Application Number:	12303947
Filing Date:	07-Jul-2010
Title of Invention:	METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yeong Hyeon Kwon
Filer:	David Gerard Majdali/Neeti Rajput
Attorney Docket Number:	2101-3596
Filed as Large Entity	

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

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

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
Submission- Information Disclosure Stmt	1806	1	180	180
		Total in USD ($)		**180**

Electronic Acknowledgement Receipt	
EFS ID:	12576106
Application Number:	12303947
International Application Number:	
Confirmation Number:	1730
Title of Invention:	METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yeong Hyeon Kwon
Customer Number:	35884
Filer:	David Gerard Majdali/Neeti Rajput
Filer Authorized By:	David Gerard Majdali
Attorney Docket Number:	2101-3596
Receipt Date:	18-APR-2012
Filing Date:	07-JUL-2010
Time Stamp:	21:20:17
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$180
RAM confirmation Number	9583
Deposit Account	502290
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.21 (Miscellaneous fees and charges)	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	2101-3596_41812_IDSform.pdf	612340 b9528ae1ec3c82a35848e04e21816f51ce2d3311	no	4
Warnings:					
Information:					
A U.S. Patent Number Citation or a U.S. Publication Number Citation is required in the Information Disclosure Statement (IDS) form for autoloading of data into USPTO systems. You may remove the form to add the required data in order to correct the Informational Message if you are citing U.S. References. If you chose not to include U.S. References, the image of the form will be processed and be made available within the Image File Wrapper (IFW) system. However, no data will be extracted from this form. Any additional data such as Foreign Patent Documents or Non Patent Literature will be manually reviewed and keyed into USPTO systems.					
2	Foreign Reference	JP2000-102067.pdf	773765 209f729cdc8011ef4636f7b902cc103d300df036	no	9
Warnings:					
Information:					
3	Foreign Reference	JP2001-268051.pdf	1963524 d2b0ef62f7e495eba21ddb750195bd45dc94bcc9	no	24
Warnings:					
Information:					
4	Foreign Reference	JP2003-179576.pdf	1870793 51772502832c3b251b1d808d950b011d69aceaa6	no	20
Warnings:					
Information:					
5	Foreign Reference	WO2005-055527.pdf	6926599 9052ceb9b6ce3d8a50d2838b330cf12daafbc7a3	no	56
Warnings:					
Information:					
6	Fee Worksheet (SB06)	fee-info.pdf	30788 f31749793a85a3e27a2195ab87425522573da4a4	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	12177809		

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

35884 7590 03/06/2012

LEE, HONG, DEGERMAN, KANG & WAIMEY
660 S. FIGUEROA STREET
Suite 2300
LOS ANGELES, CA 90017

EXAMINER
KHAJURIA, SHRIPAL K

ART UNIT	PAPER NUMBER
2478	

DATE MAILED: 03/06/2012

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/303,947	07/07/2010	Yeong Hyeon Kwon	2101-3596	1730

TITLE OF INVENTION: METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1740	$300	$0	$2040	06/06/2012

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 SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:

A. If the status is the same, pay the TOTAL FEE(S) DUE shown above.

B. If the status above is to be removed, check box 5b on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and twice the amount of the ISSUE FEE shown above, or

If the SMALL ENTITY is shown as NO:

A. Pay TOTAL FEE(S) DUE shown above, or

B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check box 5a on Part B - Fee(s) Transmittal and pay the PUBLICATION FEE (if required) and 1/2 the ISSUE FEE shown above.

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.

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)

35884 7590 03/06/2012

LEE, HONG, DEGERMAN, KANG & WAIMEY
660 S. FIGUEROA STREET
Suite 2300
LOS ANGELES, CA 90017

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.
12/303,947	07/07/2010	Yeong Hyeon Kwon	2101-3596	1730

TITLE OF INVENTION: METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1740	$300	$0	$2040	06/06/2012

EXAMINER	ART UNIT	CLASS-SUBCLASS
KHAJURIA, SHRIPAL K	2478	370-328000

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 credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

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

❑ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27.

❑ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

NOTE: The Issue Fee and Publication Fee (if required) will not be accepted from anyone other than the applicant; a registered attorney or agent; or the assignee or other party in interest as shown by the records of the United States Patent and Trademark Office.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

This collection of information 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.

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.
12/303,947	07/07/2010	Yeong Hyeon Kwon	2101-3596	1730

35884 7590 03/06/2012

LEE, HONG, DEGERMAN, KANG & WAIMEY
660 S. FIGUEROA STREET
Suite 2300
LOS ANGELES, CA 90017

EXAMINER	
KHAJURIA, SHRIPAL K	
ART UNIT	PAPER NUMBER
2478	

DATE MAILED: 03/06/2012

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

The Patent Term Adjustment to date is 5 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 5 day(s).

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 Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

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.	Applicant(s)	
	12/303,947	KWON ET AL.	
	Examiner	Art Unit	
	SHRIPAL KHAJURIA	2478	

-- 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 *the amendment filed on 12/16/11*.

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 *31-46 (Renumbered 1-16)*.

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

   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. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.

   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached

   1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.

   (b) ☐ 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).

7. ☐ 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. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 10/31/11; 12/20/11; 12/21/11
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☐ Examiner's Amendment/Comment
8. ☐ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

/S. K./	/J. P./
Examiner, Art Unit 2478	Supervisory Patent Examiner, Art Unit 2478

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12303947	KWON ET AL.
	Examiner	Art Unit
	SHRIPAL KHAJURIA	2478

✓	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	09/07/2011	02/24/2012							
1	31	✓	=							
2	32	✓	=							
3	33	✓	=							
4	34	✓	=							
5	35	✓	=							
6	36	✓	=							
7	37	✓	=							
8	38	✓	=							
9	39	✓	=							
10	40	✓	=							
11	41	✓	=							
12	42	✓	=							
13	43	✓	=							
14	44	✓	=							
15			=							
16			=							

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12303947	KWON ET AL.
	Examiner	Art Unit
	SHRIPAL KHAJURIA	2478

ORIGINAL		INTERNATIONAL CLASSIFICATION									
CLASS	SUBCLASS	CLAIMED					NON-CLAIMED				
370	328	H	0	4	L	12 / 50 (2006.0)					

CROSS REFERENCE(S)					
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)				
370	329	330			

☐ 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	31														
2	32														
3	33														
4	34														
5	35														
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12	42														
13	43														
14	44														
15	45														
16	46														

/S.K./ Examiner.Art Unit 2478	02/24/2012	Total Claims Allowed:	
(Assistant Examiner)	(Date)	16	
/JEFFREY PWU/ Supervisory Patent Examiner.Art Unit 2478	02/25/2012	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	12

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	12303947
	Filing Date	2010-07-07
	First Named Inventor	Yeong Hyeon Kwon
	Art Unit	2478
	Examiner Name	Khajuria, Shripal K.
	Attorney Docket Number	2101-3596

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/S.K./	1	2005260337	JP		2005-09-22	Renesas Tech Corp.		☐
/S.K./	2	2004274794	JP		2004-09-30	Interdigital Tech Corp.		☐
/S.K./	3	2004512728	JP		2004-04-22	Samsung Electronics Co., Ltd.		☐

Receipt date: 12/21/2011	Application Number	12303947 12303947 - GAU: 2478
INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Filing Date	2010-07-07
	First Named Inventor	Yeong Hyeon Kwon
(Not for submission under 37 CFR 1.99)	Art Unit	2478
	Examiner Name	Khajuria, Shripal K.
	Attorney Docket Number	2101-3596

/S.K./	4	04-035332	JP		1992-02-06	Sanyo Electric Co., Ltd.		☐
/S.K./	5	11-154929	JP		1999-06-08	Nippon Telegraph & Telephone		☐

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	Attorney Docket Number	2101-3596

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/S.K./	1	2005/011128	WO		2005-02-03	COHDA WIRELESS PTY LTD		☐
/S.K./	2	2006/015108	WO		2006-02-09	ZTE SAN DIEGO, INC		☐
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Filing Date	2010-07-07
	First Named Inventor	Yeong Hyeon Kwon
	Art Unit	2478
(Not for submission under 37 CFR 1.99)	Examiner Name	KHAJURIA, SHRIPAL K
	Attorney Docket Number	2101-3596

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
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Receipt date: 12/20/2011	Application Number	12303947 12303947 - GAU: 2478
INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Filing Date	2010-07-07
	First Named Inventor	Yeong Hyeon Kwon
(Not for submission under 37 CFR 1.99)	Art Unit	2478
	Examiner Name	KHAJURIA, SHRIPAL K
	Attorney Docket Number	2101-3596

/S.K./	1	CHANG ET AL: "Synchronization Method Based on a New Constant Envelop Preamble for OFDM Systems," IEEE TRANSACTIONS ON BROADCASTING, vol. 51, no. 1, March 2005, pp. 139-143, XP-011127926.	☐
/S.K./	2	TEXAS INSTRUMENTS: "On Allocation of Uplink Pilot Sub-Channels in EUTRA SC-FDMA," R1-050822, 3GPP TSG-RAN WG1 Ad Hoc on LTE, August 2005, XP-002448008.	☐

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	14884	kwon.in.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/02/24 22:58
L2	29796	han.in.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/02/24 22:58
L3	55702	park.in.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/02/24 22:58
L4	125629	kim.in.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/02/24 22:58
L5	195557	lee.in.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/02/24 22:58
L6	1930	noh.in.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/02/24 22:58
L7	4	(L1 L2 L3 L4 L5 L6) and (preamble same prefix same repeated).clm.	US-PGPUB; USPAT; USOCR	OR	OFF	2012/02/24 22:58
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L17	455	cyclic near prefix and preamble same repeat$3 and length	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/02/24 23:02
L19	87	cyclic near prefix and preamble and concatenating	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/02/24 23:03
L20	176	prefix and preamble and concatenating	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/02/24 23:03
L21	166	prefix and preamble and concatenating and length	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/02/24 23:03
L23	8753	(370/329).CCLS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/02/24 23:05
L24	1248	(370/330).CCLS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/02/24 23:06
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		concatenating	JPO; DERWENT; IBM_TDB			
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L28	7	(l23 l24) and prefix and preamble and concatenating and length	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2012/02/24 23:06
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S3	27622	han.in.	US-PGPUB; USPAT; USOCR	OR	OFF	2011/09/01 18:08
S4	52224	park.in.	US-PGPUB; USPAT; USOCR	OR	OFF	2011/09/01 18:08
S5	117541	kim.in.	US-PGPUB; USPAT; USOCR	OR	OFF	2011/09/01 18:08
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S7	1736	noh.in.	US-PGPUB; USPAT; USOCR	OR	OFF	2011/09/01 18:08
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S10	463	cyclic near prefix and preamble same repeat$3	US-PGPUB; USPAT; USOCR	OR	OFF	2011/09/07 10:52
S11	51	cyclic near prefix and preamble same repeat$3 and CAZAC	US-PGPUB; USPAT; USOCR	OR	OFF	2011/09/07 10:52

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L9	14899	kwon.in.	US-PGPUB; USPAT; UPAD	OR	OFF	2012/02/24 22:59
L10	29820	han.in.	US-PGPUB; USPAT; UPAD	OR	OFF	2012/02/24 22:59
L11	55137	park.in.	US-PGPUB; USPAT; UPAD	OR	OFF	2012/02/24 22:59
L12	125838	kim.in.	US-PGPUB; USPAT; UPAD	OR	OFF	2012/02/24 23:00
L13	187828	lee.in.	US-PGPUB; USPAT; UPAD	OR	OFF	2012/02/24 23:00
L14	4	(l9 l10 l11 l12 l13) and (preamble same prefix same repeated).clm.	US-PGPUB; USPAT; UPAD	OR	OFF	2012/02/24 23:01
L15	523	cyclic near prefix and preamble same repeat$3	US-PGPUB; USPAT; UPAD	OR	OFF	2012/02/24 23:02
L16	455	cyclic near prefix and preamble same repeat$3 and length	US-PGPUB; USPAT; UPAD	OR	OFF	2012/02/24 23:02

L18	26	cyclic near prefix and preamble and concatenating	USPAT; UPAD	OR	OFF	2012/02/24 23:03
L22	165	prefix and preamble and concatenating and length	US-PGPUB; USPAT; UPAD	OR	OFF	2012/02/24 23:03

2/24/2012 11:07:05 PM
C:\Users\skhajuria\Documents\EAST\Workspaces\12303947.wsp

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12303947	KWON ET AL.
	Examiner	Art Unit
	SHRIPAL KHAJURIA	2478

SEARCHED			
Class	Subclass	Date	Examiner
370	328	9/7/2011	skk
370	328	2/24/2012	skk

SEARCH NOTES		
Search Notes	Date	Examiner
Text search of East (USPat, USPG_Pub, JPO, EPO, Derwent, IBM_TDB) and Inventor search	9/7/2011	skk
Updated Text search of East (USPat, USPG_Pub, JPO, EPO, Derwent, IBM_TDB)	2/24/2012	skk
Limited class search of 370/329 and 370/330	2/24/2012	skk
Consulted Jeff Pwu on allowable subject matter	2/24/2012	skk

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner
PgPub and UnPub	see attached search history	2/24/2012	skk

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	2	2004274794	JP		2004-09-30	Interdigital Tech Corp.		☐
	3	2004512728	JP		2004-04-22	Samsung Electronics Co., Ltd.		☐

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	4	04-035332	JP		1992-02-06	Sanyo Electric Co., Ltd.		☐
	5	11-154929	JP		1999-06-08	Nippon Telegraph & Telephone		☐

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	Art Unit	2478
	Examiner Name	Khajuria, Shripal K.
	Attorney Docket Number	2101-3596

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☐ See attached certification statement.

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☐ A certification statement is not submitted herewith.

SIGNATURE

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

Signature	/David G. Majdali/	Date (YYYY-MM-DD)	2011-12-22
Name/Print	David G. Majdali	Registration Number	53,257

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Electronic Acknowledgement Receipt	
EFS ID:	11682132
Application Number:	12303947
International Application Number:	
Confirmation Number:	1730
Title of Invention:	METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yeong Hyeon Kwon
Customer Number:	35884
Filer:	Harry Sung Lee/Diana Kim
Filer Authorized By:	Harry Sung Lee
Attorney Docket Number:	2101-3596
Receipt Date:	21-DEC-2011
Filing Date:	07-JUL-2010
Time Stamp:	17:55:43
Application Type:	U.S. National Stage under 35 USC 371

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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	2101-3596_120911_IDSForm.pdf	612413 7e0f16d29f65865749b6e07c3d5d12bc30e12c15	no	4
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2	Foreign Reference	F1_JP2005260337.pdf	1269319 80f87564eb613a968a02c9dfc5d4d8e0af259de3	no	24
Warnings:					
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3	Foreign Reference	F2_JP2004274794.pdf	1107072 e6cbc6d65227bdd2afc551995cf282c1b2d9427e	no	21
Warnings:					
Information:					
4	Foreign Reference	F3_JP2004512728.pdf	2041519 b4a13e394d4362b4b462048a25315a26190e73e0	no	46
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5	Foreign Reference	F4_JP435332.pdf	518705 e21659cdf70051c8bc483e2b9f3e92f4af549ff7	no	6
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Information:					
6	Foreign Reference	F5_JP11154929.pdf	612130 b9dcdcd0301b90d5548c8c91206ed3b0dd9bef34	no	11
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			Total Files Size (in bytes):	6161158	

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PTO/SB/08a (01-10)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	12303947
	Filing Date	2010-07-07
	First Named Inventor	Yeong Hyeon Kwon
	Art Unit	2478
	Examiner Name	KHAJURIA, SHRIPAL K
	Attorney Docket Number	2101-3596

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	12303947
	Filing Date	2010-07-07
	First Named Inventor	Yeong Hyeon Kwon
	Art Unit	2478
	Examiner Name	KHAJURIA, SHRIPAL K
	Attorney Docket Number	2101-3596

	1	CHANG ET AL: "Synchronization Method Based on a New Constant Envelop Preamble for OFDM Systems," IEEE TRANSACTIONS ON BROADCASTING, vol. 51, no. 1, March 2005, pp. 139-143, XP-011127926.	☐
	2	TEXAS INSTRUMENTS: "On Allocation of Uplink Pilot Sub-Channels in EUTRA SC-FDMA," R1-050822, 3GPP TSG-RAN WG1 Ad Hoc on LTE, August 2005, XP-002448008.	☐

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

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

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	12303947
	Filing Date	2010-07-07
	First Named Inventor	Yeong Hyeon Kwon
	Art Unit	2478
	Examiner Name	KHAJURIA, SHRIPAL K
	Attorney Docket Number	2101-3596

CERTIFICATION STATEMENT

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

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

OR

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

☐ See attached certification statement.

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

☐ A certification statement is not submitted herewith.

SIGNATURE

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

Signature	/David Majdali/	Date (YYYY-MM-DD)	2011-12-20
Name/Print	David Majdali	Registration Number	53,257

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

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

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

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Electronic Acknowledgement Receipt	
EFS ID:	11671116
Application Number:	12303947
International Application Number:	
Confirmation Number:	1730
Title of Invention:	METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yeong Hyeon Kwon
Customer Number:	35884
Filer:	David Gerard Majdali/Neeti Rajput
Filer Authorized By:	David Gerard Majdali
Attorney Docket Number:	2101-3596
Receipt Date:	20-DEC-2011
Filing Date:	07-JUL-2010
Time Stamp:	21:06:31
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	2101-3596_112311_IDSform.pdf	612539 5f56977dbe5f5301337d1e412881fc5e4abd8221	no	4
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3	Non Patent Literature	Texas_Instruments.pdf	577575 3d5db9e2ba0f1737797f03f29dbce7f6e1a80caa	no	8
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Customer No. 035884 Attorney Docket No. 2101-3596

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Yeong Hyeon KWON et al.		Art Unit:	2478
Serial No.:	12/303,947	Examiner:	Khajuria, Shripal K.
Filed:	July 7, 2010	Conf. No.	1730
For:	METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM		

AMENDMENT

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

Dear Sir:

In response to the Office Action dated September 16, 2011, for which the Examiner set a three-month period for response, Applicant provides the following.

AMENDMENT TO THE SPECIFICATION

Please insert the following paragraph on page 1 of the Specification, after the title of the invention and before the section titled TECHNICAL FIELD, with the following heading and paragraph:

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is the National Stage filing under 35 U.S.C. § 371 of International Application No. PCT/KR07/02784, filed on January 8, 2007, which claims the benefit and right of priority to Korean Application Nos. 10-2006-0052167, filed on June 9, 2006 and 10-2006-0057488, filed on June 26, 2006.

AMENDMENTS TO THE CLAIMS

Please amend the claims as follows:

1-30. (Canceled)

31. (Currently Amended) A method of transmitting a preamble sequence in a mobile communication system, the method comprising:

~~generating said preamble sequence by repeating a specific sequence at least one time and concatenating a cyclic prefix (CP) to a front end of said repeated sequence, said CP being identical to a part of a rear end of said specific sequence; and~~

repeating a specific sequence, having a length (L), N times to generate a consecutive sequence having a length (N*L);

generating said preamble sequence by concatenating a single cyclic prefix (CP) to a front end of said consecutive sequence; and

transmitting, on a random access channel, said preamble sequence to a receiving side ~~on a random access channel~~.

32. (Currently Amended) The method of claim 31, further comprising generating said specific sequence from a Constant Amplitude Zero Auto Correlation (CAZAC) ~~(Constant Amplitude Zero Auto Correlation)~~ sequence.

33. (Currently Amended) The method of claim 32, further comprising applying a cyclic shift to said specific sequence generated from said CAZAC sequence.

34. (Currently Amended) The method of claim 33, wherein a value of said applied cyclic shift is determined as an integer ~~value~~ multiple of a predetermined circular shift unit.

35. (Previously Presented) The method of claim 33, wherein a value of said applied cyclic shift is used as additional information.

36. (Previously Presented) The method of claim 33, wherein applying said cyclic shift comprises multiplying said specific sequence by an exponential sequence.

37. (Currently Amended) The method of claim 31, further comprising generating said specific sequence by combining at least two code sequences mapped with at least one information bit~~, respectively~~.

38. (Currently Amended) A transmitter for transmitting a preamble sequence in a mobile communication system, the transmitter comprising:

a preamble generation unit configured to generate said preamble sequence by repeating a specific sequence, having a length (L), N times to generate a consecutive sequence having a length (N*L) and concatenating a single cyclic prefix (CP) to a front end of said consecutive sequence;

~~means for generating said preamble sequence by repeating a specific sequence at least one time and concatenating a cyclic prefix (CP) to a front end of said repeated sequence, said cyclic prefix being identical to a rear end of said specific sequence; and~~

~~means for transmitting~~ a transmission unit configured to transmit, on a random access channel, said preamble sequence to a receiving side ~~on a random access channel~~.

39. (Currently Amended) The transmitter of claim 38, wherein ~~said means for generating said preamble are~~ said preamble generation unit is further configured to generate said specific sequence from a Constant Amplitude Zero Auto Correlation (CAZAC) ~~(Constant Amplitude Zero Auto Correlation)~~ sequence.

40. (Currently Amended) The transmitter of claim 39, wherein said preamble generation unit ~~said means for generating said preamble are~~ is further configured to apply a cyclic shift to said specific sequence generated from said CAZAC sequence.

41. (Currently Amended) The transmitter of claim 40, wherein a value of said applied cyclic shift is determined as an integer ~~value~~ multiple of a predetermined circular shift unit.

42. (Currently Amended) The transmitter of ~~claim 39~~ claim 40, wherein a value of said applied cyclic shift is used as additional information.

43. (Currently Amended) The transmitter of ~~claim 39~~ claim 40, wherein said preamble generation unit ~~means for generating said preamble are~~ is further configured to apply ~~a cyclic~~ said cyclic shift by multiplying said specific sequence by an exponential sequence.

44. (Currently Amended) The transmitter of claim 38, wherein said preamble generation unit ~~means for generating said preamble are~~ is further configured to generate said specific sequence by combining at least two code sequences mapped with at least one information bit~~, respectively~~.

45. (New) The method of claim 31, wherein:

said consecutive sequence comprises at least a first sequence, a second sequence, and an N-th sequence; and

said CP is identical to a rear part of said N-th sequence.

46. (New) The transmitter of claim 38, wherein:

said consecutive sequence comprises at least a first sequence, a second sequence, and an N-th sequence; and

said CP is identical to a rear part of said N-th sequence.

REMARKS

Claims 31-46 are pending in the application. Claims 31-34 and 37-44 are currently amended. Claims 45 and 46 are newly submitted. No new matter has been added as the amendments and newly submitted claims have support in the specification as originally filed. It is submitted that the application, as amended, is in condition for allowance. Reconsideration is respectfully requested.

Applicant notes with appreciation the Examiner's acknowledgement of Applicant's claim for foreign priority under 35 USC 119(a)-(d) and that all certified copies of the priority documents have been received.

Claims 31-44 are rejected under 35 U.S.C. 102(b) as being anticipated by Jung et al. (US 2006/0153282). Applicant respectfully traverses these rejections, and requests reconsideration and allowance of the pending claims in view of the following arguments.

As amended, independent claim 31 recites repeating a specific sequence, having a length (L), N times to generate a consecutive sequence having a length (N*L) and generating said preamble sequence by concatenating a single cyclic prefix (CP) to a front end of said consecutive sequence.

Page 2 of the Office Action states that paragraphs 0064 and 0068 of Jung disclose generating said preamble sequence by repeating a specific sequence at least one time and concatenating a cyclic prefix (CP) to a front end of said repeated sequence. Applicant provides the following remarks.

A review of cited paragraph 0064 of Jung reveals that Jung arguably discloses repeatedly transmitting a second preamble sequence. Furthermore, cited paragraph 0064 of Jung discloses that a combination of second preamble sequences is transmitted through, for example, odd and even frames. Accordingly, Jung discloses that the second preamble sequence is repeated through separate frames, such as, odd and even frames (Jung, paragraph 0064). Applicant submits that repeating a preamble via separate frames, each of which including an individual cyclic prefix and first preamble sequences, is patentably distinguishable from repeating a specific sequence, having a length (L), N times to generate a consecutive sequence having a length (N*L), as

recited in independent claim 31. More specifically, since the second preamble sequence of Jung is repeated in different frames, the second preamble sequence of Jung is not a consecutive sequence as required by independent claim 31. Therefore, since Jung fails to disclose generating a consecutive sequence by repeating a specific sequence, Jung cannot teach or suggest "repeating a specific sequence, having a length (L), N times to generate a consecutive sequence having a length (N*L)," as recited in independent claim 31.

Furthermore, cited paragraph 0068 of Jung discloses that "the guard interval signal is inserted using a cyclic prefix scheme in which the last predetermined samples of a time domain OFDM symbol are copied and inserted into an effective OFDM symbol or a cyclic postfix scheme in which the first predetermined samples of a time domain OFDM symbol are copied and inserted into an effective OFDM symbol."

A review of cited paragraph 0068 of Jung reveals that an OFDM symbol or a cyclic postfix scheme are copied and inserted into an effective OFDM symbol. Similar to the arguments presented above with regard to cited paragraph 0064 of Jung, Applicant submits that although paragraph 0068 of Jung arguably discloses copying and inserting OFDM symbols into an effective OFDM symbol, paragraph 068 of Jung fails to disclose generating a consecutive sequence by repeating a specific sequence, as required by independent claim 31.

Furthermore, Applicant has reviewed Jung and has found no discussion with regard to "generating said preamble sequence by concatenating a single cyclic prefix to a front end of said consecutive sequence," as recited in independent claim 31. Rather, a review of FIG. 2 of Jung reveals that a preamble sequence of Jung may include more than one cyclic prefix. Therefore, Applicant submits that Jung cannot teach or suggest generating said preamble sequence by concatenating a single cyclic prefix (CP) to a front end of said consecutive sequence, as recited in independent claim 31.

To assist the Examiner in understanding the Applicant's position with regard to Jung, Applicant provides below relevant portions of FIG. 2 of Jung, which has been annotated in accordance with Applicant's position.

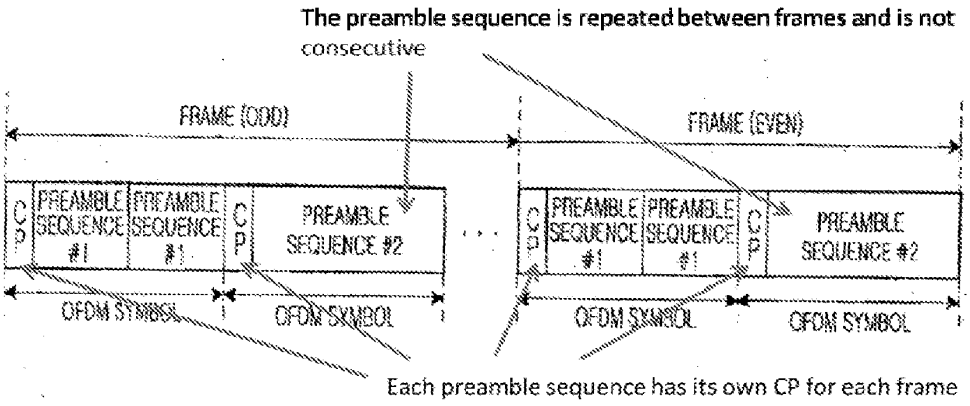

FIG.2

As illustrated in annotated FIG. 2 of Jung, the preamble sequences do not form a consecutive sequence, rather, the preamble sequences are repeated in different frames. For example, the preamble sequence #2 is split between two frames, and therefore, since the preamble sequence #2 is split between two frames, the preamble sequence #2 is not a consecutive sequence. Accordingly, as previously discussed, Jung cannot teach or suggest "repeating a specific sequence, having a length (L), N times to generate a consecutive sequence having a length (N*L)," as recited in independent claim 31.

Furthermore, as illustrated in annotated FIG. 2, each of the frames, even and odd, has its own CP. Therefore, since each frame has its own CP, the preamble sequences of Jung are not concatenated with a single CP to a front end of the consecutive sequence, as required in independent claim 31. In other words, each preamble sequence of Jung has its own CP, as opposed to a single CP concatenated to a front end of the consecutive sequence to generate a preamble symbol. Therefore, as previously discussed, since Jung does not disclose concatenating a single CP to a front end of the consecutive sequence to generate a preamble symbol, Jung cannot teach or suggest "generating said preamble sequence by concatenating a single cyclic prefix (CP) to a front end of said consecutive sequence," as recited in independent claim 31.

Furthermore, FIG. 2 of Jung arguably illustrates a consecutive "preamble sequence #1." However, Applicant submits that the consecutive "preamble sequence #1," as illustrated in FIG. 2 of Jung is entirely different from the "consecutive sequence" required in independent claim 31.

Specifically, paragraph 0041 of Jung discloses that "the preamble sequence transmitted through the first transmit antenna is referred to as the first preamble sequence (Preamble Sequence #1)." Additionally, paragraphs 0046-0051 of Jung disclose that the first preamble sequence is divided into subsequences and the generated subsequences are transmitted through the first antenna. Accordingly, Applicant submits that in view of paragraphs 0041 and 0046-0051 of Jung, the "preamble sequence #1" of FIG. 2 of Jung is a consecutive sequence of subsequences of the first preamble sequence. In other words, Jung does not repeat the first preamble sequence in order to create a consecutive sequence, and therefore, the consecutive "preamble sequence #1" illustrated in FIG. 2 of Jung, is patentably distinguishable from the "consecutive sequence" of independent claim 31. Thus, notwithstanding the arguments presented above, Applicant submits that Jung cannot teach or suggest "repeating a specific sequence, having a length (L), N times to generate a consecutive sequence having a length (N*L)," as recited in independent claim 31.

Applicant has demonstrated above that Jung fails to teach or suggest various elements recited in independent claim 31, and therefore, independent claim 31 is allowable over the cited reference. Additionally, independent claim 38 recites elements similar to those recited in independent claim 31 and is allowable for reasons similar to those presented with regard to independent claims 31. Finally, claims 32-37 and 39-44 are allowable at least by virtue of their dependence on an allowable base claim.

Finally, although not formally rejected, newly submitted claims 45 and 46 are allowable at least by virtue of their dependence on an allowable base claim.

CONCLUSION

In light of the above remarks, Applicant submits that the present Amendment places all claims of the present application in condition for allowance. Reconsideration of the application is requested.

If for any reason the Examiner finds the application other than in condition for allowance, the Examiner is requested to call the undersigned attorney at the Los Angeles, California, telephone number (213) 623-2221 to discuss the steps necessary for placing the application in condition for allowance. Please charge any additional fees and credit any overpayment to **Deposit Account No. 502290**.

Respectfully submitted,

Lee, Hong, Degerman, Kang & Waimey

Date: December 16, 2011

By: /Puya Partow-Navid/
Puya Partow-Navid
Registration No. 59,657
Attorney for Applicant(s)

Customer No. 035884

Electronic Acknowledgement Receipt

EFS ID:	11645476
Application Number:	12303947
International Application Number:	
Confirmation Number:	1730
Title of Invention:	METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yeong Hyeon Kwon
Customer Number:	35884
Filer:	Puya Partow-Navid/Anna Tounian
Filer Authorized By:	Puya Partow-Navid
Attorney Docket Number:	2101-3596
Receipt Date:	16-DEC-2011
Filing Date:	07-JUL-2010
Time Stamp:	21:12:07
Application Type:	U.S. National Stage under 35 USC 371

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Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	2101-3596-Transmittal-ROA.pdf	67361 a432e136d927bfa7fba080b33d204dcc1e700b42	no	1

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2		2101-3596-ROA.pdf	472138 3885157e7a60e672eea6582bce42f585d0a5074f	yes	10

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	Document Description	**Start**	**End**
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Specification	2	2
	Claims	3	5
	Applicant Arguments/Remarks Made in an Amendment	6	10

Warnings:	
Information:	
Total Files Size (in bytes):	539499

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
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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.

Customer No. 035884 **Docket No. 2101-3596**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	Yeong Hyeon KWON et al.	Art Unit:	2478
Serial No.:	12/303,947	Examiner:	Khajuria, Shripal K.
Filed:	July 7, 2010	Conf. No.	1730
For:	METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM		

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

Sir:
Transmitted herewith is an AMENDMENT in the above-identified application.

☐ A petition for extension of time for _ month(s) is enclosed.
☒ No additional fee is required.

The fee has been calculated as shown below:

	(Col. 1) CLAIMS REMAINING AFTER AMENDMENT		(Col. 2) HIGHEST NUMBER PREVIOUSLY PAID FOR		(Col. 3) PRESENT EXTRA*	LG/SM $ ENTITY FEE		ADD'L FEE DUE
TOTAL CLAIMS FEE	16	-	31	**	0	LG=$60 SM=$30	$60	$ 0
INDEPENDENT CLAIMS FEE	2	-	7	***	0	LG=$250 SM=$125	$250	$ 0
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIMS						LARGE ENTITY FEE = $450 SMALL ENTITY FEE = $225		$ 0
							TOTAL	$ 0

* If the entry in Col. 1 is less than the entry in Col. 2, write "0" in Col. 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, write "20" in this space.
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, write "3" in this space. The "Highest Number Previously Paid For" (Total or Independent) is the highest number found from the equivalent box on Col. 1 of a prior amendment or the number of claims originally filed.

☒ The Commissioner is hereby authorized to charge payment of the following fees associated with this communication or credit any overpayment to **Deposit Account No. 502290**:
- ☐ Excess claim(s) fee in the amount of $___.
- ☐ RCE fee in the amount of $___.
- ☐ Extension fees in the amount of $____.
- ☐ Petition fee in the amount of $____.
- ☐ Terminal Disclaimer fee in the amount of $___.
- ☒ Any filing fees under 37 CFR 1.16 for the presentation of extra claims.
- ☒ Any patent application processing fees under 37 CFR 1.17.

Respectfully submitted,
Lee, Hong, Degerman, Kang & Waimey

Date: December 16, 2011

By: /Puya Partow-Navid/
Puya Partow-Navid
Registration No. 59,657
Attorney for Applicant(s)

PTO/SB/06 (07-06)
Approved for use through 1/31/2007. 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 12/303,947	Filing Date 07/07/2010	☐ To be Mailed

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)	SMALL ENTITY ☐		OR	OTHER THAN SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	14 minus 20 =	* 0	X $ =		OR	X $52 =	0
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	* 0	X $ =			X $220 =	0
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 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			TOTAL	0

APPLICATION AS AMENDED – PART II

AMENDMENT	12/16/2011	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE ($)	ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 16	Minus	** 20	= 0	X $ =		OR	X $60=	0
	Independent (37 CFR 1.16(h))	* 2	Minus	***3	= 0	X $ =		OR	X $250=	0
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	0

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner:
/GLENN BURNS JR/

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.

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	12303947
	Filing Date	2010-07-07
	First Named Inventor	Yeong Hyeon Kwon
	Art Unit	2478
	Examiner Name	KHAJURIA, SHRIPAL K
	Attorney Docket Number	2101-3596

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] ¡	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2005/011128	WO		2005-02-03	COHDA WIRELESS PTY LTD		☐
	2	2006/015108	WO		2006-02-09	ZTE SAN DIEGO, INC		☐

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	12303947
	Filing Date	2010-07-07
	First Named Inventor	Yeong Hyeon Kwon
	Art Unit	2478
	Examiner Name	KHAJURIA, SHRIPAL K
	Attorney Docket Number	2101-3596

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		☐

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

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

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

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	12303947
	Filing Date	2010-07-07
	First Named Inventor	Yeong Hyeon Kwon
	Art Unit	2478
	Examiner Name	KHAJURIA, SHRIPAL K
	Attorney Docket Number	2101-3596

CERTIFICATION STATEMENT

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

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

OR

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

☐ See attached certification statement.

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

☐ A certification statement is not submitted herewith.

SIGNATURE

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

Signature	/Harry Lee/	Date (YYYY-MM-DD)	2011-10-31
Name/Print	Harry Lee	Registration Number	56,814

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

Privacy Act Statement

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

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

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

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

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	11305692
Application Number:	12303947
International Application Number:	
Confirmation Number:	1730
Title of Invention:	METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yeong Hyeon Kwon
Customer Number:	35884
Filer:	Harry Sung Lee/Neeti Rajput
Filer Authorized By:	Harry Sung Lee
Attorney Docket Number:	2101-3596
Receipt Date:	31-OCT-2011
Filing Date:	07-JUL-2010
Time Stamp:	19:22:13
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	2101-3596_101811_IDSform.pdf	612267 af896a81afd1184f65ec388e5c3bf63d4ddad125	no	4

Warnings:	
Information:	

A U.S. Patent Number Citation or a U.S. Publication Number Citation is required in the Information Disclosure Statement (IDS) form for autoloading of data into USPTO systems. You may remove the form to add the required data in order to correct the Informational Message if you are citing U.S. References. If you chose not to include U.S. References, the image of the form will be processed and be made available within the Image File Wrapper (IFW) system. However, no data will be extracted from this form. Any additional data such as Foreign Patent Documents or Non Patent Literature will be manually reviewed and keyed into USPTO systems.

2	Foreign Reference	WO2005011128.pdf	18286748 ffb701ce916b0d6dc389f2a37e67f4862170a354	no	113
Warnings:					
Information:					
3	Foreign Reference	WO2006015108.pdf	3533196 bd409cf6cdf1a34417374c617538163f4fae3888	no	34
Warnings:					
Information:					
			Total Files Size (in bytes):	22432211	

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

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New International Application Filed with the USPTO as a Receiving Office

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UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/303,947	07/07/2010	Yeong Hyeon Kwon	2101-3596	1730

35884 7590 09/16/2011

LEE, HONG, DEGERMAN, KANG & WAIMEY
660 S. FIGUEROA STREET
Suite 2300
LOS ANGELES, CA 90017

EXAMINER	
KHAJURIA, SHRIPAL K	
ART UNIT	PAPER NUMBER
2478	

NOTIFICATION DATE	DELIVERY MODE
09/16/2011	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):

uspto@lhlaw.com
ip.lhlaw@gmail.com
ip.lhlaw@live.com

PTOL-90A (Rev. 04/07)

Office Action Summary	Application No.	Applicant(s)	
	12/303,947	KWON ET AL.	
	Examiner	Art Unit	
	SHRIPAL KHAJURIA	2478	

-- 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* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, 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 *21 January 2009*.

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) *31-44* 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) *31-44* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☒ The drawing(s) filed on *08 December 2008* 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).

12)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

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

a)☒ All b)☐ Some * c)☐ None of:

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) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *7/17/09*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 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 31-44 are rejected under 35 U.S.C. 102(b) as being anticiapted by Jung et al US (20060153282).

a. Regarding claim 1, Jung et al teaches a method of transmitting a preamble sequence in a mobile communication system (see paragraph [0003], the preamble is transmitted), the method comprising: generating said preamble sequence by repeating a specific sequence at least one time and concatenating a cyclic prefix (CP) to a front end of said repeated sequence (see paragraphs [0064] and [0068], the first or last part of the OFDM symbol is copied and repeatedly placed), said CP being identical to a part of a rear end of said specific sequence (see paragraph [0068], the OFDM symbol is copied); and transmitting said preamble sequence to a receiving side on a random access channel (see paragraph [0069], the preamble is transmitted in every frame).

b. Regarding claim 32, Jung et al teaches further comprising generating said specific sequence from a CAZAC (Constant Amplitude Zero Auto Correlation) sequence (see paragraph [0045]).

c. Regarding claim 33, Jung et al teaches further comprising applying a cyclic shift to said specific sequence generated from said CAZAC (see paragraph [0048]).

d. Regarding claim 34, Jung et al teaches wherein a value of said applied cyclic shift is determined as an integer value of a predetermined circular shift unit (see paragraph [0048]).

e. Regarding claim 35, Jung et al teaches wherein a value of said applied cyclic shift is used as additional information (see paragraph [0068]).

f. Regarding claim 36, Jung et al teaches wherein applying said cyclic shift comprises multiplying said specific sequence by an exponential sequence (see paragraph [0048] and equation 1).

g. Regarding claim 37, Jung et al teaches further comprising generating said specific sequence by combining at least two code sequences mapped with at least one information bit, respectively (see paragraph [0043]).

h. Regarding claim 38, Jung et al teaches a transmitter for transmitting a preamble sequence in a mobile communication system (see paragraph [0025], a method of transmitting a preamble from a transmitter is disclosed), the transmitter comprising: means for generating said preamble sequence by repeating a specific sequence at least one time and concatenating a cyclic prefix

(CP) to a front end of said repeated sequence (see paragraphs [0064] and [0068], the first or last part of the OFDM symbol is copied and repeatedly placed), said cyclic prefix being identical to a rear end of said specific sequence (see paragraph [0068], the OFDM symbol is copied); and means for transmitting said preamble sequence to a receiving side on a random access channel (see paragraph [0069], the preamble is transmitted in every frame).

i. Regarding claim 39, Jung et al teaches wherein said means for generating said preamble are configured to generate said specific sequence from a CAZAC (Constant Amplitude Zero Auto Correlation) sequence (see paragraph [0045]).

j. Regarding claim 40, Jung et al teaches wherein said means for generating said preamble are configured to apply a cyclic shift to said specific sequence generated from said CAZAC (see paragraph [0048]).

k. Regarding claim 41, Jung et al teaches wherein a value of said applied cyclic shift is determined as an integer value of a predetermined circular shift unit (see paragraph [0048]).

l. Regarding claim 42, Jung et al teaches wherein a value of said applied cyclic shift is used as additional information (see paragraph [0068]).

m. Regarding claim 43, Jung et al teaches wherein said means for generating said preamble are configured to apply a cyclic shift by multiplying said specific sequence by an exponential sequence(see paragraph [0048] and equation 1).

n. Regarding claim 44, Jung et al teaches wherein said means for generating said preamble are configured to generate said specific sequence by combining at

least two code sequences mapped with at least one information bit, respectively (see paragraph [0043]).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to SHRIPAL KHAJURIA whose telephone number is (571)270-5662. The examiner can normally be reached on Monday - Friday, 10:00AM-6:30PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jeffrey Pwu can be reached on (571)272-6798. 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.

/S. K./
Examiner, Art Unit 2478

/Jeffrey Pwu/
Supervisory Patent Examiner, Art Unit 2478

Notice of References Cited	Application/Control No. 12/303,947	Applicant(s)/Patent Under Reexamination KWON ET AL.	
	Examiner SHRIPAL KHAJURIA	Art Unit 2478	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-2006/0153282 A1	07-2006	Jung et al.	375/146
	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	Classification
	N					
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	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	12303947	KWON ET AL.
	Examiner	Art Unit
	SHRIPAL KHAJURIA	2478

SEARCHED			
Class	Subclass	Date	Examiner
370	328	9/7/2011	skk

SEARCH NOTES		
Search Notes	Date	Examiner
Text search of East (USPat, USPG_Pub, JPO, EPO, Derwent, IBM_TDB) and Inventor search	9/7/2011	skk

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	12303947
	Filing Date	
	First Named Inventor	Yeong Hyeon Kwon
	Art Unit	1632
	Examiner Name	
	Attorney Docket Number	2101-3596

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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/S.K./	1	20050286409	A1	2005-12-29	Yoon et al.	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
/S.K./	1	1996037079	WO	A1	1996-11-21	QUALCOMM INC.		☐
/S.K./	2	2001/011909	WO	A1	2001-02-15	KONINKLIJKE PHILPS ELECTRONICS N.V.		☐

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Receipt date: 07/17/2009	Application Number	12303947 12303947 - GAU: 2478
INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Filing Date	
(Not for submission under 37 CFR 1.99)	First Named Inventor	Yeong Hyeon Kwon
	Art Unit	1632
	Examiner Name	
	Attorney Docket Number	2101-3596

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		☐

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EXAMINER SIGNATURE

Examiner Signature	/Shripal Khajuria/	Date Considered	09/06/2011

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

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

Receipt date: 07/17/2009	Application Number	12303947	12303947 - GAU: 2478
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Filing Date		
	First Named Inventor	Yeong Hyeon Kwon	
	Art Unit	1632	
	Examiner Name		
	Attorney Docket Number	2101-3596	

CERTIFICATION STATEMENT

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

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

OR

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

☐ See attached certification statement.

☐ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ None

SIGNATURE

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

Signature	/Harry S. Lee/	Date (YYYY-MM-DD)	2009-07-17
Name/Print	Harry S. Lee	Registration Number	56,814

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

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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.

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

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	7734	(370/328).CCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2011/09/01 18:00
S2	13808	kwon.in.	US-PGPUB; USPAT; USOCR	OR	OFF	2011/09/01 18:08
S3	27622	han.in.	US-PGPUB; USPAT; USOCR	OR	OFF	2011/09/01 18:08
S4	52224	park.in.	US-PGPUB; USPAT; USOCR	OR	OFF	2011/09/01 18:08
S5	117541	kim.in.	US-PGPUB; USPAT; USOCR	OR	OFF	2011/09/01 18:08
S6	185530	lee.in.	US-PGPUB; USPAT; USOCR	OR	OFF	2011/09/01 18:08
S7	1736	noh.in.	US-PGPUB; USPAT; USOCR	OR	OFF	2011/09/01 18:08
S8	4	(S2 S3 S4 S5 S6 S7) and (preamble same prefix same repeated).clm.	US-PGPUB; USPAT; USOCR	OR	OFF	2011/09/01 18:08
S9	1	("20050286409").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2011/09/01 19:55
S10	463	cyclic near prefix and preamble same repeat$3	US-PGPUB; USPAT; USOCR	OR	OFF	2011/09/07 10:52
S11	51	cyclic near prefix and preamble same repeat$3 and CAZAC	US-PGPUB; USPAT; USOCR	OR	OFF	2011/09/07 10:52

EAST Search History (Interference)

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BIB DATA SHEET

CONFIRMATION NO. 1730

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/303,947	07/07/2010 RULE	370	2478	2101-3596

APPLICANTS

Yeong Hyeon Kwon, Gyeonggi-do, KOREA, REPUBLIC OF;
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Min Seok Noh, Gyeonggi-do, KOREA, REPUBLIC OF;

**** CONTINUING DATA **************************

This application is a 371 of PCT/KR07/02784 06/08/2007

**** FOREIGN APPLICATIONS **************************

REPUBLIC OF KOREA 10-2006-0052167 06/09/2006
REPUBLIC OF KOREA 10-2006-0057488 06/26/2006

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ****

08/11/2010

Foreign Priority claimed		STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
☑ Yes ☐ No	☐ Met after Allowance	KOREA, REPUBLIC OF	22	14	2
35 USC 119(a-d) conditions met ☑ Yes ☐ No					
Verified and Acknowledged /SHRIPAL K KHAJURIA/ Examiner's Signature	Initials				

ADDRESS

LEE, HONG, DEGERMAN, KANG & WAIMEY
660 S. FIGUEROA STREET
Suite 2300
LOS ANGELES, CA 90017
UNITED STATES

TITLE

METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM

FILING FEE RECEIVED		
1110	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
	12303947	KWON ET AL.
	Examiner	Art Unit
	SHRIPAL KHAJURIA	2478

✓	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	09/07/2011								
	31	✓								
	32	✓								
	33	✓								
	34	✓								
	35	✓								
	36	✓								
	37	✓								
	38	✓								
	39	✓								
	40	✓								
	41	✓								
	42	✓								
	43	✓								
	44	✓								

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/303,947	07/07/2010	Yeong Hyeon Kwon	2101-3596

CONFIRMATION NO. 1730

35884
LEE, HONG, DEGERMAN, KANG & WAIMEY
660 S. FIGUEROA STREET
Suite 2300
LOS ANGELES, CA 90017

PUBLICATION NOTICE

OC000000044678118

Title:METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM

Publication No.US-2010-0296436-A1
Publication Date:11/25/2010

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

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U.S. APPLICATION NUMBER NO.	FIRST NAMED APPLICANT	ATTY. DOCKET NO.
12/303,947	Yeong Hyeon Kwon	2101-3596

35884
LEE, HONG, DEGERMAN, KANG & WAIMEY
660 S. FIGUEROA STREET
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LOS ANGELES, CA 90017

INTERNATIONAL APPLICATION NO.	
PCT/KR07/02784	
I.A. FILING DATE	PRIORITY DATE
06/08/2007	06/09/2006

CONFIRMATION NO. 1730
371 ACCEPTANCE LETTER

OC000000043016021

Date Mailed: 08/16/2010

NOTICE OF ACCEPTANCE OF APPLICATION UNDER 35 U.S.C 371 AND 37 CFR 1.495

The applicant is hereby advised that the United States Patent and Trademark Office in its capacity as a Designated / Elected Office (37 CFR 1.495), has determined that the above identified international application has met the requirements of 35 U.S.C. 371, and is ACCEPTED for national patentability examination in the United States Patent and Trademark Office.

The United States Application Number assigned to the application is shown above and the relevant dates are:

07/07/2010	07/07/2010
DATE OF RECEIPT OF 35 U.S.C. 371(c)(1), (c)(2) and (c)(4) REQUIREMENTS	DATE OF COMPLETION OF ALL 35 U.S.C. 371 REQUIREMENTS

A Filing Receipt (PTO-103X) will be issued for the present application in due course. **THE DATE APPEARING ON THE FILING RECEIPT AS THE " FILING DATE" IS THE DATE ON WHICH THE LAST OF THE 35 U.S.C. 371 (c)(1), (c)(2) and (c)(4) REQUIREMENTS HAS BEEN RECEIVED IN THE OFFICE. THIS DATE IS SHOWN ABOVE.** *The filing date of the above identified application is the international filing date of the international application (Article 11(3) and 35 U.S.C. 363).* Once the Filing Receipt has been received, send all correspondence to the Group Art Unit designated thereon.

The following items have been received:

- Copy of the International Application filed on 12/08/2008
- Copy of the International Search Report filed on 12/08/2008
- Preliminary Amendments filed on 01/21/2009
- Information Disclosure Statements filed on 07/17/2009
- Oath or Declaration filed on 07/07/2010
- U.S. Basic National Fees filed on 12/08/2008

Applicant is reminded that any communications to the United States Patent and Trademark Office must be mailed to the address given in the heading and include the U.S. application no. shown above (37 CFR 1.5)

NINA D BUTLER

Telephone: (703) 756-1446

FORM PCT/DO/EO/903 (371 Acceptance Notice)

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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
12/303,947	07/07/2010	1632	1110	2101-3596	14	2

CONFIRMATION NO. 1730

35884
LEE, HONG, DEGERMAN, KANG & WAIMEY
660 S. FIGUEROA STREET
Suite 2300
LOS ANGELES, CA 90017

FILING RECEIPT

Date Mailed: 08/16/2010

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**

Applicant(s)

Yeong Hyeon Kwon, Gyeonggi-do, KOREA, REPUBLIC OF;
Seung Hee Han, Gyeonggi-do, KOREA, REPUBLIC OF;
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Min Seok Noh, Gyeonggi-do, KOREA, REPUBLIC OF;

Power of Attorney: The patent practitioners associated with Customer Number 35884

Domestic Priority data as claimed by applicant

This application is a 371 of PCT/KR07/02784 06/08/2007

Foreign Applications

REPUBLIC OF KOREA 10-2006-0052167 06/09/2006
REPUBLIC OF KOREA 10-2006-0057488 06/26/2006

If Required, Foreign Filing License Granted: 08/11/2010

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 12/303,947**

Projected Publication Date: 11/25/2010

Non-Publication Request: No

Early Publication Request: No

Title

METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM

Preliminary Class

435

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

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Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4158).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as

set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

PATENT DOCKET NO. 2101-3596
CUSTOMER NO. 035884

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Kwon et al. Serial No: 12/303,947 Filed: December 8, 2008 For: METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM	Art Unit: - Examiner: - Confirmation No. 1730

TRANSMITTAL OF MISSING PARTS

Mail Stop Missing Parts
Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

In response to the "Notification of Missing Requirements under 35 U.S.C. 371" dated May 7, 2010 for the above-identified application, enclosed herewith is:

1. A signed Declaration and Power of Attorney.

Furthermore, please note that a copy of "Sequence Listing" in compliance to 37 CFR 1.821-1.825 requirements is not applicable to this application since this application does not include any nucleotide/amino acid sequence. Therefore, applicant is not submitting a copy of the "Sequence Listing" in computer readable form for the application.

☒ To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any additional fees due or credit any overpayment in connection with the filing of this concurrent and future replies, including extension of time fees, to Deposit Account 502290.

Respectfully submitted,

LEE, HONG, DEGERMAN, KANG & WAIMEY

Date: July 7, 2010

By: /Harry S. Lee/
Harry S. Lee
Registration No. 56,814

Customer No. 035884

PATENT (U.S.A.)

ATTORNEY'S DOCKET NO. 2101-3596

DECLARATION
and POWER OF ATTORNEY

☒ ORIGINAL
☐ CONTINUATION-IN-PART
☐ DIVISIONAL

As a below named inventor, I declare that the information given herein is true, that I believe that I am the original, first and sole inventor (if only one name is listed as 1 below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM

the specification of which is attached hereto unless the following box is checked:

☒ was filed on December 8, 2008 as United States Application Number 12/303,947.

My residence, post office address and citizenship are as stated below next to my name. I acknowledge my duty to disclose information, which is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations § 1.56. I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above. I hereby claim foreign priority benefits under Title 35, United States Code, § 119 OR 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below any foreign application for patent or inventor's certificate, or any PCT international application having a filing date before that of the application on which priority is claimed:

PRIOR FOREIGN APPLICATION(S)

COUNTRY	APPLICATION NUMBER	DATE OF FILING Month Day Year	PRIORITY CLAIMED UNDER 35 U.S.C. 119
PCT	PCT/KR2007/002784	June 8, 2007	YES
Korea	10-2006-0052167	June 9, 2006	YES
Korea	10-2006-0057488	June 26, 2006	YES

I hereby claim the benefit under Title 35, United States Code, §119 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

(Application Serial No.)	(Filing Date)	(Status)

POWER OF ATTORNEY: As a named Inventor, I hereby appoint the following attorney(s) and/or Agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

THE ATTORNEYS ASSOCIATED WITH CUSTOMER NO. 035884

SEND CORRESPONDENCE TO:	Jonathan Y. Kang, Esq. **LEE, HONG, DEGERMAN, KANG & WAIMEY** At the address associated with **Customer No. 35884**	TELEPHONE NO.: FAX NO.:	(213) 623-2221 (213) 623-2211/8601

1	Name of Inventor	Residence: CITY	STATE or COUNTRY
	Yeong Hyeon KWON	Gyeonggi-do	Republic of Korea
	Mailing Address		CITIZENSHIP
	LG Institute, Hogye 1-dong, Dongan-gu, Anyang-si, Gyeonggi-do, 431-080 Republic of Korea		Republic of Korea
2	Name of Inventor	Residence: CITY	STATE or COUNTRY
	Seung Hee HAN	Gyeonggi-do	Republic of Korea
	Mailing Address		CITIZENSHIP
	LG Institute, Hogye 1-dong, Dongan-gu, Anyang-si, Gyeonggi-do, 431-080 Republic of Korea		Republic of Korea
3	Name of Inventor	Residence: CITY	STATE or COUNTRY
	Hyun Hwa PARK	Gyeonggi-do	Republic of Korea
	Mailing Address		CITIZENSHIP
	LG Institute, Hogye 1-dong, Dongan-gu, Anyang-si, Gyeonggi-do, 431-080 Republic of Korea		Republic of Korea
4	Name of Inventor	Residence: CITY	STATE or COUNTRY
	Dong Cheol KIM	Gyeonggi-do	Republic of Korea
	Mailing Address		CITIZENSHIP
	LG Institute, Hogye 1-dong, Dongan-gu, Anyang-si, Gyeonggi-do, 431-080 Republic of Korea		Republic of Korea
5	Name of Inventor	Residence: CITY	STATE or COUNTRY
	Hyun Woo LEE	Gyeonggi-do	Republic of Korea
	Mailing Address		CITIZENSHIP
	LG Institute, Hogye 1-dong, Dongan-gu, Anyang-si, Gyeonggi-do, 431-080 Republic of Korea		Republic of Korea
6	Name of Inventor	Residence: CITY	STATE or COUNTRY
	Min Seok NOH	Gyeonggi-do	Republic of Korea
	Mailing Address		CITIZENSHIP
	LG Institute, Hogye 1-dong, Dongan-gu, Anyang-si, Gyeonggi-do, 431-080 Republic of Korea		Republic of Korea

I further declare that all statements made herein of my own knowledge are true and that all statements made on

information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 1	SIGNATURE OF INVENTOR 2
DATE	DATE 6th, July, 2010
SIGNATURE OF INVENTOR 3	SIGNATURE OF INVENTOR 4
DATE 6th. July. 2010.	DATE 6th. July. 2010
SIGNATURE OF INVENTOR 5	SIGNATURE OF INVENTOR 6
DATE 6th, July, 2010	DATE 6th. July. 2010

PATENT (U.S.A.)

ATTORNEY'S DOCKET NO. 2101-3596

DECLARATION
and POWER OF ATTORNEY

☒ ORIGINAL
☐ CONTINUATION-IN-PART
☐ DIVISIONAL

As a below named inventor, I declare that the information given herein is true, that I believe that I am the original, first and sole inventor (if only one name is listed as 1 below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM

the specification of which is attached hereto unless the following box is checked:

☒ was filed on December 8, 2008 as United States Application Number 12/303,947.

My residence, post office address and citizenship are as stated below next to my name. I acknowledge my duty to disclose information, which is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations § 1.56. I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above. I hereby claim foreign priority benefits under Title 35, United States Code, § 119 OR 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below any foreign application for patent or inventor's certificate, or any PCT international application having a filing date before that of the application on which priority is claimed:

PRIOR FOREIGN APPLICATION(S)

COUNTRY	APPLICATION NUMBER	DATE OF FILING Month Day Year	PRIORITY CLAIMED UNDER 35 U.S.C. 119
PCT	PCT/KR2007/002784	June 8, 2007	YES
Korea	10-2006-0052167	June 9, 2006	YES
Korea	10-2006-0057488	June 26, 2006	YES

I hereby claim the benefit under Title 35, United States Code, §119 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code § 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, § 1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application.

(Application Serial No.)	(Filing Date)	(Status)

POWER OF ATTORNEY: As a named Inventor, I hereby appoint the following attorney(s) and/or Agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith:

THE ATTORNEYS ASSOCIATED WITH CUSTOMER NO. 035884

SEND CORRESPONDENCE TO:	Jonathan Y. Kang, Esq. **LEE, HONG, DEGERMAN, KANG & WAIMEY** At the address associated with **Customer No. 35884**	TELEPHONE NO.: FAX NO.:	(213) 623-2221 (213) 623-2211/8601

1	Name of Inventor	Residence: CITY	STATE or COUNTRY
	Yeong Hyeon KWON	Gyeonggi-do	Republic of Korea
	Mailing Address		CITIZENSHIP
	LG Institute, Hogye 1-dong, Dongan-gu, Anyang-si, Gyeonggi-do, 431-080 Republic of Korea		Republic of Korea
2	Name of Inventor	Residence: CITY	STATE or COUNTRY
	Seung Hee HAN	Gyeonggi-do	Republic of Korea
	Mailing Address		CITIZENSHIP
	LG Institute, Hogye 1-dong, Dongan-gu, Anyang-si, Gyeonggi-do, 431-080 Republic of Korea		Republic of Korea
3	Name of Inventor	Residence: CITY	STATE or COUNTRY
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	Mailing Address		CITIZENSHIP
	LG Institute, Hogye 1-dong, Dongan-gu, Anyang-si, Gyeonggi-do, 431-080 Republic of Korea		Republic of Korea
4	Name of Inventor	Residence: CITY	STATE or COUNTRY
	Dong Cheol KIM	Gyeonggi-do	Republic of Korea
	Mailing Address		CITIZENSHIP
	LG Institute, Hogye 1-dong, Dongan-gu, Anyang-si, Gyeonggi-do, 431-080 Republic of Korea		Republic of Korea
5	Name of Inventor	Residence: CITY	STATE or COUNTRY
	Hyun Woo LEE	Gyeonggi-do	Republic of Korea
	Mailing Address		CITIZENSHIP
	LG Institute, Hogye 1-dong, Dongan-gu, Anyang-si, Gyeonggi-do, 431-080 Republic of Korea		Republic of Korea
6	Name of Inventor	Residence: CITY	STATE or COUNTRY
	Min Seok NOH	Gyeonggi-do	Republic of Korea
	Mailing Address		CITIZENSHIP
	LG Institute, Hogye 1-dong, Dongan-gu, Anyang-si, Gyeonggi-do, 431-080 Republic of Korea		Republic of Korea

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 1	SIGNATURE OF INVENTOR 2
DATE 2010. 6. 20	DATE
SIGNATURE OF INVENTOR 3	SIGNATURE OF INVENTOR 4
DATE	DATE
SIGNATURE OF INVENTOR 5	SIGNATURE OF INVENTOR 6
DATE	DATE

Electronic Patent Application Fee Transmittal

Application Number:	12303947
Filing Date:	
Title of Invention:	METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yeong Hyeon Kwon
Filer:	Harry Sung Lee/Maggie Wen
Attorney Docket Number:	2101-3596

Filed as Large Entity

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

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Oath/decl > 30 months from priority date	1617	1	130	130
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
			Total in USD ($)	**130**

Electronic Acknowledgement Receipt	
EFS ID:	7971170
Application Number:	12303947
International Application Number:	
Confirmation Number:	1730
Title of Invention:	METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yeong Hyeon Kwon
Customer Number:	35884
Filer:	Harry Sung Lee/Maggie Wen
Filer Authorized By:	Harry Sung Lee
Attorney Docket Number:	2101-3596
Receipt Date:	07-JUL-2010
Filing Date:	
Time Stamp:	19:13:20
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$130
RAM confirmation Number	5097
Deposit Account	502290
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. 1.492 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2101-3596_MP.pdf	686024 9a52fcf4a8c6577794c1dd0f689c7561e4eeb81c	yes	7

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Applicant Response to Pre-Exam Formalities Notice	1	1
Oath or Declaration filed	2	7

Warnings:

Information:

2	Fee Worksheet (PTO-875)	fee-info.pdf	30340 ead1a82488c9d77bfaaa64407721bd6f18c532ba	no	2

Warnings:

Information:

Total Files Size (in bytes):	716364

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

U.S. APPLICATION NUMBER NO.	FIRST NAMED APPLICANT	ATTY. DOCKET NO.
12/303,947	Yeong Hyeon Kwon	2101-3596

35884
LEE, HONG, DEGERMAN, KANG & WAIMEY
660 S. FIGUEROA STREET
Suite 2300
LOS ANGELES, CA 90017

INTERNATIONAL APPLICATION NO.	
PCT/KR07/02784	
I.A. FILING DATE	PRIORITY DATE
06/08/2007	06/09/2006

CONFIRMATION NO. 1730
371 FORMALITIES LETTER

Date Mailed: 05/07/2010

NOTIFICATION OF MISSING REQUIREMENTS UNDER 35 U.S.C. 371 IN THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US)

The following items have been submitted by the applicant or the IB to the United States Patent and Trademark Office as an Elected Office (37 CFR 1.495):

- Priority Document
- Copy of the International Application filed on 12/08/2008
- Copy of the International Search Report filed on 12/08/2008
- Preliminary Amendments filed on 01/21/2009
- Information Disclosure Statements filed on 07/17/2009
- U.S. Basic National Fees filed on 12/08/2008

The applicant needs to satisfy supplemental fees problems indicated below.

The following items **MUST** be furnished within the period set forth below in order to complete the requirements for acceptance under 35 U.S.C. 371:

- Oath or declaration of the inventors, in compliance with 37 CFR 1.497(a) and (b), identifying the application by the International application number and international filing date.
- To avoid abandonment, a surcharge (for late submission of filing fee, search fee, examination fee or oath or declaration) as set forth in 37 CFR 1.492(h) of $130 for a non-small entity, must be submitted with the missing items identified in this letter.

SUMMARY OF FEES DUE:

Total additional fees required for this application is $**130** for a Large Entity:

- $**130** Surcharge.
- This application clearly fails to comply with the requirements of 37 CFR. 1.821-1.825. Applicant's attention is directed to the final rulemaking notice published at 55 FR 18230 (May 1, 1990), and 1114 OG 29 (May 15, 1990). If the effective filing date is on or after July 1, 1998, see the final rulemaking notice published at 63 FR 29620 (June 1, 1998) and 1211 OG 82 (June 23, 1998). If the effective filing date is on or after September 8, 2000, see the final rulemaking notice published in the Federal Register at 65 FR 54604 (September 8, 2000) and 1238 OG 145 (September 19, 2000). Applicant must provide an initial computer readable form (CRF) copy of the "Sequence Listing", an initial paper or compact disc copy of the "Sequence Listing", **as well as an amendment specifically directing its entry into the application**. Applicant must also provide a statement that the content of the sequence listing information recorded in computer readable form is identical to the written (on paper or compact disc) sequence listing and, where applicable, includes no new matter, as required by 37 CFR 1.821(e), 1.821(f), 1.821(g), 1.825(b), or 1.825(d). If applicant desires the sequence

FORM PCT/DO/EO/905 (371 Formalities Notice)

listing in the instant application to be identical with that of another application on file in the U.S. Patent and Trademark Office, such request in accordance with 37 CFR 1.821(e) may be submitted in lieu of a new CRF.

- A copy of the "Sequence Listing" in computer readable form has not been submitted as required by 37 CFR 1.821(e). If the effective filing date is on or after September 8, 2000, see the final rulemaking notice published in the Federal Register at 65 FR 54604 (September 8, 2000) and 1238 OG 145 (September 19, 2000). Applicant must provide an initial computer readable form (CRF) copy of the "Sequence Listing" and a statement that the content of the sequence listing information recorded in computer readable form is identical to the written (on paper or compact disc) sequence listing and, where applicable, includes no new matter, as required by 37 CFR 1.821(e), 1.821(f), 1.821(g), 1.825(b), or 1.825(d). If applicant desires the sequence listing in the instant application to be identical with that of another application on file in the U.S. Patent and Trademark Office, such request in accordance with 37 CFR 1.821(e) may be submitted in lieu of a new CRF.

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.

For questions regarding compliance to 37 CFR 1.821-1.825 requirements, please contact:

- **For Rules Interpretation, call (571) 272-0951**
- **For Patentin Software Program Help, call Patent EBC at 1-866-217-9197 or directly at 703-305-3028 / 703-308-6845 between the hours of 6 a.m. and 12 midnight, Monday through Friday, EST.**
- **Send e-mail correspondence for Patentin Software Program Help @ ebc@uspto.gov**

ALL OF THE ITEMS SET FORTH ABOVE MUST BE SUBMITTED WITHIN TWO (2) MONTHS FROM THE DATE OF THIS NOTICE OR BY 32 MONTHS FROM THE PRIORITY DATE FOR THE APPLICATION, WHICHEVER IS LATER. FAILURE TO PROPERLY RESPOND WILL RESULT IN ABANDONMENT.

The time period set above may be extended by filing a petition and fee for extension of time under the provisions of 37 CFR 1.136(a).

Applicant is reminded that any communications to the United States Patent and Trademark Office must be mailed to the address given in the heading and include the U.S. application no. shown above (37 CFR 1.5)

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web.
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.

NADINE V CLARK

Telephone: (703) 756-1411

FORM PCT/DO/EO/905 (371 Formalities Notice)

MULTIPLE DEPENDENT CLAIM FEE CALCULATION SHEET

(FOR USE WITH FORM PTO-875)

SERIAL NO. 12/303,947

FILING DATE

APPLICANT(S)

CLAIMS

	AS FILED		AFTER 1ST AMENDMENT		AFTER 2ND AMENDMENT	
	IND.	DEP.	IND.	DEP.	IND.	DEP.
1	1					
2		1				
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TOTAL IND.		⬇	2	⬇		⬇
TOTAL DEP		⬅	12	⬅		⬅
TOTAL CLAIMS			14			

	AS FILED		AFTER 1ST AMENDMENT		AFTER 2ND AMENDMENT	
	IND.	DEP.	IND.	DEP.	IND.	DEP.
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TOTAL IND.		⬇		⬇		⬇
TOTAL DEP		⬅		⬅		⬅
TOTAL CLAIMS						

PATENT APPLICATION FEE DETERMINATION RECORD

Effective October 2, 2008

Application or Docket Number: 12/303,947

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)	SMALL ENTITY RATE	SMALL ENTITY FEE	OR	LARGE ENTITY RATE	LARGE ENTITY FEE
U.S. NATIONAL STAGE FEES							
BASIC FEE	$330/ $165		BASIC FEE		OR	BASIC FEE	330
EXAMINATION FEE	$220/ $110		EXAM. FEE			EXAM. FEE	220
SEARCH FEE	$430/ $215		SEARCH FEE			SEARCH FEE	430
FEE FOR EXTRA SPEC. PGS.	minus 100 =	/ 50 =	X $ 135 =			X $ 270 =	
TOTAL CHARGEABLE CLAIMS	14 minus 20 =		X $ 26 =		OR	X $ 52 =	
INDEPENDENT CLAIMS	2 minus 3 =		X $ 110 =		OR	X $ 220 =	
MULTIPLE DEPENDENT CLAIM PRESENT		☐	+ $ 195 =		OR	+ $ 390 =	
* If the difference in column 1 is less than zero, enter "0" in column 2			TOTAL		OR	TOTAL	980

CLAIMS AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
AMENDMENT A	Total		Minus	**	
	Independent		Minus	***	
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY RATE	SMALL ENTITY ADDITIONAL FEE	OR	OTHER THAN SMALL ENTITY RATE	OTHER THAN SMALL ENTITY ADDITIONAL FEE
X $ 26 =		OR	X $ 52 =	
X $ 110 =		OR	X $ 220 =	
+ $ 195 =		OR	+ $ 390 =	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
AMENDMENT B	Total		Minus	**	
	Independent		Minus	***	
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY RATE	SMALL ENTITY ADDITIONAL FEE	OR	OTHER THAN SMALL ENTITY RATE	OTHER THAN SMALL ENTITY ADDITIONAL FEE
X $ 26 =		OR	X $ 52 =	
X $ 110 =		OR	X $ 220 =	
+ $ 195 =		OR	+ $ 390 =	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. 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.

PTO/SB/08a (10-08)
Approved for use through 11/30/2008. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	12303947
	Filing Date	
	First Named Inventor	Yeong Hyeon Kwon
	Art Unit	1632
	Examiner Name	
	Attorney Docket Number	2101-3596

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1					

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20050286409	A1	2005-12-29	Yoon et al.	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] ¡	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	1996037079	WO	A1	1996-11-21	QUALCOMM INC.		☐
	2	2001/011909	WO	A1	2001-02-15	KONINKLIJKE PHILPS ELECTRONICS N.V.		☐

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	12303947
	Filing Date	
	First Named Inventor	Yeong Hyeon Kwon
	Art Unit	1632
	Examiner Name	
	Attorney Docket Number	2101-3596

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		☐

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature		Date Considered	

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

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

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	12303947
	Filing Date	
	First Named Inventor	Yeong Hyeon Kwon
	Art Unit	1632
	Examiner Name	
	Attorney Docket Number	2101-3596

CERTIFICATION STATEMENT

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

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

OR

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

☐ See attached certification statement.

☐ Fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ None

SIGNATURE

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

Signature	/Harry S. Lee/	Date (YYYY-MM-DD)	2009-07-17
Name/Print	Harry S. Lee	Registration Number	56,814

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

Privacy Act Statement

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

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

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

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

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt	
EFS ID:	5725860
Application Number:	12303947
International Application Number:	
Confirmation Number:	1730
Title of Invention:	METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yeong Hyeon Kwon
Customer Number:	35884
Filer:	Harry Sung Lee
Filer Authorized By:	
Attorney Docket Number:	2101-3596
Receipt Date:	17-JUL-2009
Filing Date:	
Time Stamp:	16:44:53
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Foreign Reference	2101-3596_F1.pdf	3306351 bee7bbfd255ac25e9275863af60ac6f13ed97f04	no	78
Warnings:					
Information:					

2	Foreign Reference	2101-3596_F2.pdf	764950 a552e41e344876e09f788d61808fdfc69d9fdbc6	no	20
Warnings:					
Information:					
3	Information Disclosure Statement (IDS) Filed (SB/08)	IDS_1449_2101-3596.pdf	608326 82864c94643be507cf3448c1707a176dbea38c85	no	4
Warnings:					
Information:					
		Total Files Size (in bytes):	4679627		

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.

Attorney Docket No. 2101-3596

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Yeong Hyeon KWON et al. Serial No.: 12/303,947 Filed: December 8, 2008 For: METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM	Art Unit: 1632 Examiner: Not yet assigned Confirmation No. 1730

PRELIMINARY AMENDMENT

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

Dear Sir:

Prior to initial examination on the merits, please amend the above-identified application as follows below. If you have any questions, please direct further correspondence to Customer Number 035884 and the undersigned attorney.

AMENDMENTS TO THE CLAIMS:

Please cancel claims 1-30 without prejudice and add new claims 31-44 as follows:

1-30. Canceled.

31. (New) A method of transmitting a preamble sequence in a mobile communication system, the method comprising:

generating said preamble sequence by repeating a specific sequence at least one time and concatenating a cyclic prefix (CP) to a front end of said repeated sequence, said CP being identical to a part of a rear end of said specific sequence; and

transmitting said preamble sequence to a receiving side on a random access channel.

32. (New) The method of claim 31, further comprising generating said specific sequence from a CAZAC (Constant Amplitude Zero Auto Correlation) sequence.

33. (New) The method of claim 32, further comprising applying a cyclic shift to said specific sequence generated from said CAZAC.

34. (New) The method of claim 33, wherein a value of said applied cyclic shift is determined as an integer value of a predetermined circular shift unit.

35. (New) The method of claim 33, wherein a value of said applied cyclic shift is used as additional information.

36. (New) The method of claim 33, wherein applying said cyclic shift comprises multiplying said specific sequence by an exponential sequence.

37. (New) The method of claim 31, further comprising generating said specific sequence by combining at least two code sequences mapped with at least one information bit, respectively.

38. (New) A transmitter for transmitting a preamble sequence in a mobile communication system, the transmitter comprising:

means for generating said preamble sequence by repeating a specific sequence at least one time and concatenating a cyclic prefix (CP) to a front end of said repeated sequence, said cyclic prefix being identical to a rear end of said specific sequence; and

means for transmitting said preamble sequence to a receiving side on a random access channel.

39. (New) The transmitter of claim 38, wherein said means for generating said preamble are configured to generate said specific sequence from a CAZAC (Constant Amplitude Zero Auto Correlation) sequence.

40. (New) The transmitter of claim 39, wherein said means for generating said preamble are configured to apply a cyclic shift to said specific sequence generated from said CAZAC.

41. (New) The transmitter of claim 40, wherein a value of said applied cyclic shift is determined as an integer value of a predetermined circular shift unit.

42. (New) The transmitter of claim 39, wherein a value of said applied cyclic shift is used as additional information.

43. (New) The transmitter of claim 39, wherein said means for generating said preamble are configured to apply a cyclic shift by multiplying said specific sequence by an exponential sequence.

44. (New) The transmitter of claim 38, wherein said means for generating said preamble are configured to generate said specific sequence by combining at least two code sequences mapped with at least one information bit, respectively.

REMARKS

With this paper, claims 1-30 have been canceled without prejudice and new claims 31-44 have been added. Applicant submits that support for the new claims is found in the specification as originally filed and that no new matter has been added.

Applicant respectfully requests a prompt examination and allowance by the Examiner. If the Examiner has any questions regarding the subject matter submitted herein, please contact the undersigned attorney at the phone number listed below.

Applicant requests that all deficits and credits in regards to this filing be referenced to Deposit Account No. 502290 order 2101-3596.

Respectfully submitted,

LEE, HONG, DEGERMAN, KANG & WAIMEY

Date: January 21, 2009

By: /Richard C. Salfelder/
Richard C. Salfelder
Registration No. 51,127
Attorney for Applicant

Customer No. 035884

Electronic Acknowledgement Receipt

EFS ID:	4653416
Application Number:	12303947
International Application Number:	
Confirmation Number:	1730
Title of Invention:	METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yeong Hyeon Kwon
Customer Number:	35884
Filer:	Richard C. Salfelder/Maggie Wen
Filer Authorized By:	Richard C. Salfelder
Attorney Docket Number:	2101-3596
Receipt Date:	21-JAN-2009
Filing Date:	
Time Stamp:	20:23:38
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2101-3596_PA_filed_01212009.pdf	240973 d969f5dd6a09d8fa74ee8c0ee409cf089bc8ce0d	yes	6

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Miscellaneous Incoming Letter	1	1
	Preliminary Amendment	2	2
	Claims	3	5
	Applicant Arguments/Remarks Made in an Amendment	6	6
Warnings:			
Information:			
	Total Files Size (in bytes):	240973	

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
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Customer No. 035884

PATENT
Attorney Docket: 2101-3596

In re application of:
Yeong Hyeon KWON et al.
Serial No: 12/303,947
Filed: December 8, 2008
For: METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM

Art Unit: 1632
Examiner: Not yet assigned
Confirmation No.: 1730

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

Sir:
Transmitted herewith is a Preliminary Amendment in the above-identified application.

☐ A petition for extension of time for __ month(s) is enclosed.
☐ A Request for Continued Examination (RCE) is enclosed.
☐ __ sheet(s) of replacement drawing(s) is/are enclosed.
☐ An information disclosure statement in accordance with 37 CFR 1.56 and 1.97 is enclosed.
☐ No additional fee is required.

The fee has been calculated as shown below:

	(Col. 1) CLAIMS REMAINING AFTER AMENDMENT		(Col. 2) HIGHEST NUMBER PREVIOUSLY PAID FOR		(Col. 3) PRESENT EXTRA*	LG/SM $ ENTITY FEE		ADD'L FEE DUE
TOTAL CLAIMS FEE	14	-	31	**	0	LG=$52 SM=$26	$52	$ 0
INDEPENDENT CLAIMS FEE	2	-	7	***	0	LG=$220 SM=$110	$220	$ 0
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIMS						LARGE ENTITY FEE = $390 SMALL ENTITY FEE = $195		$ 0
							TOTAL	$ 0

* If the entry in Col. 1 is less than the entry in Col. 2, write "0" in Col. 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, write "20" in this space.
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, write "3" in this space. The "Highest Number Previously Paid For" (Total or Independent) is the highest number found from the equivalent box on Col. 1 of a prior amendment or the number of claims originally filed.

☐ A check in the amount of $_____ to cover the filing fee is enclosed.
☐ A check in the amount of $_____ to cover the extension fee is enclosed.
☐ A check in the amount of $_____ to cover the information disclosure statement fee is enclosed.
☐ A check in the amount of $_____ to cover the petition fee is enclosed.
☒ The Commissioner is hereby authorized to charge payment of the following fees associated with this communication or credit any overpayment to Deposit Account No. 502290.
  ☐ The amount of $_____ for the filing fee.
  ☐ The amount of $_____ for the extension fee.
  ☐ The amount of $_____ for the RCE fee.
  ☒ Any filing fees under 37 CFR 1.16 for the presentation of extra claims.
  ☒ Any patent application processing fees under 37 CFR 1.17.

Respectfully submitted,
Lee, Hong, Degerman, Kang & Waimey

Date: January 21, 2009

By: /Richard C. Salfelder/
Richard C. Salfelder, Esq.
Registration No. 51,127
Attorney for Applicant(s)

Customer #035884

PTO/SB/06 (07-06)
Approved for use through 1/31/2007. 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	Filing Date	☒ To be Mailed
12/303,947	07/07/2010	

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)	SMALL ENTITY ☐		OR	OTHER THAN SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			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 $250 ($125 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			TOTAL	

APPLICATION AS AMENDED – PART II

AMENDMENT	01/21/2009	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE ($)	ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 14	Minus	** 20	= 0	X $ =		OR	X $52=	0
	Independent (37 CFR 1.16(h))	* 2	Minus	***3	= 0	X $ =		OR	X $220=	0
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	0

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	X $ =		OR	X $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	X $ =		OR	X $ =	
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

Legal Instrument Examiner:
/KATRINA HARLING/

PTO-1390 (Rev. 09-06)
Approved for use through 2/28/2010. OMB 0651-0021
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.

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

ATTORNEY'S DOCKET NUMBER	
2101-3596	
U.S. APPLICATION NO. (If known, see 37 CFR 1.5)	

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/KR2007/002784	8 June 2007	9 June 2006

TITLE OF INVENTION
METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM

APPLICANT(S) FOR DO/EO/US
Yeong Hyeon KWON, Seung Hee HAN, Hyun Hwa PARK, Dong Cheol KIM, Hyun Woo LEE and Min Seok NOH

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

1. ☑ This is a **FIRST** submission of items concerning a submission under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a submission under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. ☑ The US has been elected (Article 31).
5. ☑ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☑ is attached hereto (required only if not communicated by the International Bureau).
   b. ☐ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☐ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
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8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes of the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 20 below concern document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☐ A preliminary amendment.
14. ☐ An Application Data Sheet under 37 CFR 1.76.
15. ☐ A substitute specification.
16. ☐ A power of attorney and/or change of address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13*ter*.3 and 37 CFR 1.821- 1.825.
18. ☐ A second copy of the published International Application under 35 U.S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).

U.S. APPLICATION NO. (if known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
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20. Other items or information:

The following fees have been submitted	CALCULATIONS	PTO USE ONLY
21. ☑ Basic national fee (37 CFR 1.492(a)) **$330**	$ 330	
22. ☑ Examination fee (37 CFR 1.492(c)) If the written opinion prepared by ISA/US or the international preliminary examination report prepared by IPEA/US indicates all claims satisfy provisions of PCT Article 33(1)-(4)..... **$0** All other situations..... **$220**	$ 220	
23. ☑ Search fee (37 CFR 1.492(b)) If the written opinion of the ISA/US or the International preliminary examination report prepared by IPEA/US indicates all claims satisfy provisions of PCT Article 33(1)-(4)..... **$0** Search fee (37 CFR 1.445(a)(2)) has been paid on the international application to the USPTO as an International Searching Authority..... **$100** International Search Report prepared by an ISA other than the US and provided to the Office or previously communicated to the US by the IB..... **$430** All other situations..... **$540**	$ 540	
TOTAL OF 21, 22 and 23 =	1,090	
☐ Additional fee for specification and drawings filed in paper over 100 sheets (excluding sequence listing in compliance with 37 CFR 1.821(c) or (e) in an electronic medium or computer program listing in an electronic medium) (37 CFR 1.492(j)). The fee is **$270** for each additional 50 sheets of paper or fraction thereof.		

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CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	31 - 20 =	11	x $ 52	$ 572	
Independent claims	7 - 3 =	4	x $220	$ 880	
MULTIPLE DEPENDENT CLAIM(S) (if applicable)			+ $390	$ 390	
			TOTAL OF ABOVE CALCULATIONS =	$	
☐ Applicant claims small entity status. See 37 CFR 1.27. Fees above are reduced by ½.					
			SUBTOTAL =	$ 2,932	
Processing fee of **$130.00** for furnishing the English translation later than 30 months from the earliest claimed priority date (37 CFR 1.492(i)). +				$	
			TOTAL NATIONAL FEE =	$ 2,932	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00** per property +				$	
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			Amount to be refunded:	$	
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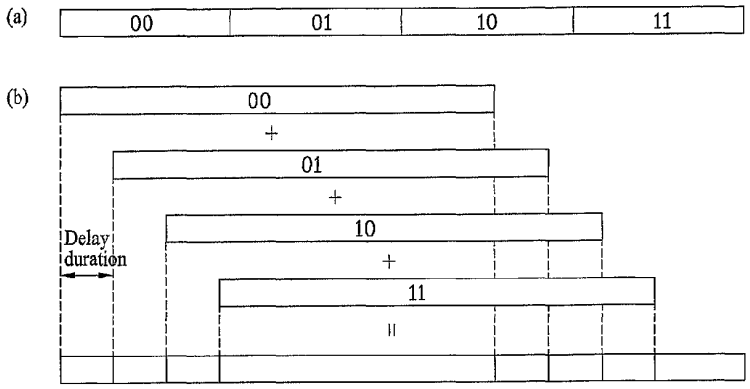
(54) Title: METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICAITON SYSTEM



(57) Abstract: Disclosed is a data transmission method in a mobile ommunication system. The data transmission method through a code sequence in a mobile communication system includes grouping input data streams into a plurality of blocks consisting of at least one bit so as to map each block to a corresponding signature sequence, multiplying a signature sequence stream, to which the plurality of blocks are mapped, by a specific code sequence, and transmitting the signature sequence stream multiplied by the specific code sequence to a receiver.

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METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICAITON SYSTEM

[DESCRIPTION]

TECHNICAL FIELD

The present invention relates to a mobile communication system, and more particularly, to a method of expanding a code sequence, a structure of a random access channel and a method of transmitting data in a mobile communication system.

BACKGROUND ART

A user equipment uses a random access channel (RACH) to access a network in a state that the user equipment is not uplink synchronized with a base station. A signal having repetitive characteristic in a time domain is used in the random access channel, so that a receiver easily searches a start position of a transmission signal. In general, the repetitive characteristic is realized by repetitive transmission of a preamble.

A representative example of a sequence for realizing the preamble includes a CAZAC (Constant Amplitude Zero Auto Correlation) sequence. The CAZAC sequence is expressed by a Dirac-Delta function in case of auto-correlation and has a constant value in case of cross-correlation. In this respect, it has been estimated that the CAZAC sequence has excellent transmission characteristics. However, the CAZAC sequence has limitation in that maximum N-1 number of sequences can be used for a sequence having a length of N. For this reason, a method for increasing available bits of the sequence while maintaining the excellent transmission characteristics is required.

Meanwhile, there are provided various methods for transmitting data from a random access channel by using the CAZAC sequence. Of them, the first method is to directly

interpret CAZAC sequence ID to message information. Assuming that data to be transmitted is a preamble, if a sufficient number of sequences that can be used as the preamble are provided, message passing can be performed with only CAZAC sequence ID without additional manipulation. However, since a method of transmitting additional information should be considered in an actual synchronized RACH, problems occur in that there is difficulty in realizing a sufficient number of CAZAC sequence sets, and the cost required for search of a receiver increases.

The second method is to simultaneously transmit CAZAC sequence and Walsh sequence by using a code division multiplexing (CDM) mode. In this case, CAZAC sequence ID is used as user equipment identification information, and the Walsh sequence transmitted in the CDM mode is interpreted as message information. FIG. 1 is a block schematic view illustrating a transmitter for realizing the second method. However, the second method has limitation in that even though the Walsh sequence is added to the CAZAC sequence, bits of message that can additionally be obtained are only $\log_2 N$ bits when the Walsh sequence has a length of N.

The third method is to transmit CAZAC sequence and Walsh sequence in such a way to mix the Walsh sequence with the CAZAC sequence. In this case, CAZAC sequence ID is used as user equipment identification information, and the Walsh sequence is interpreted as message information. FIG. 2 is a block diagram illustrating a data processing procedure at a transmitter for realizing the third method. However, according to the third method, since the Walsh sequence acts as noise in detection of the CAZAC sequence to cause difficulty in detecting sequence ID, there is limitation in that repetitive sequences should be transmitted to prevent the Walsh sequence from acting as noise in detection of the CAZAC sequence.

The fourth method is to either give orthogonality between blocks constituting a corresponding sequence by multiplying an exponential term by a CAZAC sequence or

directly apply data modulation such as DPSK, DQPSK, D8PSK, etc. In this case, CAZAC sequence ID is used as user equipment identification information, and the modulated sequence is demodulated and then used as message information. FIG. 3A illustrates data modulation according to the former method of the fourth method, and FIG. 3B illustrates data modulation according to the latter method of the fourth.

Furthermore, the fifth method is to transmit CAZAC sequence by attaching a message part to the CAZAC sequence. FIG. 4A illustrates the case where a message (coded bit) is attached to the CAZAC sequence used as a preamble, and FIG. 4B illustrates the case where a message (coded bit) is attached to a sequence consisting of a predetermined number of blocks to which orthogonality is given.

However, the fourth method and the fifth method have a problem in that they are susceptible to change of channel condition.

DISCLOSURE OF THE INVENTION

Accordingly, the present invention has been suggested to substantially obviate one or more problems due to limitations and disadvantages of the related art, and an object of the present invention is to provide a method of transmitting and receiving message between a user equipment and a base station by using a long sequence to maximize time/frequency diversity and alleviating performance attenuation due to channel.

Another object of the present invention is to provide a method of transmitting data through a code sequence in a mobile communication system, in which the quantity of data can be increased and the transmitted data becomes robust to noise or channel change.

Still another object of the present invention is to provide a method of suggesting a structure of an efficient random access channel in a multi-carrier system.

Further still another object of the present invention is to provide a method of

minimizing access time of a user equipment to a random access channel in a mobile communication system.

To achieve these objects and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, a data transmission method through a random access channel in a mobile communication system comprises generating a new code by multiplying a code sequence by an exponential sequence, and transmitting the new code sequence to a receiving side.

In another aspect of the present invention, a data transmission method by using a code sequence in a mobile communication system comprises conjugating at least one element included in at least one block of a code sequence divided by at least two blocks to indicate predetermined information, and transmitting the code sequence, in which the at least one block is conjugated, to a receiving side.

In still another aspect of the present invention, a data transmission method by using a code sequence in a mobile communication system generating a second code sequence indicating predetermined information by combining at least two first code sequences mapped with at least one information bit, respectively, and transmitting the second code sequence to a receiving side.

In further still another aspect of the present invention, a code sequence transmission method in a mobile communication system comprises generating a combination code sequence by combining a base code sequence to at least one code sequence obtained by circular shift of the base code sequence, and transmitting the combination code sequence to a receiving side.

In further still another aspect of the present invention, a code sequence transmission method in a mobile communication system generating a repetitive code sequence by repeatedly concatenating a first code sequence at least one or more times, generating a cyclic

prefix (CP) by copying a certain part of a rear end of the repetitive code sequence and concatenating the copied part to a front end of the repetitive code sequence, and transmitting the repetitive code sequence, in which the CP is generated, to a receiving side.

In further still another aspect of the present invention, a method of allocating a random access channel (RACH) in a multi-carrier system comprises allocating a random access channel to each of at least two consecutive frames in a way that frequency bands of the random access channels allocated to the at least two consecutive frames are not overlapped with each other, and transmitting allocation information of the random access channels allocated to the at least two consecutive frames to at least one user equipment.

In further still another aspect of the present invention, a data transmission method through a code sequence in a mobile communication system mapping each of a plurality of blocks having at least one bit of a input data stream, respectively to a corresponding signature sequence, multiplying a signature sequence stream, to which the plurality of blocks are mapped, by a specific code sequence, and transmitting the signature sequence stream multiplied by the specific code sequence to a receiving side.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates an example of a data transmission method through a random access channel in an OFDMA system according to the related art;

FIG. 2 illustrates another example of a data transmission method through a random access channel in an OFDMA system according to the related art;

FIG. 3A and FIG. 3B illustrate still another example of a data transmission method through a random access channel in an OFDMA system according to the related art;

FIG. 4A and FIG. 4B illustrate further still another example of a data transmission method through a random access channel in an OFDMA system according to the related art;

FIG. 5 illustrates an example of a structure of a random access channel used in an OFDMA system;

FIG. 6A and FIG. 6B illustrate examples of sending an RACH signal in a time domain or a frequency domain based on a structure of a random access channel of FIG. 5;

FIG. 7 illustrates another example of a structure of a random access channel used in an OFDMA system;

FIG. 8A and FIG. 8B illustrate still another example of a structure of a random access channel used in an OFDMA system;

FIG. 9 illustrates a structure of a random access channel according to one embodiment of the present invention;

FIG. 10 illustrates a structure of a random access channel of a sub-frame to which RACH pilot is allocated;

FIG. 11 illustrates a repetitive structure of a preamble according to one embodiment of the present invention;

FIG. 12 is a structural view of unit data to illustrate one embodiment of the present invention, which transmits data by using a code sequence expanded through conjugation;

FIG. 13 is a flow chart illustrating a procedure of receiving and decoding data transmitted in a code sequence expanded through conjugation in accordance with one embodiment of the present invention;

FIG. 14 is a structural view of unit data to illustrate one embodiment of the present invention, which transmits data by using a code sequence expanded through grouping;

FIG. 15 is a flow chart illustrating a procedure of receiving and decoding data transmitted in a code sequence expanded through grouping;

FIG. 16 is a structural view of unit data to illustrate one embodiment of the present invention, which transmits data by using a code sequence expanded through grouping and

delay processing;

FIG. 17 is a flow chart illustrating a procedure of receiving and decoding data transmitted in a code sequence expanded through grouping and delay processing;

FIG. 18 is a structural view of unit data to illustrate one embodiment of the present invention, which transmits data by using a code sequence expanded through PPM modulation;

FIG. 19 is a flow chart illustrating a procedure of receiving and decoding data transmitted in a code sequence expanded through PPM modulation;

FIG. 20A and FIG. 20B are flow charts illustrating a procedure of performing synchronization in a random access channel in accordance with a data transmission method of the present invention;

FIG. 21 illustrates a method of transmitting data to a receiver through a signaling channel in accordance with one embodiment of the present invention; and

FIG. 22 illustrates an example of a receiver and a transmitter for transmitting a preamble and data through RACH, SCH or other channel in accordance with one embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

Hereinafter, structures, operations, and other features of the present invention will be understood readily by the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

A random access channel (RACH) is used to allow a user equipment to access a network in a state that the user equipment is not uplink synchronized with a base station. A random access mode can be classified into an initial ranging access mode and a periodic ranging access mode depending on an access mode to network. According to the initial

ranging access mode, the user equipment acquires downlink synchronization and first accesses a base station. According to the periodic ranging access mode, the user equipment connected with a network accesses the network if necessary. The initial ranging access mode is used to allow the user equipment to synchronize with the network while accessing the network and receive its required ID from the network. The periodic ranging access mode is used to initiate a protocol to receive data from the base station or when a packet to be transmitted exists.

In particular, the periodic ranging access mode can be classified into two types in the 3GPP LTE (long term evolution) system, i.e., a synchronized access mode and a non-synchronized access mode. The synchronized access mode is used if an uplink signal is within a synchronization limit when the user equipment accesses the RACH. The non-synchronized access mode is used if the uplink signal is beyond the synchronization limit. The non-synchronized access mode is used when the user first accesses the base station or synchronization update is not performed after synchronization is performed. At this time, the synchronized access mode is the same as the periodic ranging access mode, and is used when the user equipment accesses the RACH for the purpose of notifying the base station of the change status of the user equipment and requesting resource allocation.

On the other hand, the synchronized access mode alleviates limitation of a guard time in the RACH by assuming that the user equipment does not depart from uplink synchronization with the base station. For this reason, much more time-frequency resources can be used. For example, a considerable amount of messages (more than 24 bits) may be added to a preamble sequence for random access in the synchronized access mode so that both the preamble sequence and the messages may be transmitted together.

A structure of the RACH, which performs a unique function of the RACH while satisfying the aforementioned synchronized and non-synchronized access modes will now be

described.

FIG. 5 is a diagram illustrating an example of a structure of a random access channel (RACH) used in an OFDMA system. As shown in FIG. 5, it is noted that the RACH is divided into N number of sub-frames on a time axis and M number of frequency bands on a frequency axis depending on a radius of a cell. Frequency in generation of the RACH is determined depending on QoS (Quality of Service) requirements in a medium access control (MAC) layer. In general, the RACH is generated per certain period (several tens of milli-seconds (ms) to several hundreds of ms). In this case, frequency diversity effect and time diversity effect are provided in generating several RACHs and at the same time collision between user equipments which access through the RACH is reduced. The length of the sub-frame can be 0.5 ms, 1 ms, etc.

In the RACH structure as shown in FIG. 5, a random sub-frame will be referred to as a time-frequency resource (TFR) which is a basic unit of data transmission. FIG. 6A is a diagram illustrating a type of sending a random access signal to the TFR in a time domain, and FIG. 6B illustrates a type of sending a RACH signal in a frequency domain.

As shown in FIG. 6A, if a random access signal is generated in a time domain, the original sub-frame structure is disregarded and the signal is aligned through only the TFR. By contrast, as shown in FIG. 6B, in case of the synchronized random access mode, the sub-frame structure is maintained in the frequency domain and at the same time a random access signal to be transmitted to sub-carriers of each OFDM symbol is generated. Accordingly, orthogonality can be maintained between respective blocks constituting TFR, and channel estimation can easily be performed.

FIG. 7 is a diagram illustrating another example of a structure of RACH used in an OFDMA system. As shown in FIG. 7, it is noted that a preamble 'b' and a pilot 'a' are partially overlapped in a TDM/FDM mode and a TDM mode of RACH burst duration of an

attached wideband pilot. It is also noted that a pilot 'a' and a pilot 'b' are simultaneously overlapped with a preamble 'a' and the preamble 'b' in the TDM/FDM mode and the TDM mode of an embedded wideband pilot. In other words, it is designed that a preamble and a pilot are together transmitted through the RACH, so that message decoding is easily performed through channel estimation if message is added to the RACH. Alternatively, a wideband pilot is used so that channel quality information (CQI) of a total of RACH bands can be acquired in addition to a preamble band of the RACH.

FIG. 8A and FIG. 8B are diagrams illustrating another examples of a structure of the RACH used in the OFDMA system,

As shown in FIG. 8A, a preamble is transmitted for a predetermined time period through a frequency band, and a short block duration is provided at a certain period so that a pilot for decoding a preamble is transmitted to a corresponding short block. At this time, the pilot transmission is performed through a part of a total of frequency bands (transmission through 25 sub-carriers corresponding to a middle band of a total of 75 sub-carriers), so that the pilot can be transmitted to a specific user equipment under a multi-access environment.

Furthermore, as shown in FIG. 8B, a message to be transmitted and a pilot for decoding the message are multiplexed and continue to be transmitted through some frequency bands (for example, 25 middle sub-carrier bands of a total of 75 sub-carrier bands) selected from a total of frequency bands. Accordingly, respective user equipments which perform multi-access can be identified by allocating some frequency bands at different frequencies.

FIG. 9 is a diagram illustrating a structure of RACH according to one embodiment of the present invention.

Generally, frequency in generation of the RACH is determined depending on QoS requirements in a MAC layer. The RACH is generated at a variable period (several ms to several hundreds of ms) depending on requirements of a cell. The RACH can be generated in

a time domain or a frequency domain as described above with reference to FIG. 6A and FIG. 6B. In the embodiment of FIG. 9, the structure of the RACH corresponds to the case where a random access signal is generated in the frequency domain.

Referring to FIG. 9, in this embodiment, to overcome a drawback of a long interval required for retry when the user equipment fails to access the RACH, a corresponding RACH resource is dispersed in each frame within one period if frequency in generation of the RACH and the quantity of overhead are determined. The number of frames included in one period can freely be determined as occasion demands. At this time, it is preferable that the RACH is divisionally arranged so as to be uniformly distributed for each frequency band with respect to a plurality of frames constituting one period. However, position on the time axis may be changed without change of position on the frequency axis and vice versa depending on specific requirements (synchronized action or decrease of inter-cell interference) of a cell or if a system band is small. Also, arrangement of any one of frequency and time may be changed to obtain the minimum interval between the RACHs arranged in each frame.

In the embodiment of FIG. 9, the network should notify the user equipment of position information of the allocated RACH resource. In other words, the network can notify each user equipment of frequency and time information occupied by the RACH resource allocated for each frame included in one period, and each user equipment can try random access through the allocated RACH resource by using the position information from the network. The position information of the RACH resource of each frame can be expressed by sub-carrier offset, the number of sub-carriers, timing offset, and the number of symbols. However, if the RACH information on each frame is expressed by the above four parameters, it may be undesirable in that the quantity of the information can be increased. Accordingly, a method of decreasing the quantity of the information for expressing the position information of the RACH allocated on each frame is required. The position information of the RACH can

be transmitted through a broadcast channel (BCH) or other downlink control channel.

As one method, a method using a hopping pattern may be considered. The hopping pattern means a pattern consisting of information indicating frequency domains of the RACH resource allocated to each frame within one period. In other words, in the embodiment of FIG. 9, since the RACH resource is divisionally arranged so as to be uniformly distributed for each frequency band with respect to a plurality of frames constituting one period, an indicator which indicates a frequency band that can be allocated to each frame as the RACH resource is previously determined, and the frequency band of the RACH resource allocated to each frame within one period can be notified through a pattern of the indicator which indicates a corresponding frequency band.

For example, if four frames are used as one period in a system which uses a total of bands of 10MHz, the position of the RACH includes sub-bands having an interval of 2.5MHz as one RACH frequency band (band smaller than 1.25MHz or 2.5MHz). At this time, a total of bands consist of four sub-bands, wherein the respective sub-bands are designated by indicators, which indicate each sub-band, as 1, 2, 3 and 4 in due order from a high frequency band to a low frequency band. In this way, the frequency band position information of the RACH resource allocated to all frames within one period can be expressed by patterns configured by the above indicators, for example 2, 3, 1, 4. The hopping pattern may be configured differently or equally depending on each frame. Time information of the RACH resource allocated to each frame within one period can generally be expressed by timing offset and the number of symbols. At this time, at least any one of the timing offset and the number of symbols may be fixed to decrease the quantity of the information. For example, if it is previously scheduled that the timing offset and the number of symbols for the RACH resource of each frame are fixed, the network only needs to transmit the hopping pattern to notify the user equipment of the position information of the RACH resource of all frames

within one period.

If each sub-band is narrow or considering influence of interference between user equipments, hopping patterns for all frames may be set equally. In this case, the network only needs to notify the user equipment of a frame period.

Hereinafter, the procedure of transmitting uplink data from the user equipment to the base station by using the structure of the RACH as shown in the embodiment of FIG. 9 will be described. In this case, data transmission is performed through the RACH among reverse common channels consisting of a plurality of frames.

First of all, the user equipment tries to access the dispersed RACH included in the current frame to transfer its information to the base station. If the user equipment successfully accesses the RACH, the user equipment transmits preamble data through the corresponding RACH. However, if the user equipment fails to access the RACH, the user equipment tries to access the RACH divisionally arranged in the frame of the next order. At this time, the RACH included in the frame of the next order is preferably arranged in a frequency band different from that of the RACH of the previous frame if the frequency band is not sufficiently wide or there are no specific requirements (inter-cell interference or limitation in action range of user equipment). Also, the above access procedure continues to be performed in the frame of the next order until the user equipment successfully accesses the RACH.

Meanwhile, in case of the synchronized RACH, the sub-frame of each frame preferably includes a short block to which a pilot for the user equipment which has accessed the corresponding RACH is allocated. At least one RACH pilot and access pilot may be allocated to the short block at a predetermined pattern. In other words, the user equipment which has accessed the RACH should know channel information to receive a channel from the base station. The channel information may be set in RACH pilot within an uplink short block. The base station allocates a proper channel to the user equipment through the

corresponding RACH pilot. Meanwhile, if the user equipment which accesses the RACH notifies the base station of information of channel quality as to whether the user equipment is preferably allocated with which channel through the RACH pilot, a favorable channel can be allocated to the user equipment during scheduling, whereby communication of good quality can be maintained.

Accordingly, the RACH pilot that can be used for the user equipment which accesses the RACH is separately allocated to the sub-frame which includes RACH. Thus, the user equipment which accesses the RACH sends a preamble to the base station through the corresponding RACH and also sends a pilot for transmission of channel quality information to the designated RACH pilot. The RACH pilot is a sequence designated depending on a preamble, and it is preferable that the user equipments, which use different preamble sequences, use different RACH pilot sequences if possible or select RACH pilot of different sub-carriers or partially overlapped sub-carriers.

FIG. 10 is a diagram illustrating a structure of a random access channel of a sub-frame to which the RACH pilot is allocated. It is noted that each sub-frame includes at least one short block to which at least one RACH pilot and access pilot are allocated at a predetermined pattern. In this case, the RACH pilot exists in the frequency band of the allocated RACH and other system bands. In this embodiment, it has been described that two short blocks exist per one frame and the RACH pilot is transmitted to the short blocks. However, the present invention is not limited to such embodiment, and various modifications can be made within the apparent range by those skilled in the art.

As described above, it has been described that preamble, synchronization timing information including pilot information, uplink resource allocation information and message such as uplink data can be transmitted through the RACH of various structures. It will be apparent that the data transmission method according to the embodiments of the present

invention can be used in the RACH and other channels.

Meanwhile, the preamble and the message may separately be transmitted through the RACH. Alternatively, the message may be transmitted by being implicitly included in the preamble. One embodiment of the present invention relates to a method of transmitting a preamble through the latter transmission manner. In one embodiment of the present invention, a code sequence more expanded than that of the related art can be used for effective transmission of the preamble. Hereinafter, a method of improving CAZAC sequence according to one embodiment of the present invention for effective transmission of the preamble will be described.

Since the receiver should search a start position of a transmission signal in the random access channel, it is generally designed that a transmission signal has a specific pattern in a time domain. To this end, the preamble is transmitted repeatedly or a certain interval is maintained between sub-carriers in a frequency domain to obtain repetitive characteristics in the time domain, thereby identifying time synchronization.

In the former case, the preamble represents a reference signal used for the purpose of initial synchronization setting, cell detection, frequency offset, and channel estimation. In a cellular mobile communication system, a sequence having good cross-correlation characteristic is preferably used for repetitive transmission of the preamble. To this end, binary hardamard code or poly-phase CAZAC sequence may be used. Particularly, the CAZAC sequence has been estimated that it has excellent transmission characteristics as it is expressed by a Dirac-Delta function in case of auto-correlation and has a constant value in case of cross-correlation.

The CAZAC sequence can be classified into GCL sequence (Equation 1) and Zadoff-Chu sequence (Equation 2) as follows.

[Equation 1]

$$c(k;N,M)=\exp\left(-\frac{j\pi Mk(k+1)}{N}\right) \quad \text{for odd N}$$

$$c(k;N,M)=\exp\left(-\frac{j\pi Mk^2}{N}\right) \quad \text{for even N}$$

[Equation 2]

$$c(k;N,M)=\exp\left(\frac{j\pi Mk(k+1)}{N}\right) \quad \text{for odd N}$$

$$c(k;N,M)=\exp\left(\frac{j\pi Mk^2}{N}\right) \quad \text{for even N}$$

In the above Equations, it is noted that if the CAZAC sequence has a length of N, actually available sequences are limited to N-1 number of sequences. Accordingly, it is necessary to increase the number of CAZAC sequences to efficiently use them in an actual system.

For example, a method of expanding the number of available sequences by 1 is suggested by providing an improved CAZAC sequence p(k) in such a way to multiply a CAZAC sequence c(k) by a predetermined modulation sequence m(k). In other words, assuming that Zadoff-Chu sequence is used as the CAZAC sequence, the CAZAC sequence c(k), the modulation sequence m(k) and the improved CAZAC sequence p(k) can be defined by the following Equations 3, 4, and 5, respectively.

[Equation 3]

CAZAC sequence:

$$c(k;N,M)=\exp\left(\frac{j\pi Mk(k+1)}{N}\right)$$

[Equation 4]

Modulation sequence:

$$m(k)=\exp\left(\frac{j2\pi\delta}{N}k\right)$$

[Equation 5]

Improved CAZAC sequence (or improved preamble):

$$p(k)=c(k)*m(k)=\exp\left(\frac{j\pi M}{N}k(k+1)+\frac{j2\pi\delta}{N}k\right)$$

The improved CAZAC sequence p(k) maintains auto-correlation and cross-correlation characteristics of the CAZAC sequence. The following Equation 6 illustrates auto-correlation characteristic of p(k), and it is noted from the Equation 6 that the final result is a Dirac-delta function. In particular, if the modulation sequence m(k) is a sequence having a certain phase, it is characterized in that the modulation sequence m(k) always maintains the auto-correlation characteristic.

[Equation 6]

$$ad(d)=\sum_k \exp\left(\frac{j\pi M}{N}(k+d)(k+d+1)+\frac{j2\pi\delta}{N}(k+d)\right)$$

$$\exp\left(-\frac{j\pi M}{N}k(k+1)-\frac{j2\pi\delta}{N}k\right)$$

$$=\sum_k \exp\left(\frac{j2\pi M}{N}(2dk+d(d+1))+\frac{j2\pi\delta}{N}d\right)$$

$$=exp\left(\frac{j2\pi\delta}{N}d\right)\sum_k \exp\left(\frac{j\pi M}{N}(2dk+d(d+1))\right)=\begin{cases}1 & d=0\\ 0 & d\neq 0\end{cases}$$

Furthermore, the following Equation 7 illustrates cross-correlation characteristic of p(k).

[Equation 7]

$$cc(d) = \sum_k \exp\left(\frac{j\pi(M+x)}{N}(k+d)(k+d+1) + \frac{j2\pi\delta}{N}(k+d)\right) \exp\left(-\frac{j\pi M}{N}k(k+1) - \frac{j2\pi\delta}{N}k\right)$$

$$= \sum_k \exp\left(\frac{j\pi x}{N}(k+d)(k+d+1)\right) \exp\left(\frac{j\pi M}{N}(k+d)(k+d+1) + \frac{j2\pi\delta}{N}(k+d)\right) \exp\left(-\frac{j\pi M}{N}k(k+1) - \frac{j2\pi\delta}{N}k\right)$$

$$= \sum_k \exp\left(\frac{j\pi x}{N}(k+d)(k+d+1)\right) \exp\left(\frac{j\pi M}{N}(2dk + d(d+1)) + \frac{j2\pi\delta}{N}d\right)$$

$$= exp\left(\frac{j\pi M}{N}d(d+1)\right)\sum_k \exp\left(\frac{j\pi x}{N}(k+d)(k+d+1)\right) \exp\left(\frac{j2\pi dM}{N}k\right)$$

In this case, although Equation 7 seems to be similar to Equation 6, it is noted that in view of summation term, auto-correlation is expressed by sum of exponential but cross-correlation is expressed by the product of two sequences. The first term is another CAZAC sequence of which seed value is x, and the second term is a simple exponential function. The sum of the product of two sequences is equal to obtaining a coefficient of the exponential function, and its value is equal to a value obtained by converting the CAZAC sequence of

which seed value is x into a frequency domain and extracting a value from the frequency position of exponential.

Since the CAZAC sequence has auto-correlation of Dirac-delta characteristic, if it undergoes Fourier transform, it maintains auto-correlation characteristic of Dirac-delta of a constant amplitude even in the transformed area. For this reason, if values of specific positions are extracted from the frequency domain, their sizes are 1 and equal to each other but their phases are different from each other. Accordingly, if this result is added to the Equation 7 to obtain cross-correlation, the obtained cross-correlation can briefly be expressed by the following Equation 8.

[Equation 8]

$$cc(d) = exp\left(\frac{j\pi M}{N}d(d+1) + \frac{j2\pi\delta}{N}d\right)\sum_{k}\exp\left(\frac{j\pi x}{N}(k+d)(k+d+1)\right)$$

$$\exp\left(\frac{j2\pi dM}{N}k\right)$$

$$= exp\left(\frac{j\pi M}{N}d(d+1) + \frac{j2\pi\delta}{N}d\right)C(dM/N;x)$$

It is noted from the Equation 8 that since C(dM/N;x) always has a size of 1 and an exponential term also has a size of 1, the cross-correlation is always fixed at 1.

After all, characteristics of the related art CAZAC sequence can be maintained by the Equation 5 and at the same time the number of codes can be increased. This means that the result in the area where the exponential terms are multiplied is equal to applying circular shift to the Fourier transformed area, and multiplying exponential sequences in the time domain is equal to performing circular shift in the frequency domain.

In other words, it is noted that if correlation between two sequences p(k;M,N,d1) and p(k;M,N,d2) of which seed values are equal to each other is obtained, impulse occurs in a

point where a delay value d in cross-correlation reaches d1-d2. Although design of the improved sequence as above has the same result as that of circular shift of the CAZAC sequence, this embodiment of the present invention is advantageous in that the result can be obtained by a simple procedure such as multiplying two exponential sequences without Fourier inverse transform after Fourier transform and circular shift.

Hereinafter, a method of improving data transmission reliability of a preamble by performing predetermined data processing for the related art code sequence and a method of expanding a length of a code sequence when data are simultaneously transmitted will be described. If the CAZAC sequence is used as the code sequence, the CAZAC sequence expanded by the above method is preferably used. However, the CAZAC sequence is not necessarily limited to the CAZAC sequence expanded by the above method, and the related art CAZAC sequence may be used.

First of all, a structure of transmission data, i.e., preamble, which is commonly applied to the embodiments of the present invention, will be described.

In a 3GPP LTE (Long Term Evolution) system, a transmitter can repeatedly transmit the same sequence two times or more so as to allow a receiver to easily detect transmission data or improve additional detection performance (i.e., increase of spreading gain). Accordingly, since the receiver only needs to detect repetitive patterns regardless of the type of the received sequence, it can simply identify time position of a user equipment which accesses the RACH and improve detection performance.

FIG. 11 is a diagram illustrating a structure of a preamble according to one embodiment of the present invention. In an orthogonal frequency divisional transmission system, a cyclic prefix (CP) is used, in which the last part of OFDM symbol is copied and then prefixed to the OFDM symbol to compensate a multi-path loss in signal transmission. Accordingly, if the OFDM symbol consists of two repetitive preambles, a part of the

preamble of the later order is copied in the first part by CP to enable compensation of the multi-path loss for the corresponding preamble. Also, the CP is advantageous in that it is easy to identify user equipments which access different RACHs in case of CAZAC having good periodic correlation.

Since inter-symbol interference does not occur even though a single sequence is transmitted by prefixing CP thereto instead of repetitive transmission of sequence, a predetermined receiving algorithm can be realized in the frequency domain without any problem. However, if the receiver realizes a receiving algorithm in the time domain with neither repetitive transmission nor CP, the receiver should detect all kinds of code sequences to identify user equipments which access the RACH. In this respect, the preamble is preferably realized by a structure of a repetitive pattern. At this time, whether to realize a repetition pattern can be determined depending on a data rate supported by the system or the number of repetitive times can be determined if a repetitive pattern is realized. For example, to support a minimum data rate supported by the system, RACH preamble can repeatedly be transmitted one or more times depending on the length of the sequence.

First to fourth embodiments which will be described later relate to a data processing method of a sequence constituting the structure of the preamble. In these embodiments, data transmitted to the receiver could be the structure of the preamble of FIG. 11 or a partially omitted structure (having neither repetitive transmission nor CP). Although it is assumed that the CAZAC sequence is used as the code sequence for data transmission, the code sequence is not necessarily limited to the CAZAC sequence. Every sequence having excellent transmission characteristic, such as Hadarmad code and gold code, can be used as the code sequence.

<First Embodiment>

To transmit data, a landmark that can be identified is generally required for a

transmission signal constituting data. In this embodiment, conjugation is used as the landmark. Since a phase variation width between a conjugated transmission signal and other transmission signal is very great, interference between transmission signals decreases, whereby reliability of data transmission can be improved in spite of influence of channel.

FIG. 12 illustrates a method of transmitting data through conjugation according to one embodiment of the present invention. In the embodiment of FIG. 12, one CAZAC sequence is divided into four blocks, and '0' or '1' indicates whether to perform conjugate for each block. For example, it may be promised that a block which is not conjugated is expressed by '0', and a block which is conjugated is expressed by '1.' In this way, one CAZAC sequence can express information of 4 bits. In other words, if one CAZAC sequence is divided into N number of blocks, information of N bits can be expressed.

At this time, in a single CAZAC sequence of a long length corresponding to a length of transmission data, a part of the single CAZAC sequence, which corresponds to a specific block having a value of 1, may be conjugated. Also, in a plurality of CAZAC sequences of a short length corresponding to each block length of transmission data, a CAZAC sequence corresponding to a specific block having a value of 1 may be conjugated.

FIG. 13 is a diagram illustrating an example of a method of receiving and decoding the sequence transmitted through conjugation from the transmitter in accordance with one embodiment of the present invention.

It is preferable that the transmitter always allocates a value of 0 to the first block of the transmission data so that the first block is used as a reference later. Accordingly, the receiver identifies sequence ID for the received first block (S1101), and then measures a peak by using only the corresponding block (S1102). Next, the receiver identifies sequence IDs for the first and second blocks (S1103), and then measures a peak by using the first and second blocks together. At this time, since it is unclear whether the sequence of the second block is in

the conjugated status, the receiver respectively measures a peak corresponding to the case where the corresponding block is conjugated (S1104) and a peak corresponding to the case where the corresponding block is not conjugated (S1105), and then selects greater one of the two peaks (S1106). Subsequently, the receiver identifies sequence IDs for the first to third blocks (S1107), and then measures a peak by using the first to third blocks together. In this case, since it is unclear whether the sequence of the third block is in the conjugated status, the receiver respectively measures a peak corresponding to the case where the corresponding block is conjugated (S1108) and a peak corresponding to the case where the corresponding block is not conjugated (S1109), and then selects greater one of the two peaks (S1110). In this way, decoding is performed for the first block to the last block so that the original data is finally decoded.

<Second Embodiment>

FIG. 14 is a diagram illustrating a method of transmitting data using a sequence according to another preferred embodiment of the present invention. Although data transmission is performed by change of the sequence in the first embodiment, in this embodiment, a type of a sequence for expressing one block is divided into a sequence (first sequence) for a block value of '0' and a sequence (second sequence) for a block value of '1,' and the first and second sequence are grouped. In this case, since the receiver detects only sequence ID (ID of the first sequence or ID of the second sequence) for each block, the receiver is less affected by noise or channel.

All sequences are expressed by one group "$\{c_0(k;M_i), c_1(k;M_j)\}$" by grouping two sub-sequences (first sequence and second sequence) (i and j are integers different from each other). In this case, $c_0(k;M_i)$ is the first sequence for the block value of 0 (or bit value), and $c_1(k;M_j)$ is the second sequence for the block value of 1. At this time, a CAZAC sequence of a long length corresponding to a length of transmission data may be used as each sub-

sequence constituting each group. Alternatively, a CAZAC sequence of a short length corresponding to each block length of transmission data may be used as each sub-sequence constituting each group.

Meanwhile, the receiver identifies sequence ID of each block, and identifies a type of the sequence (first sequence or second sequence) for each block from a sequence ID set consisting of the identified sequence IDs. At this time, the type of the sequence for each block can be expressed by group ID. In other words, in this embodiment, since it is assumed that code values of each block can be expressed by 0 and 1, two types of the sequence for each block or two types of group ID are obtained. The code values of each block can be restored through group ID. This decoding procedure will be described in detail with reference to FIG. 15.

The receiver identifies sequence ID of each block constituting a corresponding sequence if the sequence is received (S1501), and measures a peak for a sequence ID set consisting of the identified sequence IDs (S1502). In this case, two peaks having high frequency in generation are selected (S1503) so that sequences which generate the corresponding peaks are identified as the first sequence and the second sequence constituting the group. At this time, if the first sequence and the second sequence are expressed by predetermined group IDs, respectively, first group ID indicating a code value of 0 and second group ID indicating a code value of 1 can be identified. After all, group ID of each block can be identified through the step S1503 (S1504), and thus the code value of each block can be identified (S1508).

If sequence IDs that can not identify group ID exist due to error occurring during the decoding procedure, peaks are searched for a set of corresponding sequence IDs (S1505), and among the peaks, two powerful peaks are detected (S1506) so that group IDs are again identified from the detected powerful peaks (S1507). Subsequently, code values of the

corresponding blocks can be identified from the identified group IDs (S1508).

<Third Embodiment>

FIG. 16 is a diagram illustrating a method of transmitting data using a sequence according to another preferred embodiment of the present invention.

If the second embodiment is more expanded, a total number of data bits that can be transmitted through one group can be increased. For example, if two sequences are defined as one group like the second embodiment, data of 1 bit per block can be transmitted. If four sequences are defined as one group, data of 2 bits per block can be transmitted. If eight sequences are defined as one group, data of 3 bits per block can be transmitted. However, since a plurality of sequences are grouped and defined as one set, a problem occurs in that if the length of each sequence is short, the number of groups that can be selected is decreased in proportion to the short length of each sequence.

Accordingly, it is necessary to expand the length of the sequence to increase the number of groups that can be selected. To this end, in this embodiment, the length of the sequence for each block is expanded while respective sequences are multi-overlapped as shown in FIG. 16B and independence is maintained owing to transmission delay between the overlapped sequences.

Referring to FIG. 16(a), a data value of 2 bits is given to each block. Accordingly, a sequence group for each block consists of four different CAZAC sequences. Since each CAZAC sequence constituting the sequence group should identify four values, a group size should be increased correspondingly. However, in this case, a problem occurs in that the number of groups that can be used by each base station is decreased. Accordingly, as shown in FIG. 16, the length of each CAZAC sequence is expanded as much as need be while a predetermined delay is given to each CAZAC sequence during data transmission, whereby independence is maintained between the respective CAZAC sequences.

Meanwhile, the receiver identifies ID of a corresponding block based on the order of each CAZAC sequence represented in the time/frequency domain, and its method of decoding a code value from corresponding block ID is almost identical with that of the second embodiment. Hereinafter, a data decoding procedure of the receiver will be described in detail with reference to FIG. 17.

The receiver identifies sequence ID of each block constituting a corresponding sequence if the sequence is received (S1701), and measures a peak for a sequence ID set consisting of the identified sequence IDs (S1702). In this embodiment, since one block expresses two bits, first, second, third and four sequences which express 00, 01, 10, 11 form one group. Accordingly, the receiver should select 4 peaks having high frequency in generation as a result of measurement (S1703). In this case, the selected peaks are respectively mapped to the first, second, third and fourth sequences in accordance with the order represented in the time/frequency domain. Also, if the first sequence to the fourth sequence are expressed by predetermined group IDs, respectively, first group ID indicating a code value of 00, second group ID indicating a code value of 01, third group ID indicating a code value of 10, and fourth group ID indicating a code value of 11 can be identified. After all, group ID of each block can be identified through the step S1703 (S1704), and thus the code value of each block can be identified (S1708).

If sequence IDs that can not identify group ID exist due to error occurring during the decoding procedure, peaks are again searched for a set of corresponding sequence IDs (S1705), and among the peaks, four powerful peaks are detected (S1706) so that group IDs are again identified from the detected powerful peaks (S1707). Subsequently, code values of the corresponding blocks can be identified from the identified group IDs (S1708).

<Fourth Embodiment>

FIG. 18 is a diagram illustrating a method of transmitting data using a sequence

according to another preferred embodiment of the present invention.

In the case that the second embodiment and the third embodiment are more expanded, the signal position is changed through pulse position modulation (PPM) so that the length of the sequence can be expanded logically. The PPM originally transmits data with relative pulse delay but PPM based on start position of the sequence is used in this embodiment.

If bits of data to be transmitted are determined, the base station selects a sequence to be used for transmission of corresponding data and determines a length of a block for applying PPM to a corresponding sequence and a length of a duration constituting each block. A sequence corresponding to each block is separately required when a preamble is generated. However, in this embodiment, since circular shift equivalent to a specific duration within a specific block constituting a corresponding sequence is applied for the same sequence, the respective sequences are originally the same as one another but are identified from one another by circular shift.

For example, assuming that one sequence length is divided into four blocks (block 1 to block 4) and each block is expressed by 2 bits, each block is again divided into four durations (duration 1 to duration 4) to express values of "00, 01, 10, 11." At this time, four durations included in one block are used as start identification positions of circular shift for a sequence corresponding to a corresponding block. If a preamble to be transmitted has a total length of 256, block 1 can have a circular shift value of 0~63, block 2 64~127, block 3 128~195, and block 4 196~255. If a specific sequence to be used for transmission of the preamble is determined and "00" is transmitted through block 1, sequence 1 undergoes circular shift so that a start position is arranged in duration 1 (0~15) of block 1. If "10" is transmitted to block 2, sequence 2 undergoes circular shift so that a start position is arranged in duration 3 (96~111) of block 2. In this way, circular shift is applied for the other blocks

and then the respective sequences (sequence 1 to sequence 4) are grouped into one to generate one preamble. In this case, the number of blocks can be generated from 1 to every random number. Also, a minimum unit of circular shift can be limited to more than a certain value considering channel or timing error.

Meanwhile, the receiver identifies respective sub sequences (sequence 1 to sequence 4) constituting corresponding sequences by data processing the transmitted sequences, and searches a start position of each of the identified sequences to perform data decoding. This will be described in detail with reference to FIG. 19.

If a sequence is received in the receiver (S1901), the receiver detects ID of the corresponding sequence (S1903) and performs full correlation through predetermined data processing for a total of received signals (received sequence) by using the detected result (S1905). At this time, a full search algorithm or a differential search algorithm can be used for detection of the sequence ID.

Since the received signal is transmitted from the transmitter by gathering a plurality of sequences, the signal which has undergone the correlation includes a plurality of peaks. In this embodiment, four peaks are detected, and the receiver determines whether each of the detected peaks corresponds to which one of block 1 to block 4 and also corresponds to which duration of a corresponding block (S1909) to decode bit order and bit value of the original data (S1911).

The method of effectively transmitting the preamble sequence and message through the RACH has been described as above. Finally, a procedure of transmitting a preamble from a user equipment (UE) to a base station (Node-B) and performing synchronization between both the user equipment and the base station will be described based on two embodiments. FIG. 20A and FIG. 20B illustrate the two embodiments.

In the embodiment of FIG. 20A, synchronization is performed in such a manner the

user equipment accesses the base station only once. In other words, if the user equipment transmits a preamble and a messing including information required for synchronization to the base station (S2001), the base station transmits timing information to the user equipment (S2003) and at the same time allocates a resource for transmission of uplink data (S2005). The user equipment transmits the uplink data to the base station through the allocated resource (S2007).

In the embodiment of FIG. 20B, for synchronization, the user equipment accesses the base station twice. In other words, if the user equipment transmits a preamble to the base station (S2011), the base station transmits timing information to the user equipment and at the same time allocates a resource for a request of scheduling (S2013). The user equipment transmits a message for a request of scheduling to the base station through the allocated resource (S2015). Then, the base station allocates a resource for transmission of uplink data to the user equipment (S2017). In this way, the user equipment transmits to the uplink data to the base station through the secondly allocated resource (S2019).

FIG. 21 is a diagram illustrating a method of transmitting data to a receiver through a signaling channel in accordance with one embodiment of the present invention.

Since the receiver should search a start position of a transmission signal in actually realizing the random access channel, it is generally designed that the random access channel has a specific pattern in the time domain. To this end, a preamble sequence may be used so that the random access signal originally has a repetitive pattern. Alternatively, a certain interval may be maintained between sub-carriers in the frequency domain to obtain repetitive characteristics in the time domain. Accordingly, the access modes of FIG. 6A and FIG. 6B are characterized in that the start position of the transmission signal should easily be searched in the time domain. To this end, the CAZAC sequence is used. The CAZAC sequence can be classified into GCL sequence (Equation 1) and Zadoff-Chu sequence (Equation 2).

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Meanwhile, a specific sequence of a long length is preferably used to transmit unique information of the user equipment or the base station through RACH (Random Access Channel) or SCH (Synchronization Channel). This is because that the receiver easily detects corresponding ID and more various kinds of sequences can be used to provide convenience for system design.

However, if message is transmitted with corresponding ID at a sequence of a long length, since the quantity of the message is increased by $\log_2$ function, there is limitation in message passing with ID only when the sequence exceeds a certain length. Accordingly, in this embodiment, the sequence is divided by several short blocks, and a short signature sequence corresponding to data to be transmitted to each block of the sequence is used instead of specific manipulation such as conjugation or negation.

Referring to FIG. 21, the sequence is divided into a predetermined number of blocks, and a short signature sequence corresponding to data to be transmitted is applied for each of the divided blocks. A long CAZAC sequence is multiplied by combination of the blocks for which the short signature sequence is applied, whereby a final data sequence to be transmitted to the receiver is completed.

In this case, assuming that the short signature sequence consists of four signatures, the following signature sets can be used. Also, if there is difference between respective data constituting the signature sets, any other signature set may be used without specific limitation.

1) Modulation values: {1+j, 1-j, -1-j, -1+j}

2) Exponential sequence: {[exp(jw_0n)], [exp(jw_1n)], [exp(jw_2n)], [exp(jw_3n)]}, where n=0...Ns, and Ns is a length of each block

3) Walsh Hadamard sequence: {[1111], [1-11-1], [11-1-1], [1-1-11]}, where, if the length Ns of each block is longer than 4, each sequence is repeated to adjust the length.

Examples of the long CAZAC sequence that can be used in the embodiment of FIG.

21 include, but not limited to, one GCL CAZAC sequence, Zadoff-Chu CAZAC sequence, and a sequence generated by concatenation of two or more short GCL or Zadoff-Chu CAZAC sequences having the same length or different lengths.

The aforementioned manner of applying a short signature sequence for data transmission and reception to the long CAZAC sequence is advantageous in that it is less affected by channel than the related art modulation method of transmission data and performance is little decreased even though the number of bits constituting one signature is increased.

FIG. 22 illustrates an example of a receiver and a transmitter for transmitting a preamble and data through RACH, SCH or other channel by using the aforementioned manner.

Since the number of bits can be increased in accordance with increase of signatures, channel coding can be applied for the transmitter. If channel coding is performed, time/frequency diversity can be obtained through an interleaver. Also, bit to signature mapping can be performed to minimize a bit error rate. In this case, Gray mapping can be used. The sequence which has undergone this procedure is mixed with CAZAC and then transmitted.

The receiver detects CAZAC ID, and calculates a log-likelihood ratio (LLR) for each of bits. Then, the receiver decodes transmission data through a channel decoder. Considering complexity according to sequence search of the receiver configured as shown in FIG. 22, the transmitter preferably uses an exponential sequence as a signature sequence. In this case, the receiver can simply search CAZAC ID through phase difference Fourier Transform. Afterwards, the receiver can again simply calculate LLR from the signature through Fourier Transform.

According to the present invention, the structure on the frequency axis/time axis of

the RACH can be identified more definitely. Also, since the RACH resource is divisionally distributed for each frame, even though the user equipment fails to access a specific RACH, the user equipment can directly access RACH of the next frame, whereby access to the base station is improved. Moreover, the user equipment can easily access the RACH even in case of a traffic area of which QoS condition is strict.

Furthermore, according to the present invention, since information is transmitted and received between the user equipment and the base station by using the code sequence, time/frequency diversity can be maximized, and performance attenuation due to influence of channel can be alleviated through the signature manner.

According to the present invention, since the total length of the corresponding sequence can be used with maintaining the advantage of the code sequence according to the related art, data transmission can be performed more efficiently. Also, since the code sequence undergoes predetermined data processing, the quantity of information to be transmitted can be increased and the transmitted data becomes robust to noise or channel.

It will be apparent to those skilled in the art that the present invention can be embodied in other specific forms without departing from the spirit and essential characteristics of the invention. Thus, the above embodiments are to be considered in all respects as illustrative and not restrictive. The scope of the invention should be determined by reasonable interpretation of the appended claims and all change which comes within the equivalent scope of the invention are included in the scope of the invention.

INDUSTRIAL APPLICABILITY

The present invention is applicable to a wireless communication system such as a mobile communication system or a wireless Internet system.

[CLAIMS]

1. A method of transmitting data on a random access channel in a mobile communication system, the method comprising:

generating a new code by multiplying a code sequence by an exponential sequence; and

transmitting the new code sequence to a receiving side.

2. The method of claim 1, wherein the code sequence is a CAZAC (constant amplitude zero autocorrelation) sequence.

3. The method of claim 1 or 2, wherein the code sequence is transmitted as a preamble.

4. A method of transmitting data by using a code sequence in a mobile communication system, the method comprising:

conjugating at least one element included in at least one block of a code sequence divided by at least two blocks to indicate predetermined information; and

transmitting the code sequence, in which the at least one block is conjugated, to a receiving side.

5. The method of claim 4, wherein the code sequence is a CAZAC sequence.

6. A method of transmitting data by using a code sequence in a mobile communication system, the method comprising:

generating a second code sequence indicating predetermined information by combining at least two first code sequences mapped with at least one information bit, respectively; and

transmitting the second code sequence to a receiving side.

7. The method of claim 6, wherein the first code sequence is a CAZAC sequence.

8. The method of claim 6, wherein, if each of the first code sequences is mapped with 'n' number of information bits, the at least two first code sequences are selected from a sequence group consisting of 2^n number of first code sequences.

9. The method of claim 6, wherein the combination of the at least two first code sequences is performed by summing the at least two first code sequences after giving predetermined delay to each of the at least two first code sequences.

10. A method of transmitting a code sequence in a mobile communication system, the method comprising:

generating a combination code sequence by combining a base code sequence to at least one code sequence obtained by circular shift of the base code sequence; and

transmitting the combination code sequence to a receiving side.

11. The method of claim 10, wherein each of the base code sequence and the at least one code sequence identifies one or more information bit.

12. The method of claim 10, wherein the step of generating the combination code sequence is performed in a frequency domain.

13. The method of claim 10, wherein the step of generating the combination code sequence is performed in a time domain.

14. The method of claim 10, wherein the combination code sequence is transmitted through a random access channel (RACH).

15. The method of claim 10, wherein the at least one code sequence is obtained by circular shift of the base code sequence as much as integer times of circular shift unit.

16. A method of transmitting a code sequence in a mobile communication system, the method comprising:

generating a repetitive code sequence by repeatedly concatenating a first code sequence at least one or more times;

generating a cyclic prefix (CP) by copying a certain part of a rear end of the repetitive code sequence and concatenating the copied part to a front end of the repetitive code sequence; and

transmitting the repetitive code sequence, in which the CP is generated, to a receiving side.

17. The method of claim 16, wherein the repetitive code sequence is transmitted as a preamble on a random access channel.

18. A method of allocating a random access channel in a multi-carrier system, the method comprising:

allocating a random access channel to each of at least two consecutive frames in a

way that frequency bands of the random access channels allocated to the at least two consecutive frames are not overlapped with each other; and

transmitting allocation information of the random access channels allocated to the at least two consecutive frames to at least one user equipment.

19. The method of claim 18, wherein the frequency bands of the random access channels allocated to the at least two consecutive frames have a pattern which is periodically repeated.

20. The method of claim 18, wherein the allocation information includes a hopping pattern of the frequency bands of the random access channels allocated to the at least two consecutive frames.

21. The method of claim 18, wherein the random access channels are uniformly allocated to the at least two consecutive frames.

22. The method of claim 18, further comprising allocating a channel region for transmission of a pilot signal at the user equipment to at least one sub-frame to which the random access channel is allocated.

23. The method of claim 22, wherein the user equipment trying to random access through the random access channel transmits a pilot signal through the channel region.

24. A method of transmitting data by using a code sequence in a mobile communication system, the method comprising:

mapping each of a plurality of blocks having at least one bit of a input data stream, respectively to a corresponding signature sequence;

multiplying a signature sequence stream, to which the plurality of blocks are mapped, by a specific code sequence; and

transmitting the signature sequence stream multiplied by the specific code sequence to a receiving side.

25. The method of claim 24, wherein the specific code sequence is a single CAZAC sequence.

26. The method of claim 24, wherein the specific code sequence is a sequence obtained by concatenating at least two different CAZAC sequences.

27. The method of claim 24, wherein the signature sequence is an exponential sequence.

28. The method of claim 24, wherein the signature sequence is a Hadamard sequence.

29. The method of claim 24, further comprising repeating each signature sequence so as to match a length of the signature sequence stream, to which the plurality of blocks are mapped, with a length of the specific code sequence.

30. The method of claim 24, wherein the signature sequence mapping is Gray mapping.

FIG. 1

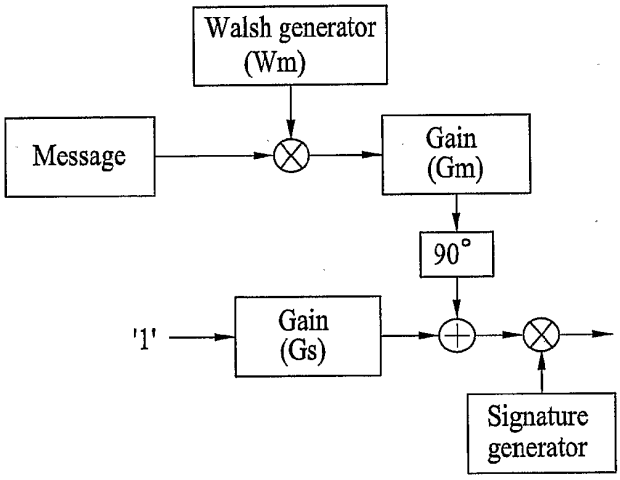

Walsh generator
(Wm)
Message
Gain
(Gm)
90°
'1'
Gain
(Gs)
Signature
generator

FIG. 2

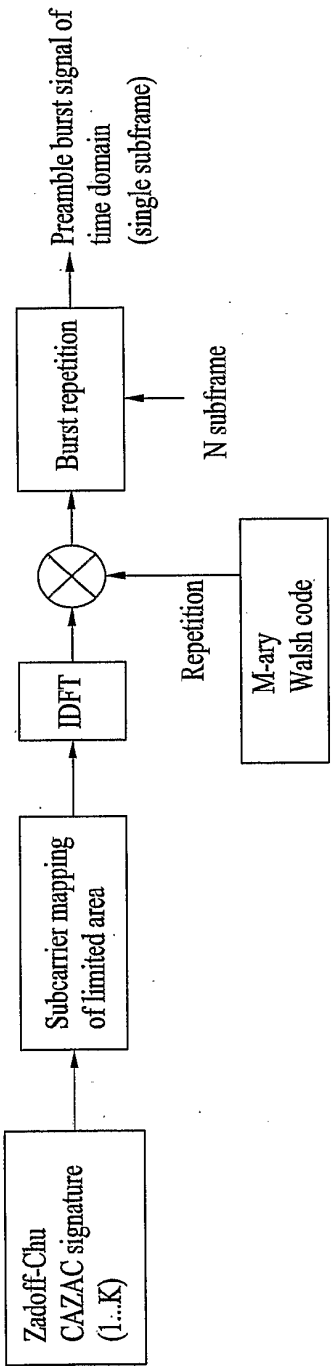

Zadoff-Chu CAZAC signature (1...K)
Subcarrier mapping of limited area
IDFT
Repetition
M-ary Walsh code
Burst repetition
N subframe
Preamble burst signal of time domain (single subframe)

FIG. 3A

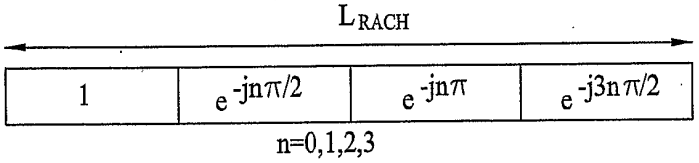


FIG. 3B

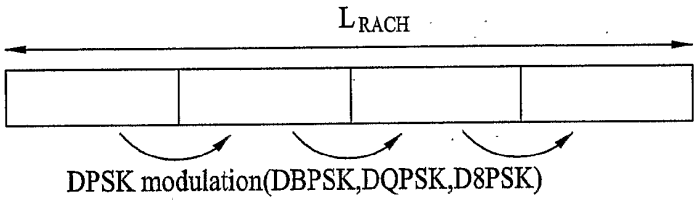


FIG. 4A

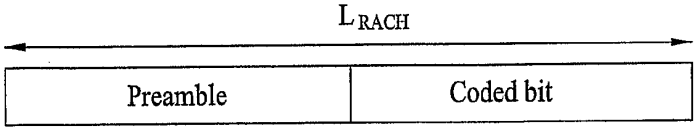


FIG. 4B

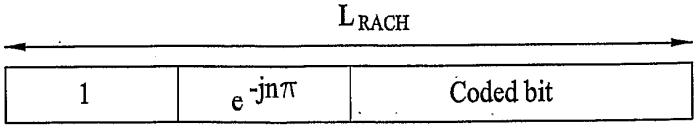


FIG. 5

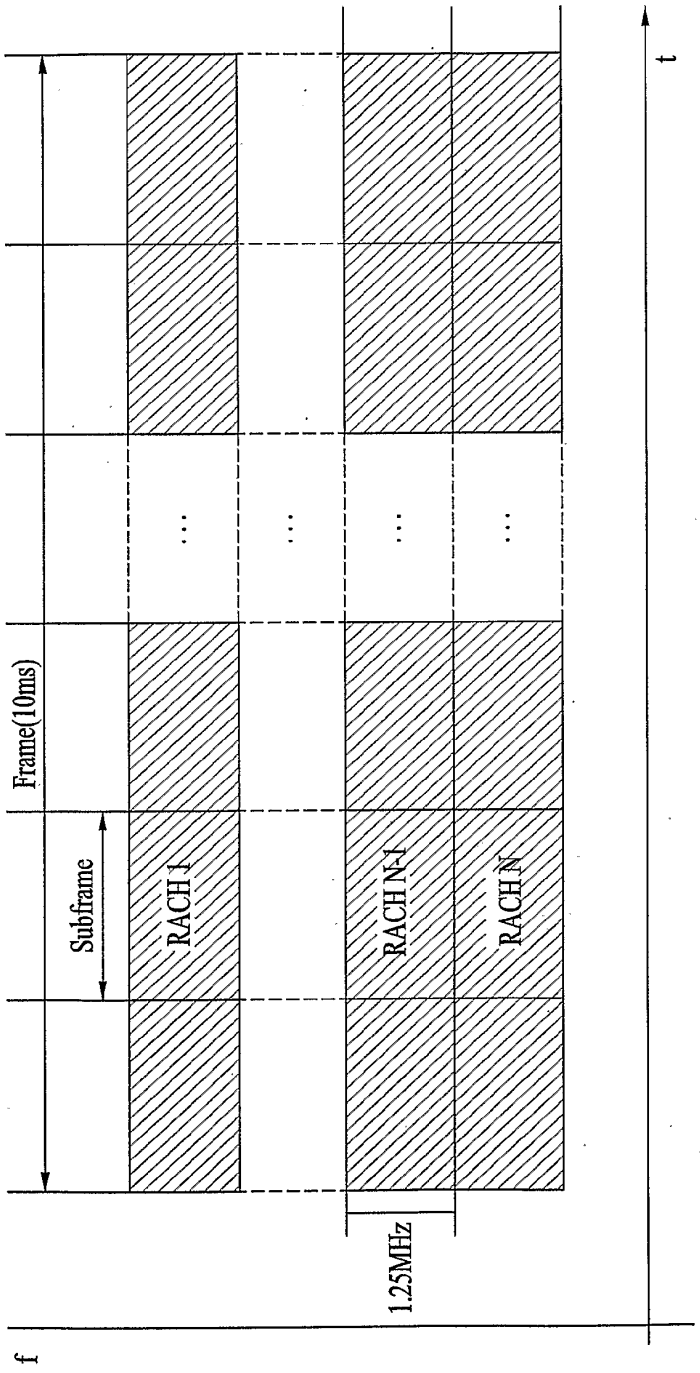


FIG. 6A

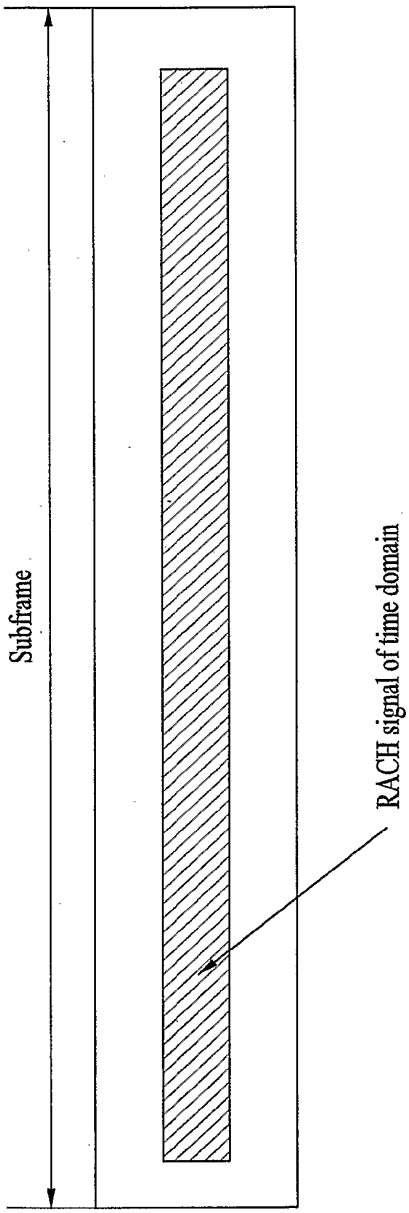


FIG. 6B

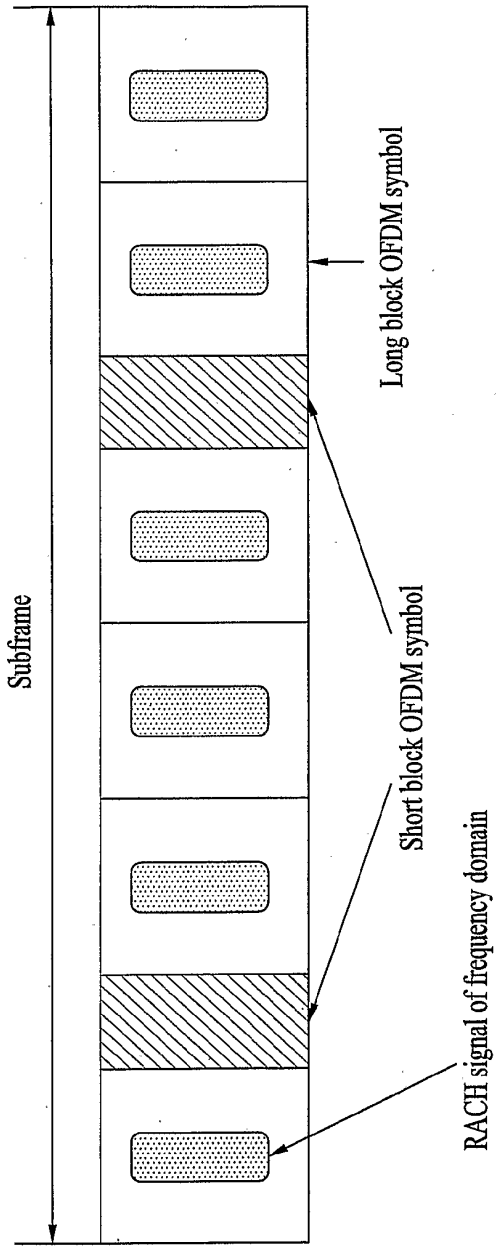

Subframe
Long block OFDM symbol
Short block OFDM symbol
RACH signal of frequency domain

FIG. 7

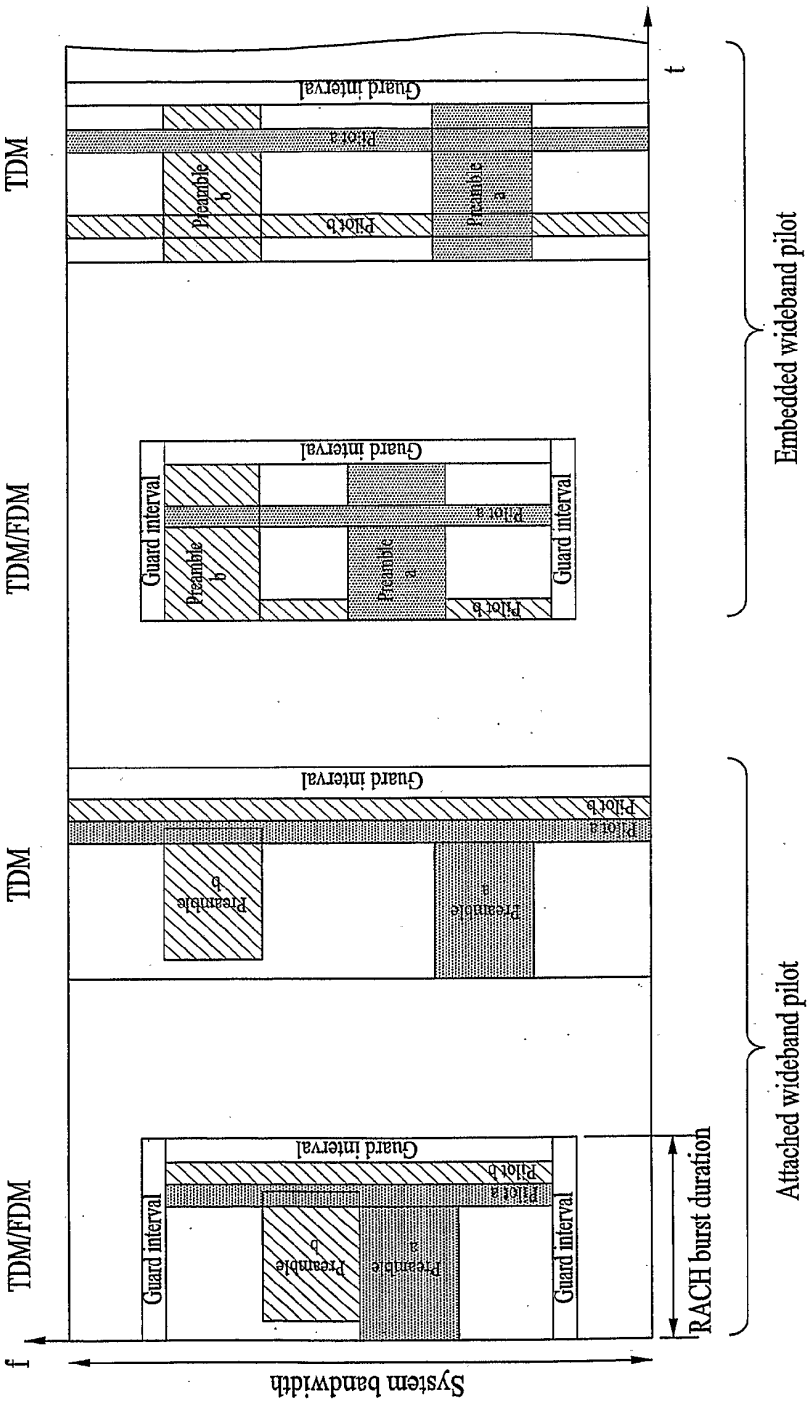

t
f
System bandwidth
TDM
TDM/FDM
TDM
TDM/FDM
Guard interval
Pilot b
Pilot a
Preamble b
Preamble a
Guard interval
Embedded wideband pilot
Attached wideband pilot
RACH burst duration

FIG. 8A

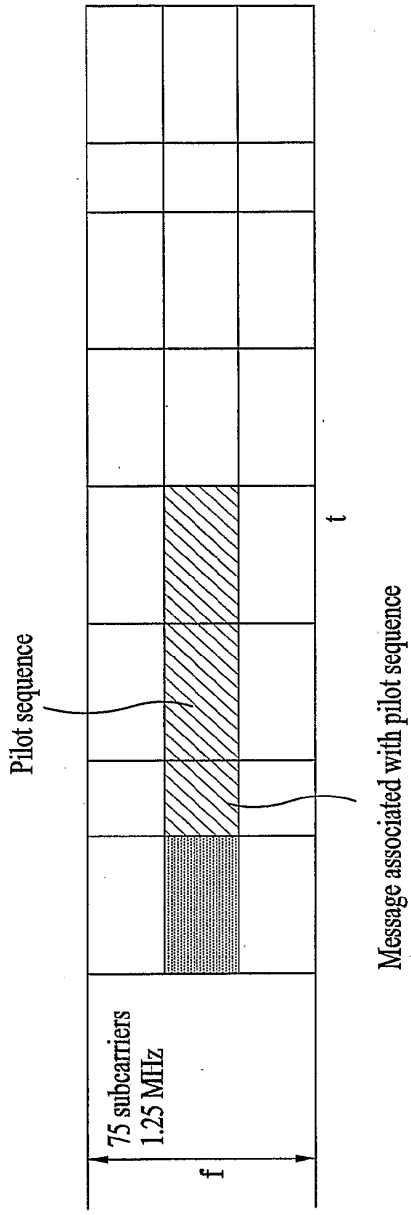

Pilot sequence
Message associated with pilot sequence
t
f
75 subcarriers
1.25 MHz

FIG. 8B

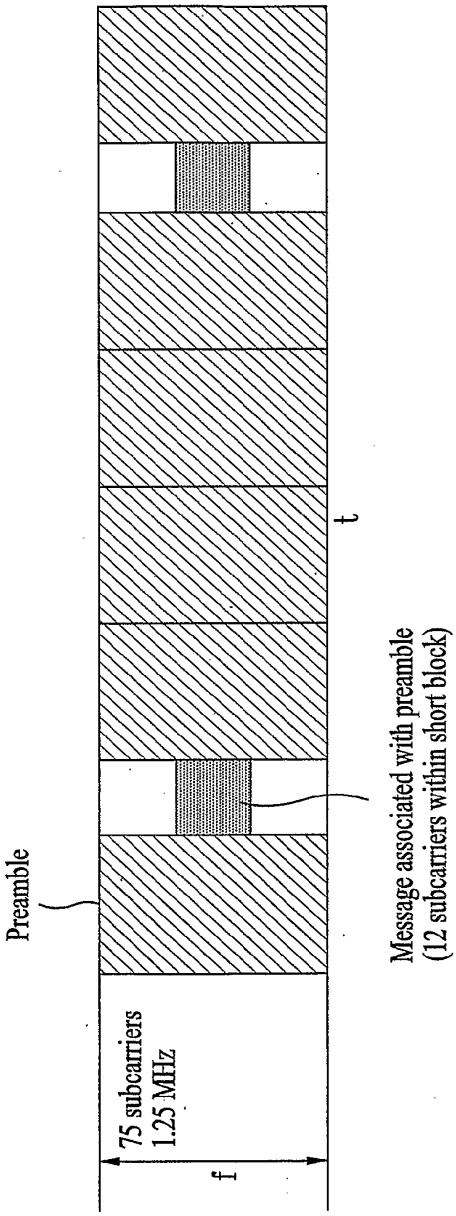

Preamble
Message associated with preamble
(12 subcarriers within short block)
t
75 subcarriers
1.25 MHz
f

FIG. 9

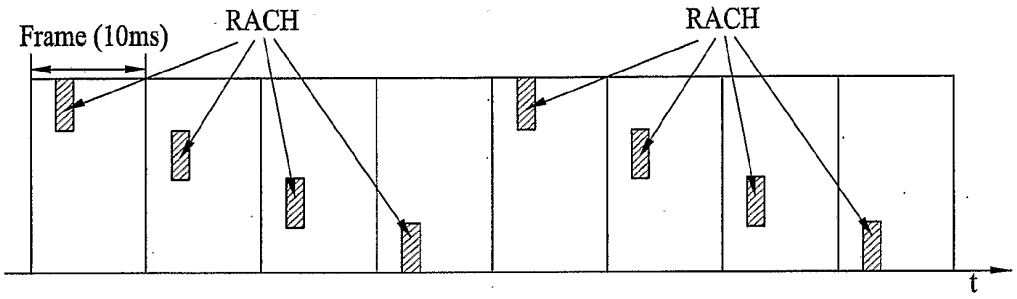


FIG. 10

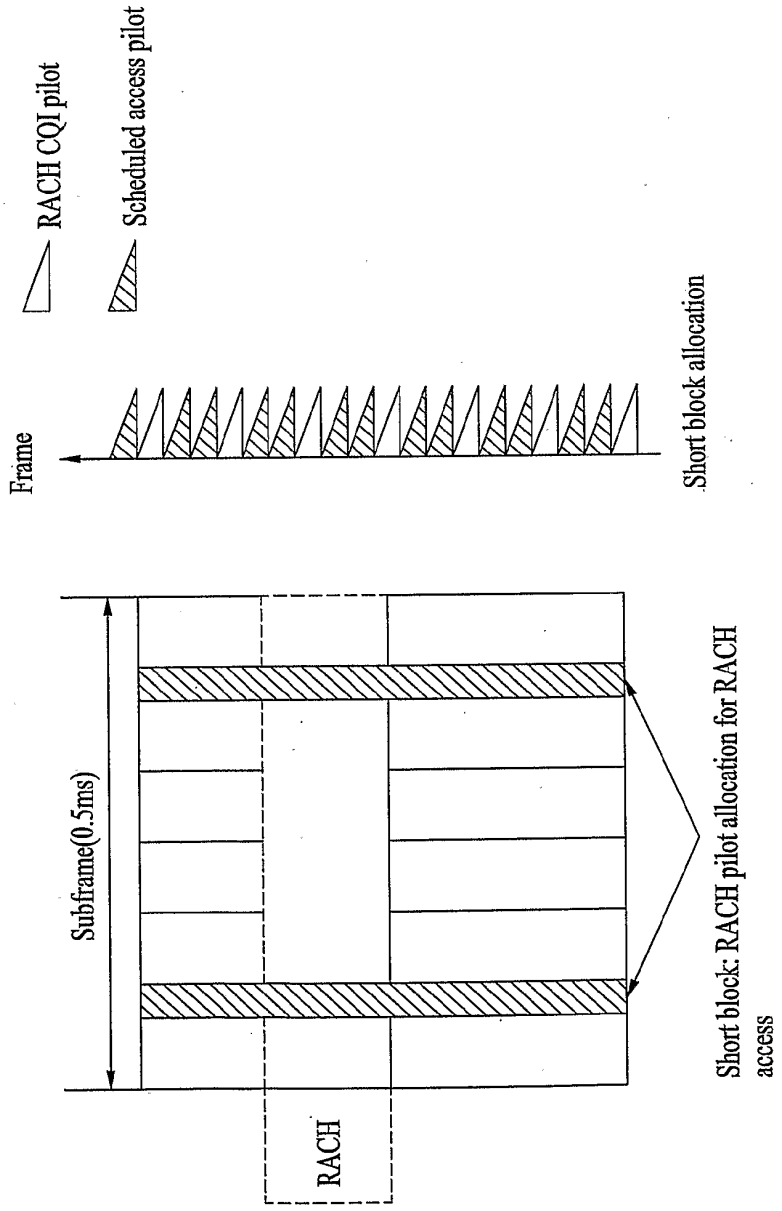

RACH CQI pilot
Scheduled access pilot
Frame
Short block allocation
Subframe(0.5ms)
RACH
Short block: RACH pilot allocation for RACH access

FIG. 11

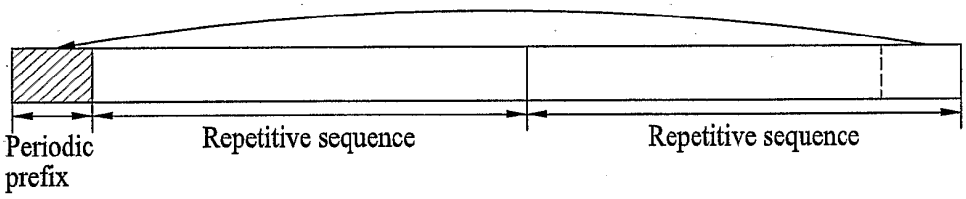

Periodic prefix
Repetitive sequence
Repetitive sequence

FIG. 12

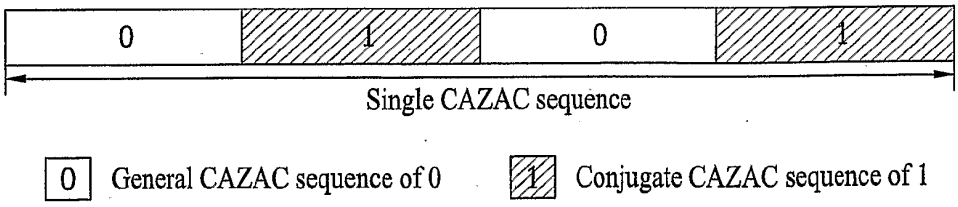

0
1
0
1
Single CAZAC sequence
0 General CAZAC sequence of 0
1 Conjugate CAZAC sequence of 1

FIG. 13

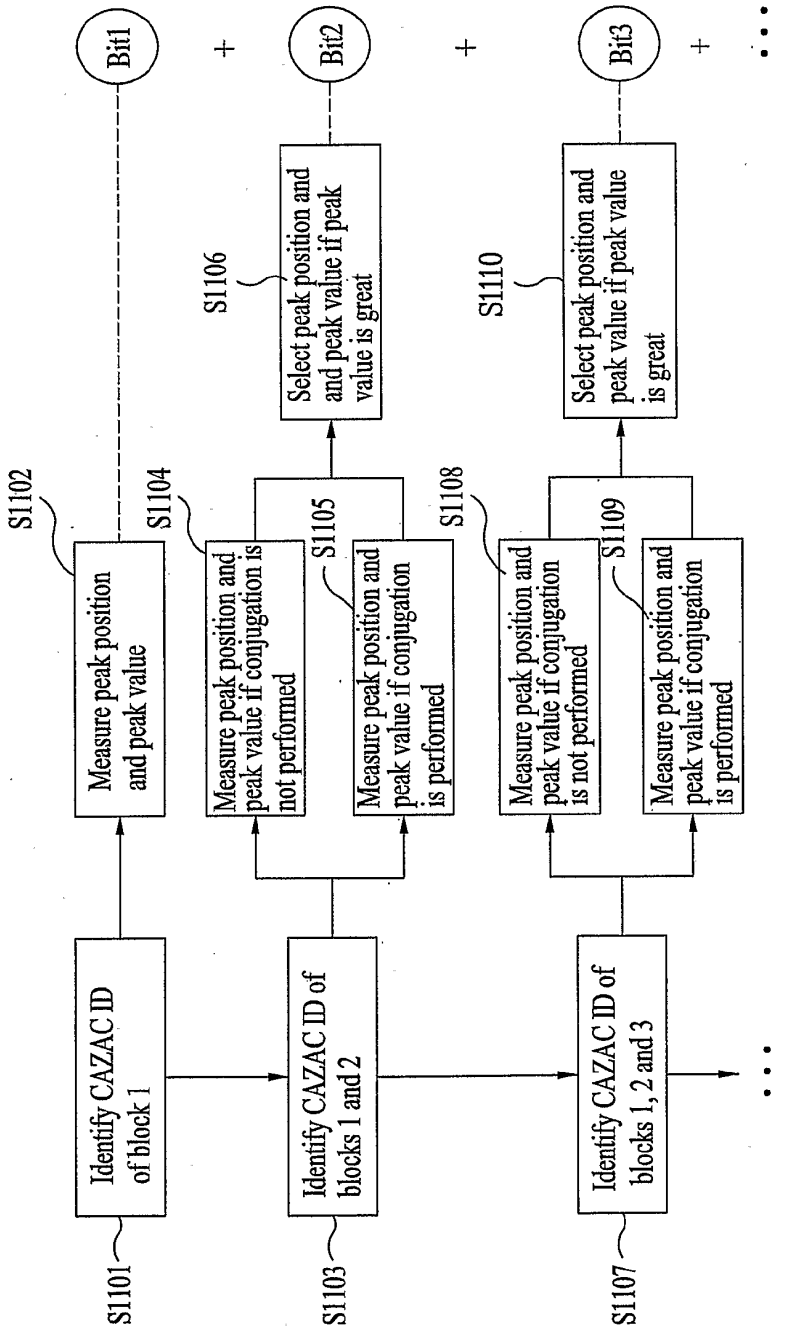

Identify CAZAC ID of block 1
S1101
Measure peak position and peak value
S1102
Bit1
+
Identify CAZAC ID of blocks 1 and 2
S1103
Measure peak position and peak value if conjugation is not performed
S1104
Measure peak position and peak value if conjugation is performed
S1105
Select peak position and and peak value if peak value is great
S1106
Bit2
+
Identify CAZAC ID of blocks 1, 2 and 3
S1107
Measure peak position and peak value if conjugation is not performed
S1108
Measure peak position and peak value if conjugation is performed
S1109
Select peak position and peak value if peak value is great
S1110
Bit3
+
...
...

FIG. 14

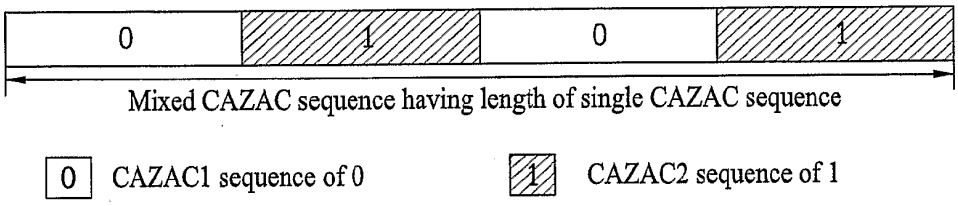

0
1
0
1
Mixed CAZAC sequence having length of single CAZAC sequence
0 CAZAC1 sequence of 0
1 CAZAC2 sequence of 1

FIG. 15

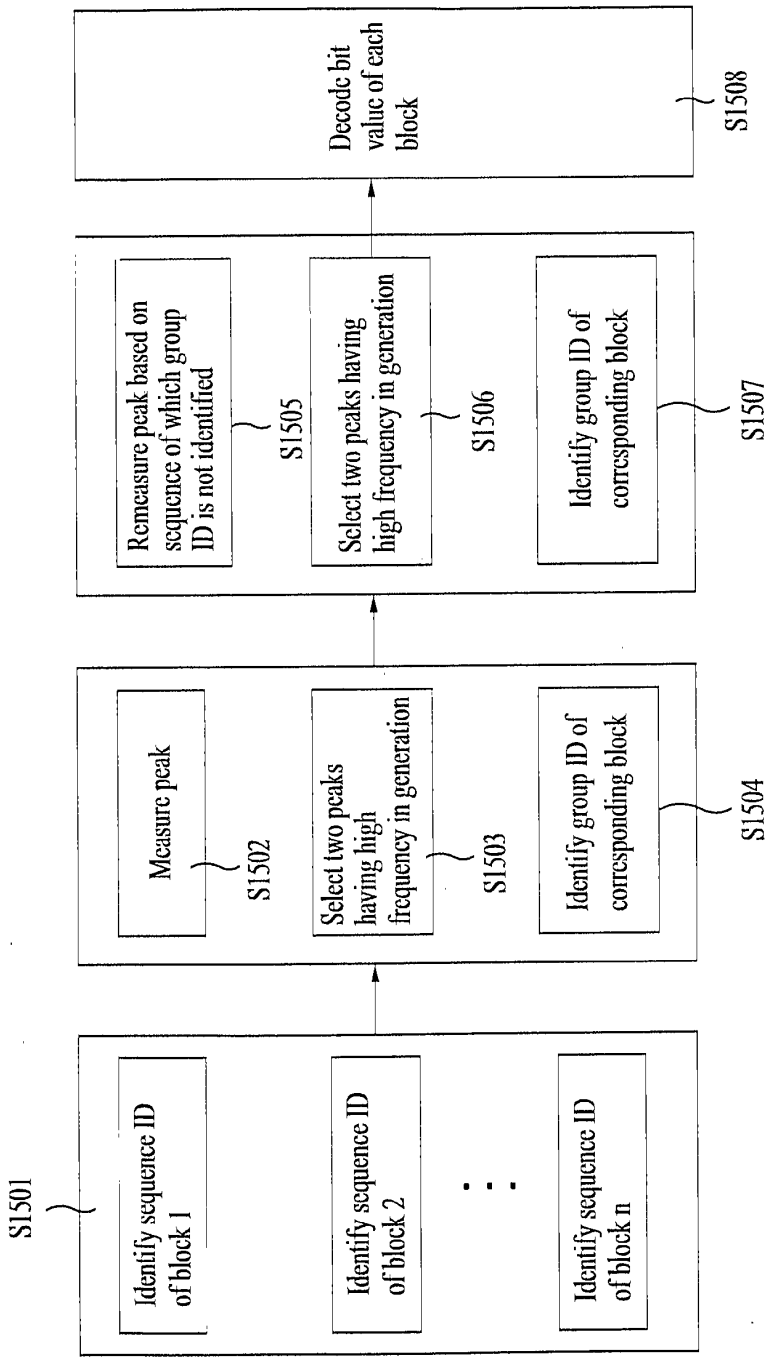

S1501
Identify sequence ID of block 1
Identify sequence ID of block 2
Identify sequence ID of block n
Measure peak
S1502
Select two peaks having high frequency in generation
S1503
Identify group ID of corresponding block
S1504
Remeasure peak based on sequence of which group ID is not identified
S1505
Select two peaks having high frequency in generation
S1506
Identify group ID of corresponding block
S1507
Decode bit value of each block
S1508

FIG. 16

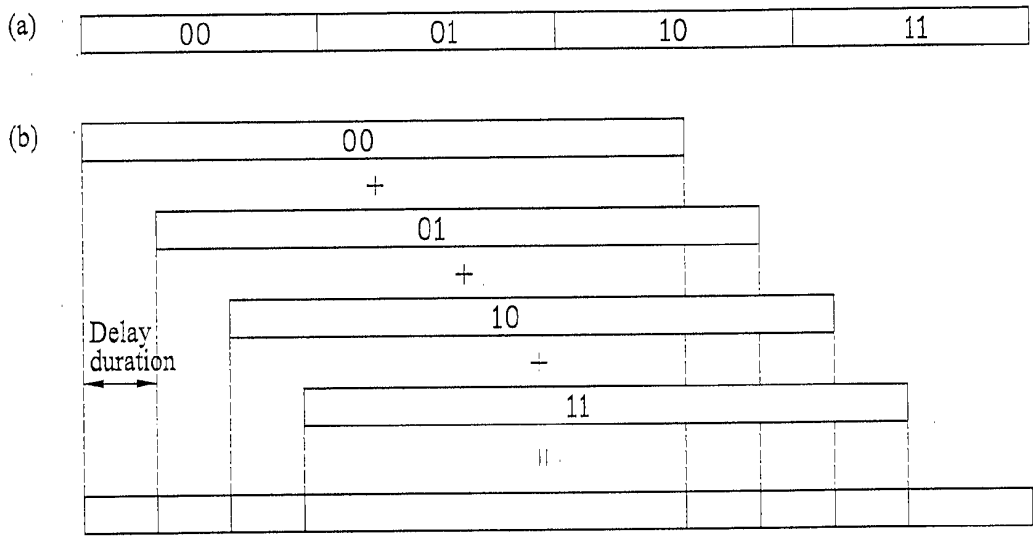


FIG. 17

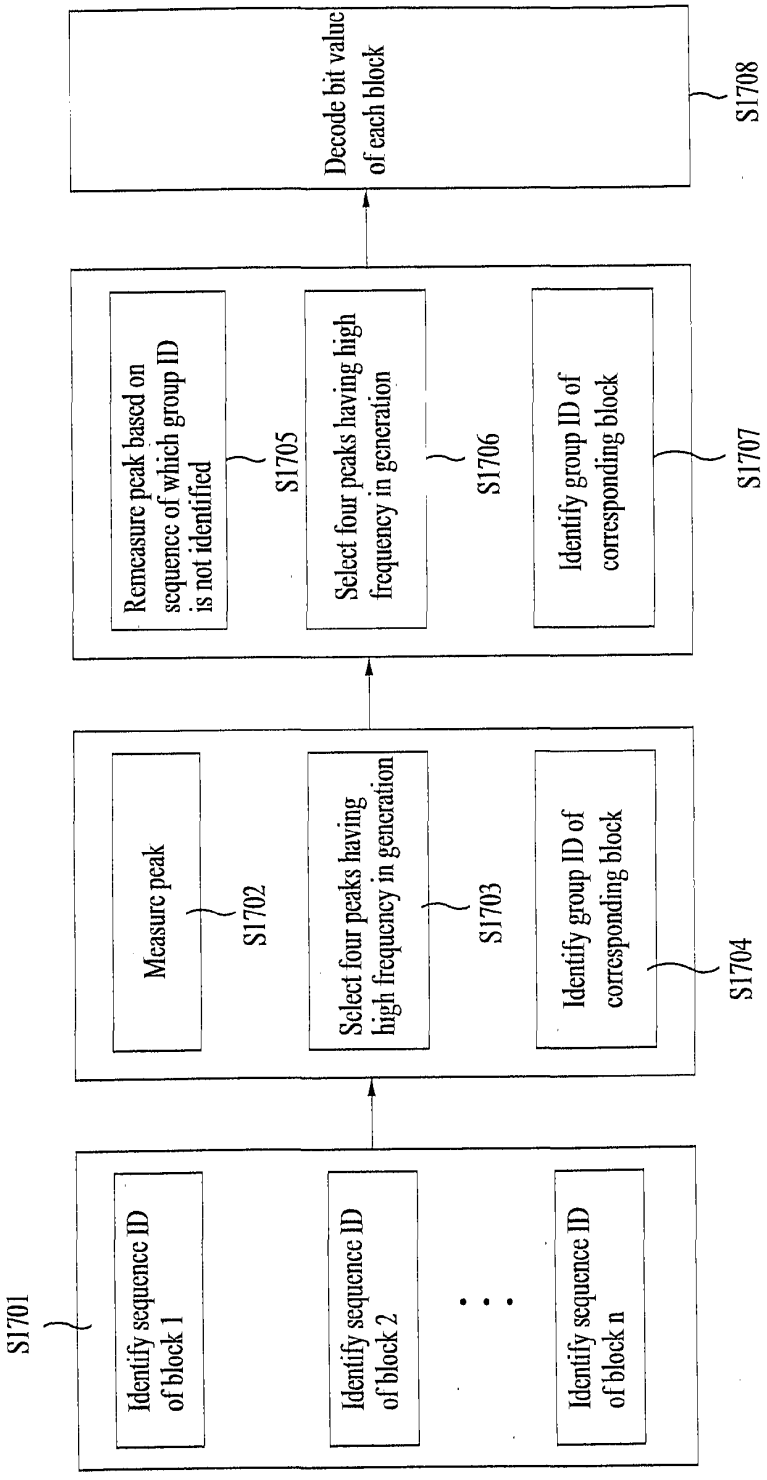

S1701
Identify sequence ID of block 1
Identify sequence ID of block 2
Identify sequence ID of block n
S1702
Measure peak
S1703
Select four peaks having high frequency in generation
S1704
Identify group ID of corresponding block
S1705
Remeasure peak based on sequence of which group ID is not identified
S1706
Select four peaks having high frequency in generation
S1707
Identify group ID of corresponding block
S1708
Decode bit value of each block

FIG. 18

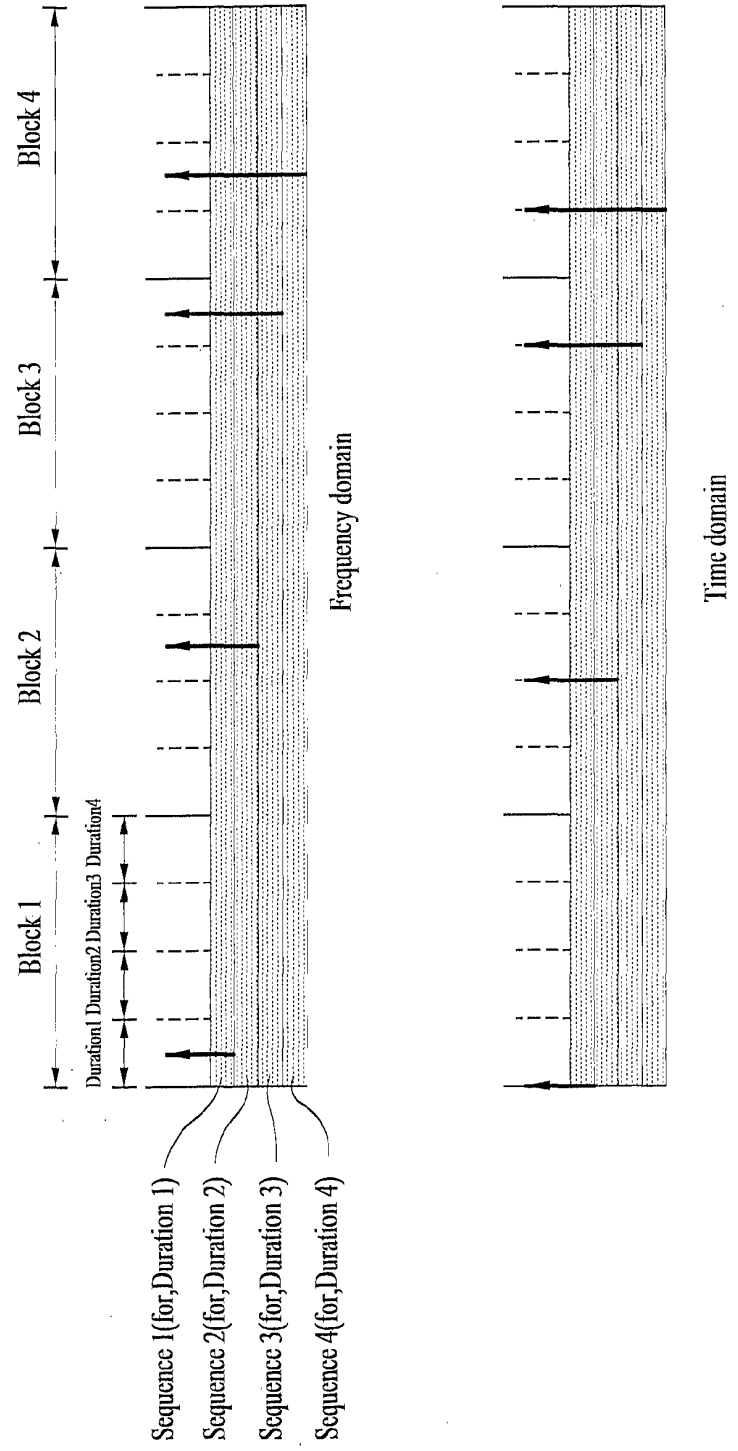

Block 1
Block 2
Block 3
Block 4
Duration1 Duration2 Duration3 Duration4
Frequency domain
Time domain
Sequence 1(for,Duration 1)
Sequence 2(for,Duration 2)
Sequence 3(for,Duration 3)
Sequence 4(for,Duration 4)

FIG. 19

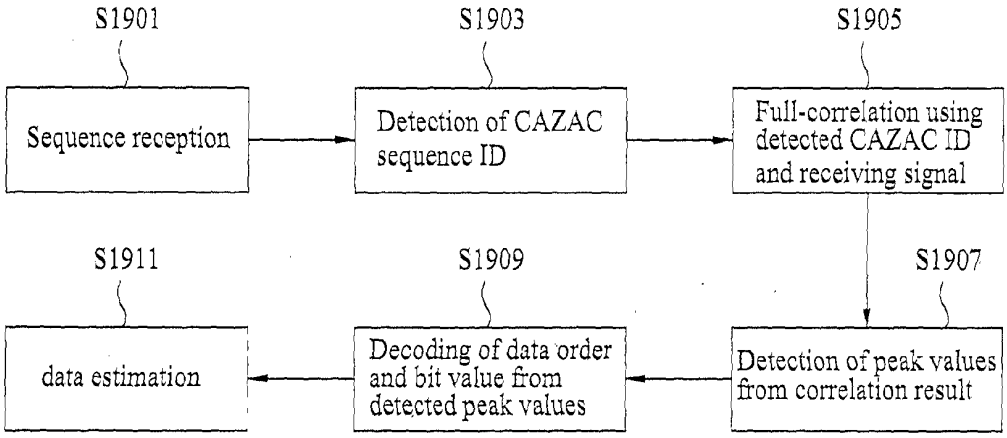

S1901
Sequence reception
S1903
Detection of CAZAC sequence ID
S1905
Full-correlation using detected CAZAC ID and receiving signal
S1907
Detection of peak values from correlation result
S1909
Decoding of data order and bit value from detected peak values
S1911
data estimation

FIG. 20A

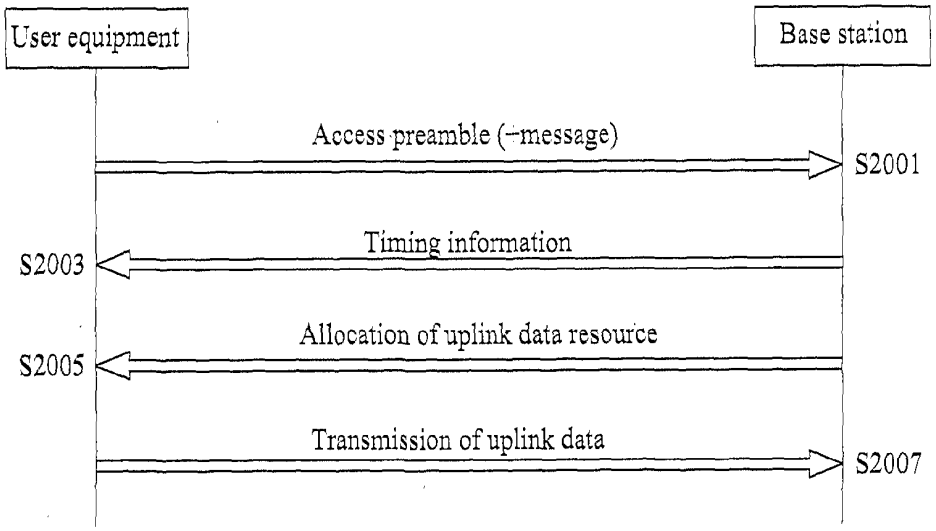


FIG. 20B

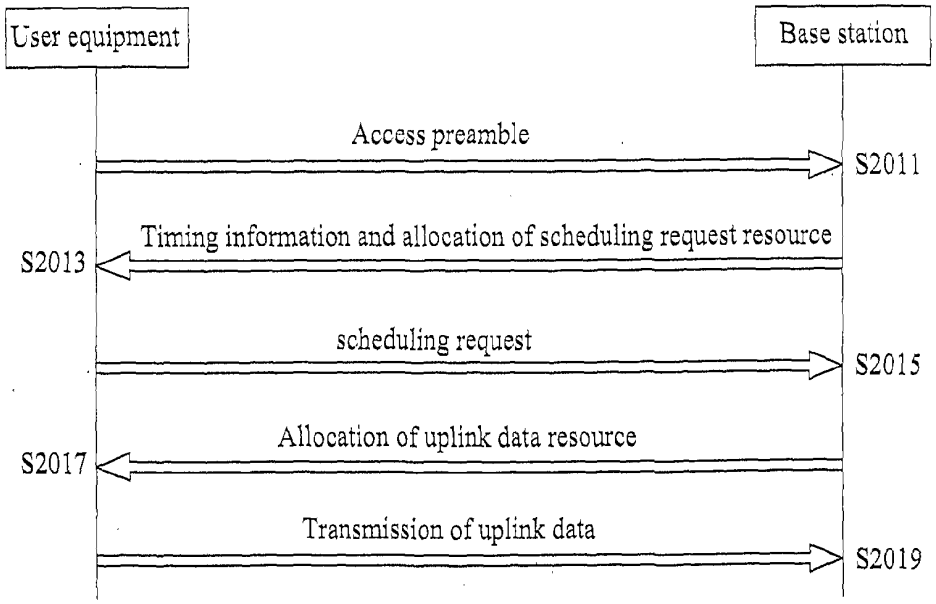


FIG. 21

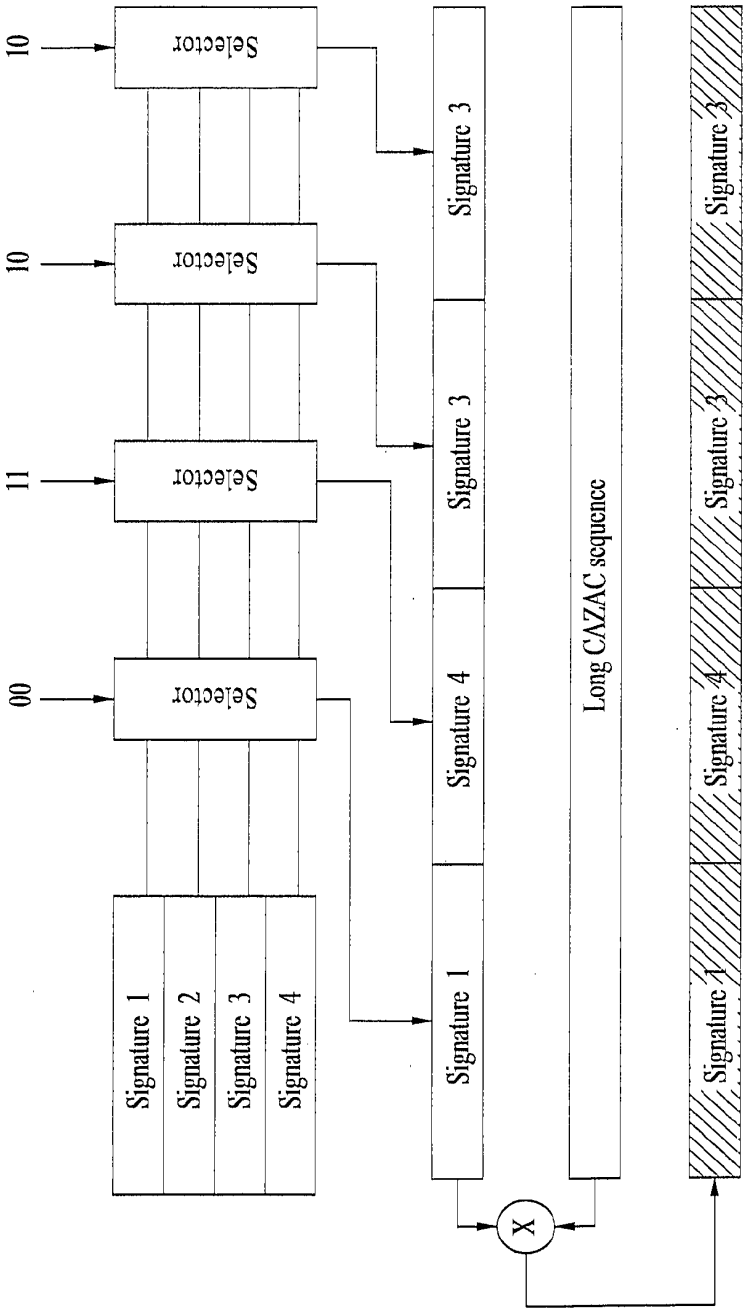
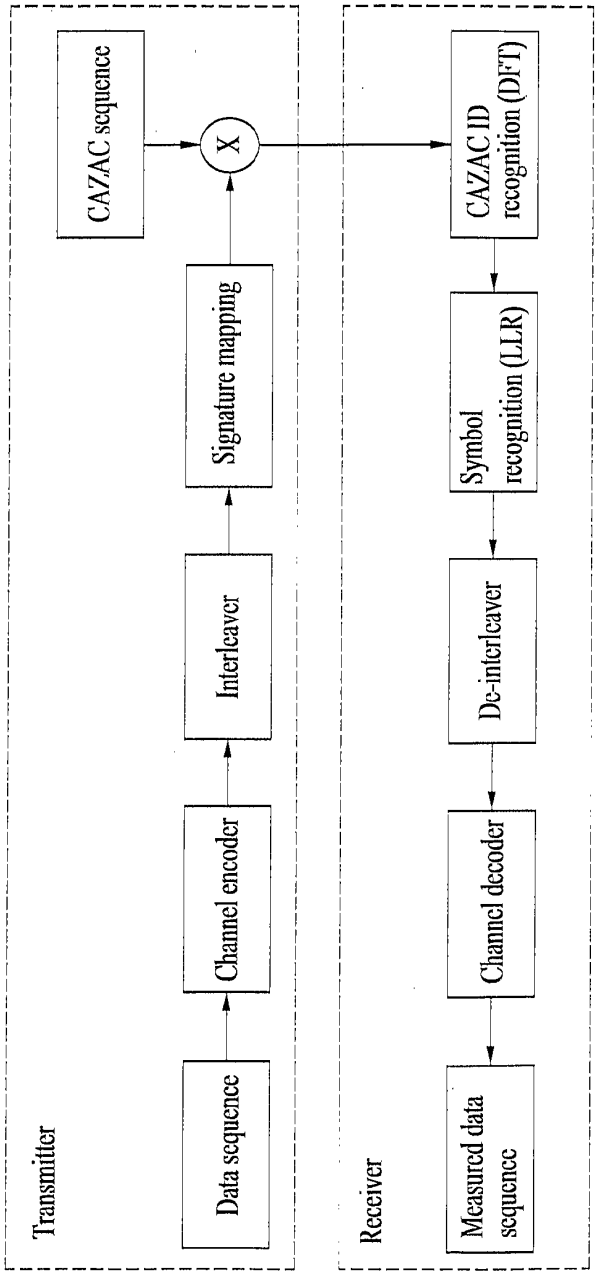

10
10
11
00
Selector
Selector
Selector
Selector
Signature 1
Signature 2
Signature 3
Signature 4
Signature 1
Signature 4
Signature 3
Signature 3
Long CAZAC sequence
Signature 1
Signature 4
Signature 3
Signature 3
X

FIG. 22


Transmitter
Data sequence
Channel encoder
Interleaver
Signature mapping
CAZAC sequence
X
Receiver
Measured data sequence
Channel decoder
De-interleaver
Symbol recognition (LLR)
CAZAC ID recognition (DFT)

Electronic Patent Application Fee Transmittal	
Application Number:	
Filing Date:	
Title of Invention:	METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yeong Hyeon Kwon
Filer:	Lew Edward V. Macapagal/Maggie Wen
Attorney Docket Number:	2101-3596
Filed as Large Entity	

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

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
National Stage Fee	1631	1	330	330
National Stage Search - all other cases	1632	1	540	540
National Stage Exam - all other cases	1633	1	220	220
Pages:				
Claims:				
Claims in excess of 20	1615	11	52	572
Independent claims in excess of 3	1614	4	220	880
Multiple dependent claims	1616	1	390	390

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**2932**

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EFS ID:	4416792
Application Number:	12303947
International Application Number:	PCT/KR07/02784
Confirmation Number:	1730
Title of Invention:	METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Yeong Hyeon Kwon
Customer Number:	35884
Filer:	Lew Edward V. Macapagal/Maggie Wen
Filer Authorized By:	Lew Edward V. Macapagal
Attorney Docket Number:	2101-3596
Receipt Date:	08-DEC-2008
Filing Date:	
Time Stamp:	19:27:05
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Payment was successfully received in RAM	$2932
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Deposit Account	
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)

1	Transmittal of New Application	2101-3596_XM.pdf	44459 c0220a3f87c4c94648483a9fb65b9f66c453feb9	no	3
Warnings:					
Information:					
2		TZ07-108_PUB_WO2007142492.pdf	2269392 6f337df35d68a2f95211d742450d96cf4d6a1178	yes	60

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Abstract	1	1
	Specification	2	33
	Claims	34	38
	Drawings-only black and white line drawings	39	60

Warnings:					
Information:					
3	Fee Worksheet (PTO-06)	fee-info.pdf	39925 bbfb9132278e51e331beaafd1cb498e5795d0bc4	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	2353776		

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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.

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.

12/303,947

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(72) Inventors; and

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(74) Agents: **KIM, Yong In** et al.; KBK & Associates, 15 th Floor, Yosam-Building, 648-23, Yeoksam-dong, Kangnam-gu, Seoul, 135-080 (KR).

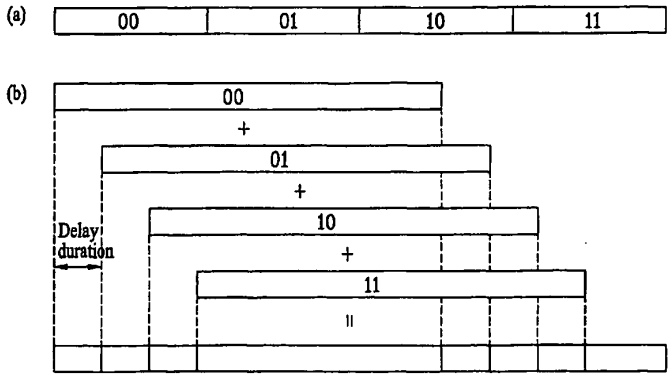
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

[Continued on next page]

(54) Title: METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICAITON SYSTEM



(57) Abstract: Disclosed is a data transmission method in a mobile ommunication system. The data transmission method through a code sequence in a mobile communication system includes grouping input data streams into a plurality of blocks consisting of at least one bit so as to map each block to a corresponding signature sequence, multiplying a signature sequence stream, to which the plurality of blocks are mapped, by a specific code sequence, and transmitting the signature sequence stream multiplied by the specific code sequence to a receiver.

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— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

(88) Date of publication of the international search report:
11 June 2009

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR 2007/002784

A. CLASSIFICATION OF SUBJECT MATTER
IPC[8]: ***H04L 27/26*** (2006.01); ***H04W 74/08*** (2009.01)
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC[8]: H04L, H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2005/0286409 A1 (Yoon et al.) 29 December 2005 (29.12.2005) *Abstract, columns 0030 - 0046*	1-30
A	WO 1996/037079 A1 (QUALCOMM INC.) 21 November 1996 (21.11.1996) *Abstract, fig. 2, page 5, line 16 - page 7, line32*	1-30
A	WO 2001/011909 A1 (KONINKLIJKE PHILIPS ELECTRONICS N.V.) 15 February 2001 (15.02.2001) *Abstract, page 2, line 4 -line 31*	1-30

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

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

Date of the actual completion of the international search	Date of mailing of the international search report
16 February 2009 (16.02.2009)	22 April 2009 (22.04.2009)
Name and mailing address of the ISA/ AT **Austrian Patent Office** Dresdner Straße 87, A-1200 Vienna Facsimile No. +43 / 1 / 534 24 / 535	Authorized officer ERDÖS György Telephone No. +36 /1/ 474-5918

Form PCT/ISA/210 (second sheet) (January 2004)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/KR 2007/002784

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US A 2005286409		KR A 20050122756	2005-12-29
		US A1 2005286409	2005-12-29
WO A 9637079		MX A 9708855	1998-03-31
		JP A 2000324139	2000-11-24
		BR A 9608353	1998-07-28
		FI A 974215	1998-01-16
		WO A1 9637079	1996-11-21
		RU C2 2209528	2003-07-27
WO A 0111909		US B1 6795420	2004-09-21
		JP T 2003506980T	2003-02-18
		WO A1 0111909	2001-02-15
		EP A1 1118237	2001-07-25
		CN A 1327699	2001-12-19

Form PCT/ISA/210 (patent family annex) (July 1998; reprint January 2004)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY
(Chapter I of the Patent Cooperation Treaty)

(PCT Rule 44*bis*)

Applicant's or agent's file reference TZ07-108WOCT	**FOR FURTHER ACTION**	See item 4 below
International application No. PCT/KR2007/002784	International filing date *(day/month/year)* 08 June 2007 (08.06.2007)	Priority date *(day/month/year)* 09 June 2006 (09.06.2006)
International Patent Classification (8th edition unless older edition indicated) See relevant information in Form PCT/ISA/237		
Applicant LG ELECTRONICS INC.		

1. This international preliminary report on patentability (Chapter I) is issued by the International Bureau on behalf of the International Searching Authority under Rule 44 *bis*.1(a).

2. This REPORT consists of a total of 3 sheets, including this cover sheet.

   In the attached sheets, any reference to the written opinion of the International Searching Authority should be read as a reference to the international preliminary report on patentability (Chapter I) instead.

3. This report contains indications relating to the following items:

☒	Box No. I	Basis of the report
☐	Box No. II	Priority
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☐	Box No. VII	Certain defects in the international application
☐	Box No. VIII	Certain observations on the international application

4. The International Bureau will communicate this report to designated Offices in accordance with Rules 44*bis*.3(c) and 93*bis*.1 but not, except where the applicant makes an express request under Article 23(2), before the expiration of 30 months from the priority date (Rule 44*bis* .2).

	Date of issuance of this report 12 May 2009 (12.05.2009)
The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. +41 22 338 82 70	Authorized officer Philippe Becamel e-mail: pt12.pct@wipo.int

Form PCT/IB/373 (January 2004)

PATENT COOPERATION TREATY

To:

KIM Yong In
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Republic of Korea

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing *(day/month/year)*	22 April 2009 (22.04.2009)
Applicant's or agent's file reference: TZ07-108WOCT	**FOR FURTHER ACTION** See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority Date *(day/month/year)*
PCT/KR 2007/002784	08 June 2007 (08.06.2007)	09 June 2006 (09.06.2006)

International Patent Classification (IPC) or both national classification and IPC
H04L 27/26 (2006.01); ***H04W 74/08*** (2009.01)

Applicant
LG ELECTRONICS INC.

1. This opinion contains indications relating to the following items:

- ☒ Cont. No. I — Basis of the opinion
- ☐ Cont. No. II — Priority
- ☐ Cont. No. III — Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Cont. No. IV — Lack of unity of invention
- ☒ Cont. No. V — Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Cont. No. VI — Certain documents cited
- ☐ Cont. No. VII — Certain defects in the international application
- ☐ Cont. No. VIII — Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA/ AT	Authorized officer
Austrian Patent Office Dresdner Straße 87, A-1200 Vienna	ERDÖS György
Facsimile No. +43 / 1 / 534 24 / 535	Telephone No. +36 /1/ 474-5918

Form PCT/ISA/237 (cover sheet) (January 2004)

Continuation No. I

Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of

a translation from the original language into the following language: English, which is the language of a translation furnished for the purposes of international search (under Rules 12.3 and 23.1(b)).

Continuation No. V

Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims **1-30**	**YES**
	Claims **-**	**NO**
Inventive step (IS)	Claims **1-30**	**YES**
	Claims **-**	**NO**
Industrial applicability (IA)	Claims **1-30**	**YES**
	Claims **-**	**NO**

2. Citations and explanations:

This report makes reference to the following documents:

D1. US 2005/0286409 A1
D2: WO 1996/37070 A1
D3: WO 2001/11909 A1

The present application relates to a data transmission method in a mobile communication system. The data transmission method through a code sequence in a mobile communication system includes grouping input data streams into a plurality of blocks consisting of at least one bit so as to map each block to a corresponding signature sequence, multiplying a signature sequence stream, to which the plurality of blocks are mapped, by a specific code sequence, and transmitting the signature sequence stream multiplied by the specific code sequence to a receiver.

Neither of the retrieved and cited documents taken them alone or in combination discloses or suggests methods transmitting data or code sequence in a mobile communication system as defined in claim 1 or 4 or 10 or 16 or 24. As this pertains to the independent claims 1, 4, 10, 16, 24 and as all other claims refer to said claims, the whole subject matter of the present application is considered novel and inventive. Industrial applicability is given.

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION CONCERNING
SUBMISSION OR TRANSMITTAL
OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

To:

KIM, Yong In
KBK & Associates
15 th Floor, Yosam-Building, 648-23
Yeoksam-dong, Kangnam-gu
Seoul, 135-080
RÉPUBLIQUE DE CORÉE

Date of mailing *(day/month/year)* 06 September 2007 (06.09.2007)	
Applicant's or agent's file reference TZ07-108WOCT	**IMPORTANT NOTIFICATION**
International application No. PCT/KR2007/002784	International filing date *(day/month/year)* 08 June 2007 (08.06.2007)
International publication date *(day/month/year)* **Not yet published**	Priority date *(day/month/year)* 09 June 2006 (09.06.2006)
Applicant LG ELECTRONICS INC. 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
09 June 2006 (09.06.2006)	10-2006-0052167	KR	05 July 2007 (05.07.2007)
26 June 2006 (26.06.2006)	10-2006-0057488	KR	05 July 2007 (05.07.2007)

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(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

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13 December 2007 (13.12.2007)

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(71) Applicant *(for all designated States except US)*: **LG ELECTRONICS INC.** [KR/KR]; 20, Yeouido-dong, Yeongdeungpo-gu, Seoul 150-721 (KR).

(72) Inventors; and

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(74) Agents: **KIM, Yong In** et al.; KBK & Associates, 15 th Floor, Yosam-Building, 648-23, Yeoksam-dong, Kangnam-gu, Seoul, 135-080 (KR).

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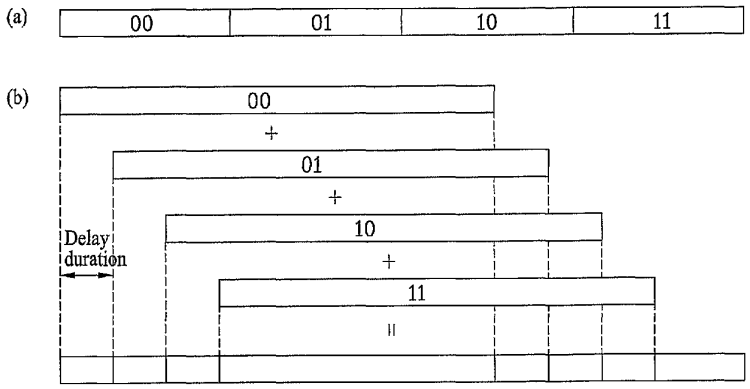
Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICAITON SYSTEM



(57) Abstract: Disclosed is a data transmission method in a mobile ommunication system. The data transmission method through a code sequence in a mobile communication system includes grouping input data streams into a plurality of blocks consisting of at least one bit so as to map each block to a corresponding signature sequence, multiplying a signature sequence stream, to which the plurality of blocks are mapped, by a specific code sequence, and transmitting the signature sequence stream multiplied by the specific code sequence to a receiver.

WO 2007/142492 A2

METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICAITON SYSTEM

[DESCRIPTION]

TECHNICAL FIELD

The present invention relates to a mobile communication system, and more particularly, to a method of expanding a code sequence, a structure of a random access channel and a method of transmitting data in a mobile communication system.

BACKGROUND ART

A user equipment uses a random access channel (RACH) to access a network in a state that the user equipment is not uplink synchronized with a base station. A signal having repetitive characteristic in a time domain is used in the random access channel, so that a receiver easily searches a start position of a transmission signal. In general, the repetitive characteristic is realized by repetitive transmission of a preamble.

A representative example of a sequence for realizing the preamble includes a CAZAC (Constant Amplitude Zero Auto Correlation) sequence. The CAZAC sequence is expressed by a Dirac-Delta function in case of auto-correlation and has a constant value in case of cross-correlation. In this respect, it has been estimated that the CAZAC sequence has excellent transmission characteristics. However, the CAZAC sequence has limitation in that maximum N-1 number of sequences can be used for a sequence having a length of N. For this reason, a method for increasing available bits of the sequence while maintaining the excellent transmission characteristics is required.

Meanwhile, there are provided various methods for transmitting data from a random access channel by using the CAZAC sequence. Of them, the first method is to directly

interpret CAZAC sequence ID to message information. Assuming that data to be transmitted is a preamble, if a sufficient number of sequences that can be used as the preamble are provided, message passing can be performed with only CAZAC sequence ID without additional manipulation. However, since a method of transmitting additional information should be considered in an actual synchronized RACH, problems occur in that there is difficulty in realizing a sufficient number of CAZAC sequence sets, and the cost required for search of a receiver increases.

The second method is to simultaneously transmit CAZAC sequence and Walsh sequence by using a code division multiplexing (CDM) mode. In this case, CAZAC sequence ID is used as user equipment identification information, and the Walsh sequence transmitted in the CDM mode is interpreted as message information. FIG. 1 is a block schematic view illustrating a transmitter for realizing the second method. However, the second method has limitation in that even though the Walsh sequence is added to the CAZAC sequence, bits of message that can additionally be obtained are only $\log_2 N$ bits when the Walsh sequence has a length of N.

The third method is to transmit CAZAC sequence and Walsh sequence in such a way to mix the Walsh sequence with the CAZAC sequence. In this case, CAZAC sequence ID is used as user equipment identification information, and the Walsh sequence is interpreted as message information. FIG. 2 is a block diagram illustrating a data processing procedure at a transmitter for realizing the third method. However, according to the third method, since the Walsh sequence acts as noise in detection of the CAZAC sequence to cause difficulty in detecting sequence ID, there is limitation in that repetitive sequences should be transmitted to prevent the Walsh sequence from acting as noise in detection of the CAZAC sequence.

The fourth method is to either give orthogonality between blocks constituting a corresponding sequence by multiplying an exponential term by a CAZAC sequence or

directly apply data modulation such as DPSK, DQPSK, D8PSK, etc. In this case, CAZAC sequence ID is used as user equipment identification information, and the modulated sequence is demodulated and then used as message information. FIG. 3A illustrates data modulation according to the former method of the fourth method, and FIG. 3B illustrates data modulation according to the latter method of the fourth.

Furthermore, the fifth method is to transmit CAZAC sequence by attaching a message part to the CAZAC sequence. FIG. 4A illustrates the case where a message (coded bit) is attached to the CAZAC sequence used as a preamble, and FIG. 4B illustrates the case where a message (coded bit) is attached to a sequence consisting of a predetermined number of blocks to which orthogonality is given.

However, the fourth method and the fifth method have a problem in that they are susceptible to change of channel condition.

DISCLOSURE OF THE INVENTION

Accordingly, the present invention has been suggested to substantially obviate one or more problems due to limitations and disadvantages of the related art, and an object of the present invention is to provide a method of transmitting and receiving message between a user equipment and a base station by using a long sequence to maximize time/frequency diversity and alleviating performance attenuation due to channel.

Another object of the present invention is to provide a method of transmitting data through a code sequence in a mobile communication system, in which the quantity of data can be increased and the transmitted data becomes robust to noise or channel change.

Still another object of the present invention is to provide a method of suggesting a structure of an efficient random access channel in a multi-carrier system.

Further still another object of the present invention is to provide a method of

minimizing access time of a user equipment to a random access channel in a mobile communication system.

To achieve these objects and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, a data transmission method through a random access channel in a mobile communication system comprises generating a new code by multiplying a code sequence by an exponential sequence, and transmitting the new code sequence to a receiving side.

In another aspect of the present invention, a data transmission method by using a code sequence in a mobile communication system comprises conjugating at least one element included in at least one block of a code sequence divided by at least two blocks to indicate predetermined information, and transmitting the code sequence, in which the at least one block is conjugated, to a receiving side.

In still another aspect of the present invention, a data transmission method by using a code sequence in a mobile communication system generating a second code sequence indicating predetermined information by combining at least two first code sequences mapped with at least one information bit, respectively, and transmitting the second code sequence to a receiving side.

In further still another aspect of the present invention, a code sequence transmission method in a mobile communication system comprises generating a combination code sequence by combining a base code sequence to at least one code sequence obtained by circular shift of the base code sequence, and transmitting the combination code sequence to a receiving side.

In further still another aspect of the present invention, a code sequence transmission method in a mobile communication system generating a repetitive code sequence by repeatedly concatenating a first code sequence at least one or more times, generating a cyclic

prefix (CP) by copying a certain part of a rear end of the repetitive code sequence and concatenating the copied part to a front end of the repetitive code sequence, and transmitting the repetitive code sequence, in which the CP is generated, to a receiving side.

In further still another aspect of the present invention, a method of allocating a random access channel (RACH) in a multi-carrier system comprises allocating a random access channel to each of at least two consecutive frames in a way that frequency bands of the random access channels allocated to the at least two consecutive frames are not overlapped with each other, and transmitting allocation information of the random access channels allocated to the at least two consecutive frames to at least one user equipment.

In further still another aspect of the present invention, a data transmission method through a code sequence in a mobile communication system mapping each of a plurality of blocks having at least one bit of a input data stream, respectively to a corresponding signature sequence, multiplying a signature sequence stream, to which the plurality of blocks are mapped, by a specific code sequence, and transmitting the signature sequence stream multiplied by the specific code sequence to a receiving side.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates an example of a data transmission method through a random access channel in an OFDMA system according to the related art;

FIG. 2 illustrates another example of a data transmission method through a random access channel in an OFDMA system according to the related art;

FIG. 3A and FIG. 3B illustrate still another example of a data transmission method through a random access channel in an OFDMA system according to the related art;

FIG. 4A and FIG. 4B illustrate further still another example of a data transmission method through a random access channel in an OFDMA system according to the related art;

FIG. 5 illustrates an example of a structure of a random access channel used in an OFDMA system;

FIG. 6A and FIG. 6B illustrate examples of sending an RACH signal in a time domain or a frequency domain based on a structure of a random access channel of FIG. 5;

FIG. 7 illustrates another example of a structure of a random access channel used in an OFDMA system;

FIG. 8A and FIG. 8B illustrate still another example of a structure of a random access channel used in an OFDMA system;

FIG. 9 illustrates a structure of a random access channel according to one embodiment of the present invention;

FIG. 10 illustrates a structure of a random access channel of a sub-frame to which RACH pilot is allocated;

FIG. 11 illustrates a repetitive structure of a preamble according to one embodiment of the present invention;

FIG. 12 is a structural view of unit data to illustrate one embodiment of the present invention, which transmits data by using a code sequence expanded through conjugation;

FIG. 13 is a flow chart illustrating a procedure of receiving and decoding data transmitted in a code sequence expanded through conjugation in accordance with one embodiment of the present invention;

FIG. 14 is a structural view of unit data to illustrate one embodiment of the present invention, which transmits data by using a code sequence expanded through grouping;

FIG. 15 is a flow chart illustrating a procedure of receiving and decoding data transmitted in a code sequence expanded through grouping;

FIG. 16 is a structural view of unit data to illustrate one embodiment of the present invention, which transmits data by using a code sequence expanded through grouping and

delay processing;

FIG. 17 is a flow chart illustrating a procedure of receiving and decoding data transmitted in a code sequence expanded through grouping and delay processing;

FIG. 18 is a structural view of unit data to illustrate one embodiment of the present invention, which transmits data by using a code sequence expanded through PPM modulation;

FIG. 19 is a flow chart illustrating a procedure of receiving and decoding data transmitted in a code sequence expanded through PPM modulation;

FIG. 20A and FIG. 20B are flow charts illustrating a procedure of performing synchronization in a random access channel in accordance with a data transmission method of the present invention;

FIG. 21 illustrates a method of transmitting data to a receiver through a signaling channel in accordance with one embodiment of the present invention; and

FIG. 22 illustrates an example of a receiver and a transmitter for transmitting a preamble and data through RACH, SCH or other channel in accordance with one embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

Hereinafter, structures, operations, and other features of the present invention will be understood readily by the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

A random access channel (RACH) is used to allow a user equipment to access a network in a state that the user equipment is not uplink synchronized with a base station. A random access mode can be classified into an initial ranging access mode and a periodic ranging access mode depending on an access mode to network. According to the initial

ranging access mode, the user equipment acquires downlink synchronization and first accesses a base station. According to the periodic ranging access mode, the user equipment connected with a network accesses the network if necessary. The initial ranging access mode is used to allow the user equipment to synchronize with the network while accessing the network and receive its required ID from the network. The periodic ranging access mode is used to initiate a protocol to receive data from the base station or when a packet to be transmitted exists.

In particular, the periodic ranging access mode can be classified into two types in the 3GPP LTE (long term evolution) system, i.e., a synchronized access mode and a non-synchronized access mode. The synchronized access mode is used if an uplink signal is within a synchronization limit when the user equipment accesses the RACH. The non-synchronized access mode is used if the uplink signal is beyond the synchronization limit. The non-synchronized access mode is used when the user first accesses the base station or synchronization update is not performed after synchronization is performed. At this time, the synchronized access mode is the same as the periodic ranging access mode, and is used when the user equipment accesses the RACH for the purpose of notifying the base station of the change status of the user equipment and requesting resource allocation.

On the other hand, the synchronized access mode alleviates limitation of a guard time in the RACH by assuming that the user equipment does not depart from uplink synchronization with the base station. For this reason, much more time-frequency resources can be used. For example, a considerable amount of messages (more than 24 bits) may be added to a preamble sequence for random access in the synchronized access mode so that both the preamble sequence and the messages may be transmitted together.

A structure of the RACH, which performs a unique function of the RACH while satisfying the aforementioned synchronized and non-synchronized access modes will now be

described.

FIG. 5 is a diagram illustrating an example of a structure of a random access channel (RACH) used in an OFDMA system. As shown in FIG. 5, it is noted that the RACH is divided into N number of sub-frames on a time axis and M number of frequency bands on a frequency axis depending on a radius of a cell. Frequency in generation of the RACH is determined depending on QoS (Quality of Service) requirements in a medium access control (MAC) layer. In general, the RACH is generated per certain period (several tens of milli-seconds (ms) to several hundreds of ms). In this case, frequency diversity effect and time diversity effect are provided in generating several RACHs and at the same time collision between user equipments which access through the RACH is reduced. The length of the sub-frame can be 0.5 ms, 1 ms, etc.

In the RACH structure as shown in FIG. 5, a random sub-frame will be referred to as a time-frequency resource (TFR) which is a basic unit of data transmission. FIG. 6A is a diagram illustrating a type of sending a random access signal to the TFR in a time domain, and FIG. 6B illustrates a type of sending a RACH signal in a frequency domain.

As shown in FIG. 6A, if a random access signal is generated in a time domain, the original sub-frame structure is disregarded and the signal is aligned through only the TFR. By contrast, as shown in FIG. 6B, in case of the synchronized random access mode, the sub-frame structure is maintained in the frequency domain and at the same time a random access signal to be transmitted to sub-carriers of each OFDM symbol is generated. Accordingly, orthogonality can be maintained between respective blocks constituting TFR, and channel estimation can easily be performed.

FIG. 7 is a diagram illustrating another example of a structure of RACH used in an OFDMA system. As shown in FIG. 7, it is noted that a preamble 'b' and a pilot 'a' are partially overlapped in a TDM/FDM mode and a TDM mode of RACH burst duration of an

attached wideband pilot. It is also noted that a pilot 'a' and a pilot 'b' are simultaneously overlapped with a preamble 'a' and the preamble 'b' in the TDM/FDM mode and the TDM mode of an embedded wideband pilot. In other words, it is designed that a preamble and a pilot are together transmitted through the RACH, so that message decoding is easily performed through channel estimation if message is added to the RACH. Alternatively, a wideband pilot is used so that channel quality information (CQI) of a total of RACH bands can be acquired in addition to a preamble band of the RACH.

FIG. 8A and FIG. 8B are diagrams illustrating another examples of a structure of the RACH used in the OFDMA system,

As shown in FIG. 8A, a preamble is transmitted for a predetermined time period through a frequency band, and a short block duration is provided at a certain period so that a pilot for decoding a preamble is transmitted to a corresponding short block. At this time, the pilot transmission is performed through a part of a total of frequency bands (transmission through 25 sub-carriers corresponding to a middle band of a total of 75 sub-carriers), so that the pilot can be transmitted to a specific user equipment under a multi-access environment.

Furthermore, as shown in FIG. 8B, a message to be transmitted and a pilot for decoding the message are multiplexed and continue to be transmitted through some frequency bands (for example, 25 middle sub-carrier bands of a total of 75 sub-carrier bands) selected from a total of frequency bands. Accordingly, respective user equipments which perform multi-access can be identified by allocating some frequency bands at different frequencies.

FIG. 9 is a diagram illustrating a structure of RACH according to one embodiment of the present invention.

Generally, frequency in generation of the RACH is determined depending on QoS requirements in a MAC layer. The RACH is generated at a variable period (several ms to several hundreds of ms) depending on requirements of a cell. The RACH can be generated in

a time domain or a frequency domain as described above with reference to FIG. 6A and FIG. 6B. In the embodiment of FIG. 9, the structure of the RACH corresponds to the case where a random access signal is generated in the frequency domain.

Referring to FIG. 9, in this embodiment, to overcome a drawback of a long interval required for retry when the user equipment fails to access the RACH, a corresponding RACH resource is dispersed in each frame within one period if frequency in generation of the RACH and the quantity of overhead are determined. The number of frames included in one period can freely be determined as occasion demands. At this time, it is preferable that the RACH is divisionally arranged so as to be uniformly distributed for each frequency band with respect to a plurality of frames constituting one period. However, position on the time axis may be changed without change of position on the frequency axis and vice versa depending on specific requirements (synchronized action or decrease of inter-cell interference) of a cell or if a system band is small. Also, arrangement of any one of frequency and time may be changed to obtain the minimum interval between the RACHs arranged in each frame.

In the embodiment of FIG. 9, the network should notify the user equipment of position information of the allocated RACH resource. In other words, the network can notify each user equipment of frequency and time information occupied by the RACH resource allocated for each frame included in one period, and each user equipment can try random access through the allocated RACH resource by using the position information from the network. The position information of the RACH resource of each frame can be expressed by sub-carrier offset, the number of sub-carriers, timing offset, and the number of symbols. However, if the RACH information on each frame is expressed by the above four parameters, it may be undesirable in that the quantity of the information can be increased. Accordingly, a method of decreasing the quantity of the information for expressing the position information of the RACH allocated on each frame is required. The position information of the RACH can

be transmitted through a broadcast channel (BCH) or other downlink control channel.

As one method, a method using a hopping pattern may be considered. The hopping pattern means a pattern consisting of information indicating frequency domains of the RACH resource allocated to each frame within one period. In other words, in the embodiment of FIG. 9, since the RACH resource is divisionally arranged so as to be uniformly distributed for each frequency band with respect to a plurality of frames constituting one period, an indicator which indicates a frequency band that can be allocated to each frame as the RACH resource is previously determined, and the frequency band of the RACH resource allocated to each frame within one period can be notified through a pattern of the indicator which indicates a corresponding frequency band.

For example, if four frames are used as one period in a system which uses a total of bands of 10MHz, the position of the RACH includes sub-bands having an interval of 2.5MHz as one RACH frequency band (band smaller than 1.25MHz or 2.5MHz). At this time, a total of bands consist of four sub-bands, wherein the respective sub-bands are designated by indicators, which indicate each sub-band, as 1, 2, 3 and 4 in due order from a high frequency band to a low frequency band. In this way, the frequency band position information of the RACH resource allocated to all frames within one period can be expressed by patterns configured by the above indicators, for example 2, 3, 1, 4. The hopping pattern may be configured differently or equally depending on each frame. Time information of the RACH resource allocated to each frame within one period can generally be expressed by timing offset and the number of symbols. At this time, at least any one of the timing offset and the number of symbols may be fixed to decrease the quantity of the information. For example, if it is previously scheduled that the timing offset and the number of symbols for the RACH resource of each frame are fixed, the network only needs to transmit the hopping pattern to notify the user equipment of the position information of the RACH resource of all frames

within one period.

If each sub-band is narrow or considering influence of interference between user equipments, hopping patterns for all frames may be set equally. In this case, the network only needs to notify the user equipment of a frame period.

Hereinafter, the procedure of transmitting uplink data from the user equipment to the base station by using the structure of the RACH as shown in the embodiment of FIG. 9 will be described. In this case, data transmission is performed through the RACH among reverse common channels consisting of a plurality of frames.

First of all, the user equipment tries to access the dispersed RACH included in the current frame to transfer its information to the base station. If the user equipment successfully accesses the RACH, the user equipment transmits preamble data through the corresponding RACH. However, if the user equipment fails to access the RACH, the user equipment tries to access the RACH divisionally arranged in the frame of the next order. At this time, the RACH included in the frame of the next order is preferably arranged in a frequency band different from that of the RACH of the previous frame if the frequency band is not sufficiently wide or there are no specific requirements (inter-cell interference or limitation in action range of user equipment). Also, the above access procedure continues to be performed in the frame of the next order until the user equipment successfully accesses the RACH.

Meanwhile, in case of the synchronized RACH, the sub-frame of each frame preferably includes a short block to which a pilot for the user equipment which has accessed the corresponding RACH is allocated. At least one RACH pilot and access pilot may be allocated to the short block at a predetermined pattern. In other words, the user equipment which has accessed the RACH should know channel information to receive a channel from the base station. The channel information may be set in RACH pilot within an uplink short block. The base station allocates a proper channel to the user equipment through the

corresponding RACH pilot. Meanwhile, if the user equipment which accesses the RACH notifies the base station of information of channel quality as to whether the user equipment is preferably allocated with which channel through the RACH pilot, a favorable channel can be allocated to the user equipment during scheduling, whereby communication of good quality can be maintained.

Accordingly, the RACH pilot that can be used for the user equipment which accesses the RACH is separately allocated to the sub-frame which includes RACH. Thus, the user equipment which accesses the RACH sends a preamble to the base station through the corresponding RACH and also sends a pilot for transmission of channel quality information to the designated RACH pilot. The RACH pilot is a sequence designated depending on a preamble, and it is preferable that the user equipments, which use different preamble sequences, use different RACH pilot sequences if possible or select RACH pilot of different sub-carriers or partially overlapped sub-carriers.

FIG. 10 is a diagram illustrating a structure of a random access channel of a sub-frame to which the RACH pilot is allocated. It is noted that each sub-frame includes at least one short block to which at least one RACH pilot and access pilot are allocated at a predetermined pattern. In this case, the RACH pilot exists in the frequency band of the allocated RACH and other system bands. In this embodiment, it has been described that two short blocks exist per one frame and the RACH pilot is transmitted to the short blocks. However, the present invention is not limited to such embodiment, and various modifications can be made within the apparent range by those skilled in the art.

As described above, it has been described that preamble, synchronization timing information including pilot information, uplink resource allocation information and message such as uplink data can be transmitted through the RACH of various structures. It will be apparent that the data transmission method according to the embodiments of the present

invention can be used in the RACH and other channels.

Meanwhile, the preamble and the message may separately be transmitted through the RACH. Alternatively, the message may be transmitted by being implicitly included in the preamble. One embodiment of the present invention relates to a method of transmitting a preamble through the latter transmission manner. In one embodiment of the present invention, a code sequence more expanded than that of the related art can be used for effective transmission of the preamble. Hereinafter, a method of improving CAZAC sequence according to one embodiment of the present invention for effective transmission of the preamble will be described.

Since the receiver should search a start position of a transmission signal in the random access channel, it is generally designed that a transmission signal has a specific pattern in a time domain. To this end, the preamble is transmitted repeatedly or a certain interval is maintained between sub-carriers in a frequency domain to obtain repetitive characteristics in the time domain, thereby identifying time synchronization.

In the former case, the preamble represents a reference signal used for the purpose of initial synchronization setting, cell detection, frequency offset, and channel estimation. In a cellular mobile communication system, a sequence having good cross-correlation characteristic is preferably used for repetitive transmission of the preamble. To this end, binary hardamard code or poly-phase CAZAC sequence may be used. Particularly, the CAZAC sequence has been estimated that it has excellent transmission characteristics as it is expressed by a Dirac-Delta function in case of auto-correlation and has a constant value in case of cross-correlation.

The CAZAC sequence can be classified into GCL sequence (Equation 1) and Zadoff-Chu sequence (Equation 2) as follows.

[Equation 1]

$$c(k;N,M)=\exp\left(-\frac{j\pi Mk(k+1)}{N}\right) \quad \text{for odd N}$$

$$c(k;N,M)=\exp\left(-\frac{j\pi Mk^2}{N}\right) \quad \text{for even N}$$

[Equation 2]

$$c(k;N,M)=\exp\left(\frac{j\pi Mk(k+1)}{N}\right) \quad \text{for odd N}$$

$$c(k;N,M)=\exp\left(\frac{j\pi Mk^2}{N}\right) \quad \text{for even N}$$

In the above Equations, it is noted that if the CAZAC sequence has a length of N, actually available sequences are limited to N-1 number of sequences. Accordingly, it is necessary to increase the number of CAZAC sequences to efficiently use them in an actual system.

For example, a method of expanding the number of available sequences by 1 is suggested by providing an improved CAZAC sequence p(k) in such a way to multiply a CAZAC sequence c(k) by a predetermined modulation sequence m(k). In other words, assuming that Zadoff-Chu sequence is used as the CAZAC sequence, the CAZAC sequence c(k), the modulation sequence m(k) and the improved CAZAC sequence p(k) can be defined by the following Equations 3, 4, and 5, respectively.

[Equation 3]

CAZAC sequence:

$$c(k;N,M)=\exp\left(\frac{j\pi Mk(k+1)}{N}\right)$$

[Equation 4]

Modulation sequence:

$$m(k)=\exp\left(\frac{j2\pi\delta}{N}k\right)$$

[Equation 5]

Improved CAZAC sequence (or improved preamble):

$$p(k)=c(k)*m(k)=\exp\left(\frac{j\pi M}{N}k(k+1)+\frac{j2\pi\delta}{N}k\right)$$

The improved CAZAC sequence p(k) maintains auto-correlation and cross-correlation characteristics of the CAZAC sequence. The following Equation 6 illustrates auto-correlation characteristic of p(k), and it is noted from the Equation 6 that the final result is a Dirac-delta function. In particular, if the modulation sequence m(k) is a sequence having a certain phase, it is characterized in that the modulation sequence m(k) always maintains the auto-correlation characteristic.

[Equation 6]

$$ad(d)=\sum_k \exp\left(\frac{j\pi M}{N}(k+d)(k+d+1)+\frac{j2\pi\delta}{N}(k+d)\right)$$

$$\exp\left(-\frac{j\pi M}{N}k(k+1)-\frac{j2\pi\delta}{N}k\right)$$

$$=\sum_k \exp\left(\frac{j2\pi M}{N}(2dk+d(d+1))+\frac{j2\pi\delta}{N}d\right)$$

$$=exp\left(\frac{j2\pi\delta}{N}d\right)\sum_k \exp\left(\frac{j\pi M}{N}(2dk+d(d+1))\right)=\begin{cases}1 & d=0\\ 0 & d\neq 0\end{cases}$$

Furthermore, the following Equation 7 illustrates cross-correlation characteristic of p(k).

[Equation 7]

$$cc(d) = \sum_k \exp\left(\frac{j\pi(M+x)}{N}(k+d)(k+d+1) + \frac{j2\pi\delta}{N}(k+d)\right) \exp\left(-\frac{j\pi M}{N}k(k+1) - \frac{j2\pi\delta}{N}k\right)$$

$$= \sum_k \exp\left(\frac{j\pi x}{N}(k+d)(k+d+1)\right) \exp\left(\frac{j\pi M}{N}(k+d)(k+d+1) + \frac{j2\pi\delta}{N}(k+d)\right) \exp\left(-\frac{j\pi M}{N}k(k+1) - \frac{j2\pi\delta}{N}k\right)$$

$$= \sum_k \exp\left(\frac{j\pi x}{N}(k+d)(k+d+1)\right) \exp\left(\frac{j\pi M}{N}(2dk + d(d+1)) + \frac{j2\pi\delta}{N}d\right)$$

$$= exp\left(\frac{j\pi M}{N}d(d+1)\right)\sum_k \exp\left(\frac{j\pi x}{N}(k+d)(k+d+1)\right) \exp\left(\frac{j2\pi dM}{N}k\right)$$

In this case, although Equation 7 seems to be similar to Equation 6, it is noted that in view of summation term, auto-correlation is expressed by sum of exponential but cross-correlation is expressed by the product of two sequences. The first term is another CAZAC sequence of which seed value is x, and the second term is a simple exponential function. The sum of the product of two sequences is equal to obtaining a coefficient of the exponential function, and its value is equal to a value obtained by converting the CAZAC sequence of

which seed value is x into a frequency domain and extracting a value from the frequency position of exponential.

Since the CAZAC sequence has auto-correlation of Dirac-delta characteristic, if it undergoes Fourier transform, it maintains auto-correlation characteristic of Dirac-delta of a constant amplitude even in the transformed area. For this reason, if values of specific positions are extracted from the frequency domain, their sizes are 1 and equal to each other but their phases are different from each other. Accordingly, if this result is added to the Equation 7 to obtain cross-correlation, the obtained cross-correlation can briefly be expressed by the following Equation 8.

[Equation 8]

$$cc(d) = exp\left(\frac{j\pi M}{N}d(d+1) + \frac{j2\pi\delta}{N}d\right)\sum_{k}\exp\left(\frac{j\pi x}{N}(k+d)(k+d+1)\right)$$

$$\exp\left(\frac{j2\pi dM}{N}k\right)$$

$$= exp\left(\frac{j\pi M}{N}d(d+1) + \frac{j2\pi\delta}{N}d\right)C(dM/N;x)$$

It is noted from the Equation 8 that since C(dM/N;x) always has a size of 1 and an exponential term also has a size of 1, the cross-correlation is always fixed at 1.

After all, characteristics of the related art CAZAC sequence can be maintained by the Equation 5 and at the same time the number of codes can be increased. This means that the result in the area where the exponential terms are multiplied is equal to applying circular shift to the Fourier transformed area, and multiplying exponential sequences in the time domain is equal to performing circular shift in the frequency domain.

In other words, it is noted that if correlation between two sequences p(k;M,N,d1) and p(k;M,N,d2) of which seed values are equal to each other is obtained, impulse occurs in a

point where a delay value d in cross-correlation reaches d1-d2. Although design of the improved sequence as above has the same result as that of circular shift of the CAZAC sequence, this embodiment of the present invention is advantageous in that the result can be obtained by a simple procedure such as multiplying two exponential sequences without Fourier inverse transform after Fourier transform and circular shift.

Hereinafter, a method of improving data transmission reliability of a preamble by performing predetermined data processing for the related art code sequence and a method of expanding a length of a code sequence when data are simultaneously transmitted will be described. If the CAZAC sequence is used as the code sequence, the CAZAC sequence expanded by the above method is preferably used. However, the CAZAC sequence is not necessarily limited to the CAZAC sequence expanded by the above method, and the related art CAZAC sequence may be used.

First of all, a structure of transmission data, i.e., preamble, which is commonly applied to the embodiments of the present invention, will be described.

In a 3GPP LTE (Long Term Evolution) system, a transmitter can repeatedly transmit the same sequence two times or more so as to allow a receiver to easily detect transmission data or improve additional detection performance (i.e., increase of spreading gain). Accordingly, since the receiver only needs to detect repetitive patterns regardless of the type of the received sequence, it can simply identify time position of a user equipment which accesses the RACH and improve detection performance.

FIG. 11 is a diagram illustrating a structure of a preamble according to one embodiment of the present invention. In an orthogonal frequency divisional transmission system, a cyclic prefix (CP) is used, in which the last part of OFDM symbol is copied and then prefixed to the OFDM symbol to compensate a multi-path loss in signal transmission. Accordingly, if the OFDM symbol consists of two repetitive preambles, a part of the

preamble of the later order is copied in the first part by CP to enable compensation of the multi-path loss for the corresponding preamble. Also, the CP is advantageous in that it is easy to identify user equipments which access different RACHs in case of CAZAC having good periodic correlation.

Since inter-symbol interference does not occur even though a single sequence is transmitted by prefixing CP thereto instead of repetitive transmission of sequence, a predetermined receiving algorithm can be realized in the frequency domain without any problem. However, if the receiver realizes a receiving algorithm in the time domain with neither repetitive transmission nor CP, the receiver should detect all kinds of code sequences to identify user equipments which access the RACH. In this respect, the preamble is preferably realized by a structure of a repetitive pattern. At this time, whether to realize a repetition pattern can be determined depending on a data rate supported by the system or the number of repetitive times can be determined if a repetitive pattern is realized. For example, to support a minimum data rate supported by the system, RACH preamble can repeatedly be transmitted one or more times depending on the length of the sequence.

First to fourth embodiments which will be described later relate to a data processing method of a sequence constituting the structure of the preamble. In these embodiments, data transmitted to the receiver could be the structure of the preamble of FIG. 11 or a partially omitted structure (having neither repetitive transmission nor CP). Although it is assumed that the CAZAC sequence is used as the code sequence for data transmission, the code sequence is not necessarily limited to the CAZAC sequence. Every sequence having excellent transmission characteristic, such as Hadarmad code and gold code, can be used as the code sequence.

<First Embodiment>

To transmit data, a landmark that can be identified is generally required for a

transmission signal constituting data. In this embodiment, conjugation is used as the landmark. Since a phase variation width between a conjugated transmission signal and other transmission signal is very great, interference between transmission signals decreases, whereby reliability of data transmission can be improved in spite of influence of channel.

FIG. 12 illustrates a method of transmitting data through conjugation according to one embodiment of the present invention. In the embodiment of FIG. 12, one CAZAC sequence is divided into four blocks, and '0' or '1' indicates whether to perform conjugate for each block. For example, it may be promised that a block which is not conjugated is expressed by '0', and a block which is conjugated is expressed by '1.' In this way, one CAZAC sequence can express information of 4 bits. In other words, if one CAZAC sequence is divided into N number of blocks, information of N bits can be expressed.

At this time, in a single CAZAC sequence of a long length corresponding to a length of transmission data, a part of the single CAZAC sequence, which corresponds to a specific block having a value of 1, may be conjugated. Also, in a plurality of CAZAC sequences of a short length corresponding to each block length of transmission data, a CAZAC sequence corresponding to a specific block having a value of 1 may be conjugated.

FIG. 13 is a diagram illustrating an example of a method of receiving and decoding the sequence transmitted through conjugation from the transmitter in accordance with one embodiment of the present invention.

It is preferable that the transmitter always allocates a value of 0 to the first block of the transmission data so that the first block is used as a reference later. Accordingly, the receiver identifies sequence ID for the received first block (S1101), and then measures a peak by using only the corresponding block (S1102). Next, the receiver identifies sequence IDs for the first and second blocks (S1103), and then measures a peak by using the first and second blocks together. At this time, since it is unclear whether the sequence of the second block is in

the conjugated status, the receiver respectively measures a peak corresponding to the case where the corresponding block is conjugated (S1104) and a peak corresponding to the case where the corresponding block is not conjugated (S1105), and then selects greater one of the two peaks (S1106). Subsequently, the receiver identifies sequence IDs for the first to third blocks (S1107), and then measures a peak by using the first to third blocks together. In this case, since it is unclear whether the sequence of the third block is in the conjugated status, the receiver respectively measures a peak corresponding to the case where the corresponding block is conjugated (S1108) and a peak corresponding to the case where the corresponding block is not conjugated (S1109), and then selects greater one of the two peaks (S1110). In this way, decoding is performed for the first block to the last block so that the original data is finally decoded.

<Second Embodiment>

FIG. 14 is a diagram illustrating a method of transmitting data using a sequence according to another preferred embodiment of the present invention. Although data transmission is performed by change of the sequence in the first embodiment, in this embodiment, a type of a sequence for expressing one block is divided into a sequence (first sequence) for a block value of '0' and a sequence (second sequence) for a block value of '1,' and the first and second sequence are grouped. In this case, since the receiver detects only sequence ID (ID of the first sequence or ID of the second sequence) for each block, the receiver is less affected by noise or channel.

All sequences are expressed by one group "$\{c_0(k;M_i), c_1(k;M_j)\}$" by grouping two sub-sequences (first sequence and second sequence) (i and j are integers different from each other). In this case, $c_0(k;M_i)$ is the first sequence for the block value of 0 (or bit value), and $c_1(k;M_j)$ is the second sequence for the block value of 1. At this time, a CAZAC sequence of a long length corresponding to a length of transmission data may be used as each sub-

sequence constituting each group. Alternatively, a CAZAC sequence of a short length corresponding to each block length of transmission data may be used as each sub-sequence constituting each group.

Meanwhile, the receiver identifies sequence ID of each block, and identifies a type of the sequence (first sequence or second sequence) for each block from a sequence ID set consisting of the identified sequence IDs. At this time, the type of the sequence for each block can be expressed by group ID. In other words, in this embodiment, since it is assumed that code values of each block can be expressed by 0 and 1, two types of the sequence for each block or two types of group ID are obtained. The code values of each block can be restored through group ID. This decoding procedure will be described in detail with reference to FIG. 15.

The receiver identifies sequence ID of each block constituting a corresponding sequence if the sequence is received (S1501), and measures a peak for a sequence ID set consisting of the identified sequence IDs (S1502). In this case, two peaks having high frequency in generation are selected (S1503) so that sequences which generate the corresponding peaks are identified as the first sequence and the second sequence constituting the group. At this time, if the first sequence and the second sequence are expressed by predetermined group IDs, respectively, first group ID indicating a code value of 0 and second group ID indicating a code value of 1 can be identified. After all, group ID of each block can be identified through the step S1503 (S1504), and thus the code value of each block can be identified (S1508).

If sequence IDs that can not identify group ID exist due to error occurring during the decoding procedure, peaks are searched for a set of corresponding sequence IDs (S1505), and among the peaks, two powerful peaks are detected (S1506) so that group IDs are again identified from the detected powerful peaks (S1507). Subsequently, code values of the

corresponding blocks can be identified from the identified group IDs (S1508).

<Third Embodiment>

FIG. 16 is a diagram illustrating a method of transmitting data using a sequence according to another preferred embodiment of the present invention.

If the second embodiment is more expanded, a total number of data bits that can be transmitted through one group can be increased. For example, if two sequences are defined as one group like the second embodiment, data of 1 bit per block can be transmitted. If four sequences are defined as one group, data of 2 bits per block can be transmitted. If eight sequences are defined as one group, data of 3 bits per block can be transmitted. However, since a plurality of sequences are grouped and defined as one set, a problem occurs in that if the length of each sequence is short, the number of groups that can be selected is decreased in proportion to the short length of each sequence.

Accordingly, it is necessary to expand the length of the sequence to increase the number of groups that can be selected. To this end, in this embodiment, the length of the sequence for each block is expanded while respective sequences are multi-overlapped as shown in FIG. 16B and independence is maintained owing to transmission delay between the overlapped sequences.

Referring to FIG. 16(a), a data value of 2 bits is given to each block. Accordingly, a sequence group for each block consists of four different CAZAC sequences. Since each CAZAC sequence constituting the sequence group should identify four values, a group size should be increased correspondingly. However, in this case, a problem occurs in that the number of groups that can be used by each base station is decreased. Accordingly, as shown in FIG. 16, the length of each CAZAC sequence is expanded as much as need be while a predetermined delay is given to each CAZAC sequence during data transmission, whereby independence is maintained between the respective CAZAC sequences.

Meanwhile, the receiver identifies ID of a corresponding block based on the order of each CAZAC sequence represented in the time/frequency domain, and its method of decoding a code value from corresponding block ID is almost identical with that of the second embodiment. Hereinafter, a data decoding procedure of the receiver will be described in detail with reference to FIG. 17.

The receiver identifies sequence ID of each block constituting a corresponding sequence if the sequence is received (S1701), and measures a peak for a sequence ID set consisting of the identified sequence IDs (S1702). In this embodiment, since one block expresses two bits, first, second, third and four sequences which express 00, 01, 10, 11 form one group. Accordingly, the receiver should select 4 peaks having high frequency in generation as a result of measurement (S1703). In this case, the selected peaks are respectively mapped to the first, second, third and fourth sequences in accordance with the order represented in the time/frequency domain. Also, if the first sequence to the fourth sequence are expressed by predetermined group IDs, respectively, first group ID indicating a code value of 00, second group ID indicating a code value of 01, third group ID indicating a code value of 10, and fourth group ID indicating a code value of 11 can be identified. After all, group ID of each block can be identified through the step S1703 (S1704), and thus the code value of each block can be identified (S1708).

If sequence IDs that can not identify group ID exist due to error occurring during the decoding procedure, peaks are again searched for a set of corresponding sequence IDs (S1705), and among the peaks, four powerful peaks are detected (S1706) so that group IDs are again identified from the detected powerful peaks (S1707). Subsequently, code values of the corresponding blocks can be identified from the identified group IDs (S1708).

<Fourth Embodiment>

FIG. 18 is a diagram illustrating a method of transmitting data using a sequence

according to another preferred embodiment of the present invention.

In the case that the second embodiment and the third embodiment are more expanded, the signal position is changed through pulse position modulation (PPM) so that the length of the sequence can be expanded logically. The PPM originally transmits data with relative pulse delay but PPM based on start position of the sequence is used in this embodiment.

If bits of data to be transmitted are determined, the base station selects a sequence to be used for transmission of corresponding data and determines a length of a block for applying PPM to a corresponding sequence and a length of a duration constituting each block. A sequence corresponding to each block is separately required when a preamble is generated. However, in this embodiment, since circular shift equivalent to a specific duration within a specific block constituting a corresponding sequence is applied for the same sequence, the respective sequences are originally the same as one another but are identified from one another by circular shift.

For example, assuming that one sequence length is divided into four blocks (block 1 to block 4) and each block is expressed by 2 bits, each block is again divided into four durations (duration 1 to duration 4) to express values of "00, 01, 10, 11." At this time, four durations included in one block are used as start identification positions of circular shift for a sequence corresponding to a corresponding block. If a preamble to be transmitted has a total length of 256, block 1 can have a circular shift value of 0~63, block 2 64~127, block 3 128~195, and block 4 196~255. If a specific sequence to be used for transmission of the preamble is determined and "00" is transmitted through block 1, sequence 1 undergoes circular shift so that a start position is arranged in duration 1 (0~15) of block 1. If "10" is transmitted to block 2, sequence 2 undergoes circular shift so that a start position is arranged in duration 3 (96~111) of block 2. In this way, circular shift is applied for the other blocks

and then the respective sequences (sequence 1 to sequence 4) are grouped into one to generate one preamble. In this case, the number of blocks can be generated from 1 to every random number. Also, a minimum unit of circular shift can be limited to more than a certain value considering channel or timing error.

Meanwhile, the receiver identifies respective sub sequences (sequence 1 to sequence 4) constituting corresponding sequences by data processing the transmitted sequences, and searches a start position of each of the identified sequences to perform data decoding. This will be described in detail with reference to FIG. 19.

If a sequence is received in the receiver (S1901), the receiver detects ID of the corresponding sequence (S1903) and performs full correlation through predetermined data processing for a total of received signals (received sequence) by using the detected result (S1905). At this time, a full search algorithm or a differential search algorithm can be used for detection of the sequence ID.

Since the received signal is transmitted from the transmitter by gathering a plurality of sequences, the signal which has undergone the correlation includes a plurality of peaks. In this embodiment, four peaks are detected, and the receiver determines whether each of the detected peaks corresponds to which one of block 1 to block 4 and also corresponds to which duration of a corresponding block (S1909) to decode bit order and bit value of the original data (S1911).

The method of effectively transmitting the preamble sequence and message through the RACH has been described as above. Finally, a procedure of transmitting a preamble from a user equipment (UE) to a base station (Node-B) and performing synchronization between both the user equipment and the base station will be described based on two embodiments. FIG. 20A and FIG. 20B illustrate the two embodiments.

In the embodiment of FIG. 20A, synchronization is performed in such a manner the

user equipment accesses the base station only once. In other words, if the user equipment transmits a preamble and a messing including information required for synchronization to the base station (S2001), the base station transmits timing information to the user equipment (S2003) and at the same time allocates a resource for transmission of uplink data (S2005). The user equipment transmits the uplink data to the base station through the allocated resource (S2007).

In the embodiment of FIG. 20B, for synchronization, the user equipment accesses the base station twice. In other words, if the user equipment transmits a preamble to the base station (S2011), the base station transmits timing information to the user equipment and at the same time allocates a resource for a request of scheduling (S2013). The user equipment transmits a message for a request of scheduling to the base station through the allocated resource (S2015). Then, the base station allocates a resource for transmission of uplink data to the user equipment (S2017). In this way, the user equipment transmits to the uplink data to the base station through the secondly allocated resource (S2019).

FIG. 21 is a diagram illustrating a method of transmitting data to a receiver through a signaling channel in accordance with one embodiment of the present invention.

Since the receiver should search a start position of a transmission signal in actually realizing the random access channel, it is generally designed that the random access channel has a specific pattern in the time domain. To this end, a preamble sequence may be used so that the random access signal originally has a repetitive pattern. Alternatively, a certain interval may be maintained between sub-carriers in the frequency domain to obtain repetitive characteristics in the time domain. Accordingly, the access modes of FIG. 6A and FIG. 6B are characterized in that the start position of the transmission signal should easily be searched in the time domain. To this end, the CAZAC sequence is used. The CAZAC sequence can be classified into GCL sequence (Equation 1) and Zadoff-Chu sequence (Equation 2).

30

Meanwhile, a specific sequence of a long length is preferably used to transmit unique information of the user equipment or the base station through RACH (Random Access Channel) or SCH (Synchronization Channel). This is because that the receiver easily detects corresponding ID and more various kinds of sequences can be used to provide convenience for system design.

However, if message is transmitted with corresponding ID at a sequence of a long length, since the quantity of the message is increased by $\log_2$ function, there is limitation in message passing with ID only when the sequence exceeds a certain length. Accordingly, in this embodiment, the sequence is divided by several short blocks, and a short signature sequence corresponding to data to be transmitted to each block of the sequence is used instead of specific manipulation such as conjugation or negation.

Referring to FIG. 21, the sequence is divided into a predetermined number of blocks, and a short signature sequence corresponding to data to be transmitted is applied for each of the divided blocks. A long CAZAC sequence is multiplied by combination of the blocks for which the short signature sequence is applied, whereby a final data sequence to be transmitted to the receiver is completed.

In this case, assuming that the short signature sequence consists of four signatures, the following signature sets can be used. Also, if there is difference between respective data constituting the signature sets, any other signature set may be used without specific limitation.

1) Modulation values: {1+j, 1-j, -1-j, -1+j}

2) Exponential sequence: {[exp(jw_0n)], [exp(jw_1n)], [exp(jw_2n)], [exp(jw_3n)]}, where n=0...Ns, and Ns is a length of each block

3) Walsh Hadamard sequence: {[1111], [1-11-1], [11-1-1], [1-1-11]}, where, if the length Ns of each block is longer than 4, each sequence is repeated to adjust the length.

Examples of the long CAZAC sequence that can be used in the embodiment of FIG.

21 include, but not limited to, one GCL CAZAC sequence, Zadoff-Chu CAZAC sequence, and a sequence generated by concatenation of two or more short GCL or Zadoff-Chu CAZAC sequences having the same length or different lengths.

The aforementioned manner of applying a short signature sequence for data transmission and reception to the long CAZAC sequence is advantageous in that it is less affected by channel than the related art modulation method of transmission data and performance is little decreased even though the number of bits constituting one signature is increased.

FIG. 22 illustrates an example of a receiver and a transmitter for transmitting a preamble and data through RACH, SCH or other channel by using the aforementioned manner.

Since the number of bits can be increased in accordance with increase of signatures, channel coding can be applied for the transmitter. If channel coding is performed, time/frequency diversity can be obtained through an interleaver. Also, bit to signature mapping can be performed to minimize a bit error rate. In this case, Gray mapping can be used. The sequence which has undergone this procedure is mixed with CAZAC and then transmitted.

The receiver detects CAZAC ID, and calculates a log-likelihood ratio (LLR) for each of bits. Then, the receiver decodes transmission data through a channel decoder. Considering complexity according to sequence search of the receiver configured as shown in FIG. 22, the transmitter preferably uses an exponential sequence as a signature sequence. In this case, the receiver can simply search CAZAC ID through phase difference Fourier Transform. Afterwards, the receiver can again simply calculate LLR from the signature through Fourier Transform.

According to the present invention, the structure on the frequency axis/time axis of

the RACH can be identified more definitely. Also, since the RACH resource is divisionally distributed for each frame, even though the user equipment fails to access a specific RACH, the user equipment can directly access RACH of the next frame, whereby access to the base station is improved. Moreover, the user equipment can easily access the RACH even in case of a traffic area of which QoS condition is strict.

Furthermore, according to the present invention, since information is transmitted and received between the user equipment and the base station by using the code sequence, time/frequency diversity can be maximized, and performance attenuation due to influence of channel can be alleviated through the signature manner.

According to the present invention, since the total length of the corresponding sequence can be used with maintaining the advantage of the code sequence according to the related art, data transmission can be performed more efficiently. Also, since the code sequence undergoes predetermined data processing, the quantity of information to be transmitted can be increased and the transmitted data becomes robust to noise or channel.

It will be apparent to those skilled in the art that the present invention can be embodied in other specific forms without departing from the spirit and essential characteristics of the invention. Thus, the above embodiments are to be considered in all respects as illustrative and not restrictive. The scope of the invention should be determined by reasonable interpretation of the appended claims and all change which comes within the equivalent scope of the invention are included in the scope of the invention.

INDUSTRIAL APPLICABILITY

The present invention is applicable to a wireless communication system such as a mobile communication system or a wireless Internet system.

[CLAIMS]

1. A method of transmitting data on a random access channel in a mobile communication system, the method comprising:

generating a new code by multiplying a code sequence by an exponential sequence; and

transmitting the new code sequence to a receiving side.

2. The method of claim 1, wherein the code sequence is a CAZAC (constant amplitude zero autocorrelation) sequence.

3. The method of claim 1 or 2, wherein the code sequence is transmitted as a preamble.

4. A method of transmitting data by using a code sequence in a mobile communication system, the method comprising:

conjugating at least one element included in at least one block of a code sequence divided by at least two blocks to indicate predetermined information; and

transmitting the code sequence, in which the at least one block is conjugated, to a receiving side.

5. The method of claim 4, wherein the code sequence is a CAZAC sequence.

6. A method of transmitting data by using a code sequence in a mobile communication system, the method comprising:

generating a second code sequence indicating predetermined information by combining at least two first code sequences mapped with at least one information bit, respectively; and

transmitting the second code sequence to a receiving side.

7. The method of claim 6, wherein the first code sequence is a CAZAC sequence.

8. The method of claim 6, wherein, if each of the first code sequences is mapped with 'n' number of information bits, the at least two first code sequences are selected from a sequence group consisting of 2^n number of first code sequences.

9. The method of claim 6, wherein the combination of the at least two first code sequences is performed by summing the at least two first code sequences after giving predetermined delay to each of the at least two first code sequences.

10. A method of transmitting a code sequence in a mobile communication system, the method comprising:

generating a combination code sequence by combining a base code sequence to at least one code sequence obtained by circular shift of the base code sequence; and

transmitting the combination code sequence to a receiving side.

11. The method of claim 10, wherein each of the base code sequence and the at least one code sequence identifies one or more information bit.

12. The method of claim 10, wherein the step of generating the combination code sequence is performed in a frequency domain.

13. The method of claim 10, wherein the step of generating the combination code sequence is performed in a time domain.

14. The method of claim 10, wherein the combination code sequence is transmitted through a random access channel (RACH).

15. The method of claim 10, wherein the at least one code sequence is obtained by circular shift of the base code sequence as much as integer times of circular shift unit.

16. A method of transmitting a code sequence in a mobile communication system, the method comprising:

generating a repetitive code sequence by repeatedly concatenating a first code sequence at least one or more times;

generating a cyclic prefix (CP) by copying a certain part of a rear end of the repetitive code sequence and concatenating the copied part to a front end of the repetitive code sequence; and

transmitting the repetitive code sequence, in which the CP is generated, to a receiving side.

17. The method of claim 16, wherein the repetitive code sequence is transmitted as a preamble on a random access channel.

18. A method of allocating a random access channel in a multi-carrier system, the method comprising:

allocating a random access channel to each of at least two consecutive frames in a

way that frequency bands of the random access channels allocated to the at least two consecutive frames are not overlapped with each other; and

transmitting allocation information of the random access channels allocated to the at least two consecutive frames to at least one user equipment.

19. The method of claim 18, wherein the frequency bands of the random access channels allocated to the at least two consecutive frames have a pattern which is periodically repeated.

20. The method of claim 18, wherein the allocation information includes a hopping pattern of the frequency bands of the random access channels allocated to the at least two consecutive frames.

21. The method of claim 18, wherein the random access channels are uniformly allocated to the at least two consecutive frames.

22. The method of claim 18, further comprising allocating a channel region for transmission of a pilot signal at the user equipment to at least one sub-frame to which the random access channel is allocated.

23. The method of claim 22, wherein the user equipment trying to random access through the random access channel transmits a pilot signal through the channel region.

24. A method of transmitting data by using a code sequence in a mobile communication system, the method comprising:

mapping each of a plurality of blocks having at least one bit of a input data stream, respectively to a corresponding signature sequence;

multiplying a signature sequence stream, to which the plurality of blocks are mapped, by a specific code sequence; and

transmitting the signature sequence stream multiplied by the specific code sequence to a receiving side.

25. The method of claim 24, wherein the specific code sequence is a single CAZAC sequence.

26. The method of claim 24, wherein the specific code sequence is a sequence obtained by concatenating at least two different CAZAC sequences.

27. The method of claim 24, wherein the signature sequence is an exponential sequence.

28. The method of claim 24, wherein the signature sequence is a Hadamard sequence.

29. The method of claim 24, further comprising repeating each signature sequence so as to match a length of the signature sequence stream, to which the plurality of blocks are mapped, with a length of the specific code sequence.

30. The method of claim 24, wherein the signature sequence mapping is Gray mapping.

FIG. 1

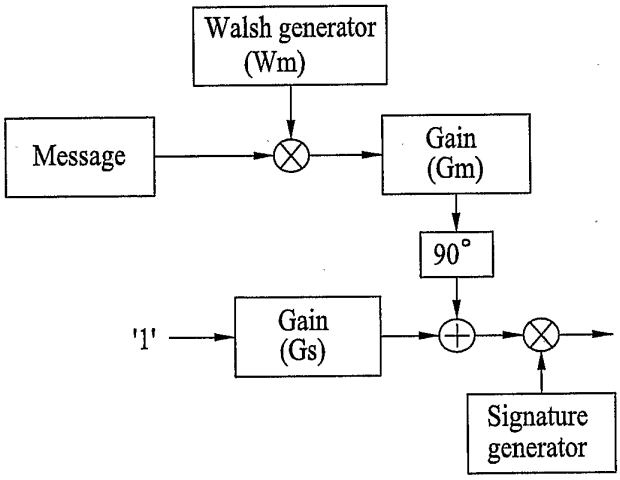

Walsh generator
(Wm)
Message
Gain
(Gm)
90°
'1'
Gain
(Gs)
Signature
generator

FIG. 2

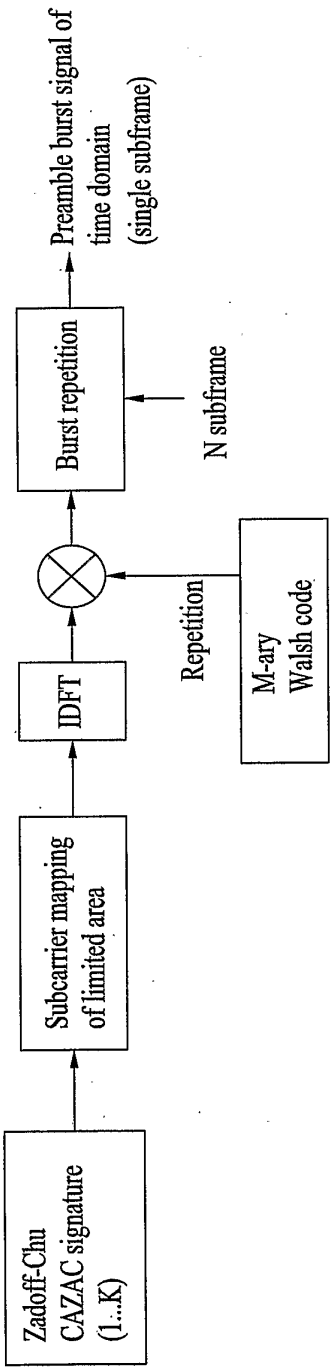

Zadoff-Chu CAZAC signature (1...K)
Subcarrier mapping of limited area
IDFT
Repetition
M-ary Walsh code
Burst repetition
N subframe
Preamble burst signal of time domain (single subframe)

FIG. 3A

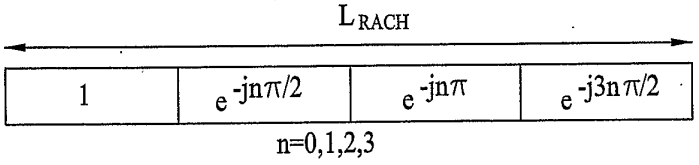


FIG. 3B

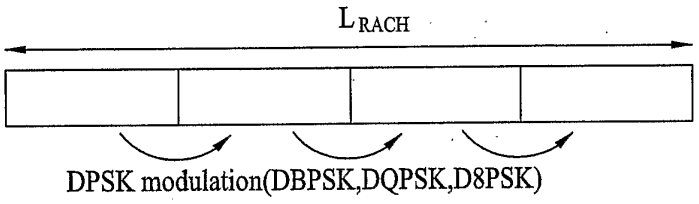


FIG. 4A

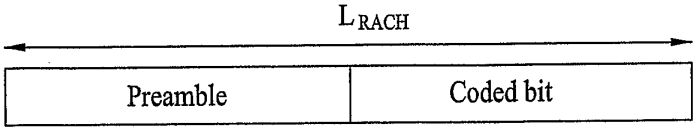


FIG. 4B

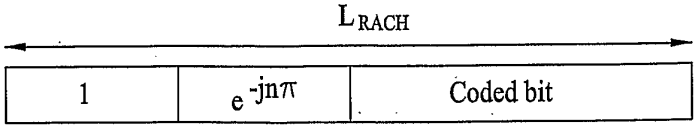


FIG. 5

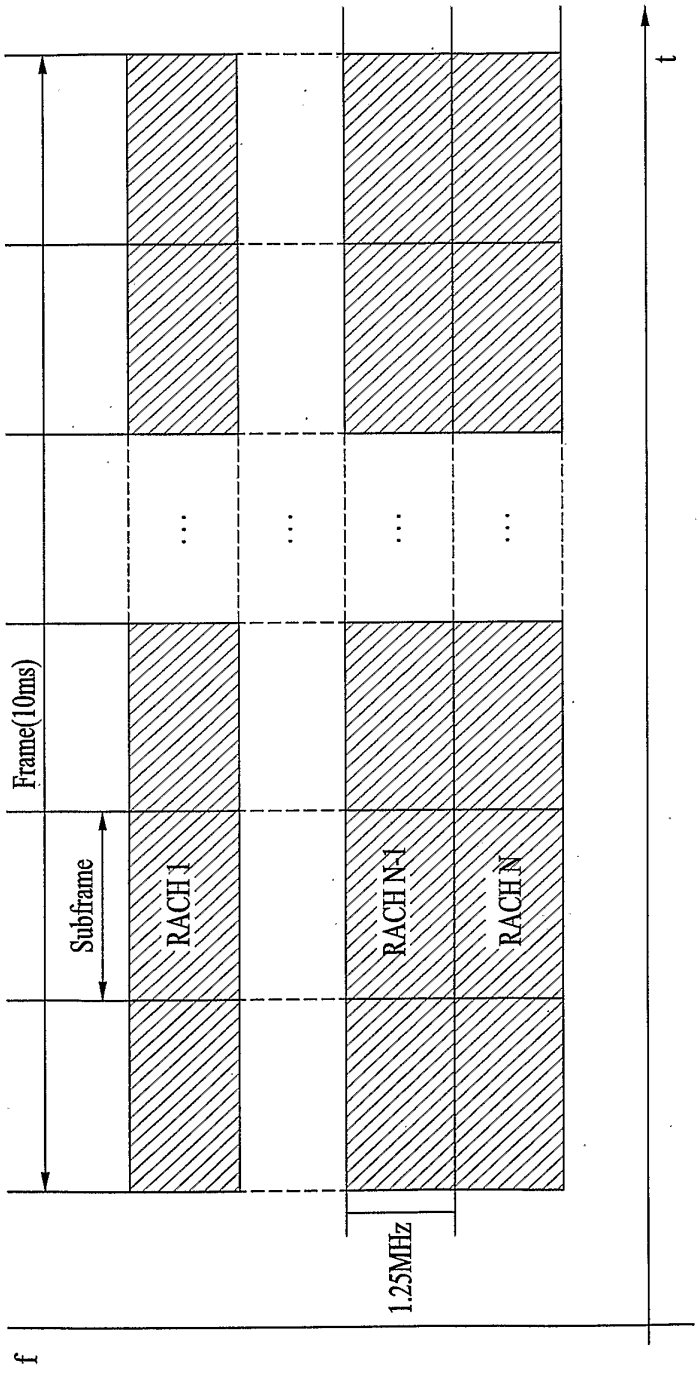


FIG. 6A

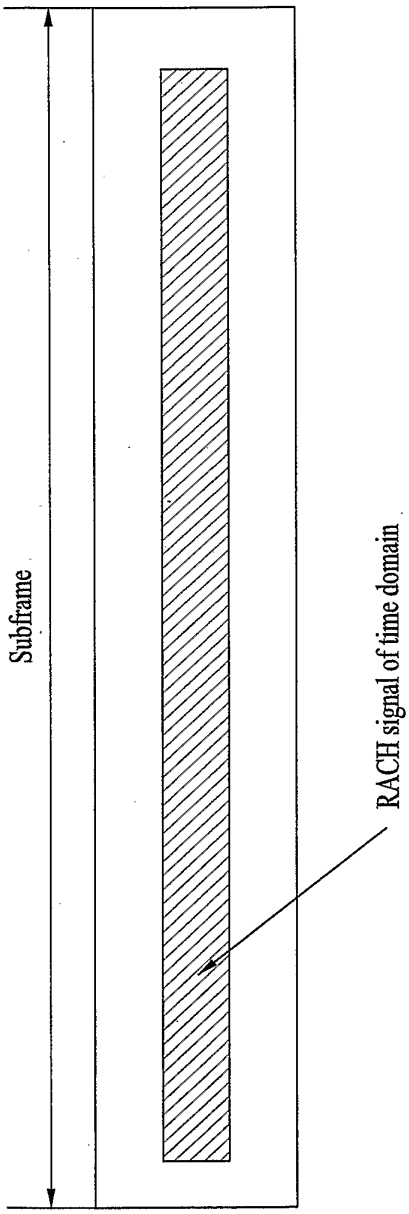


FIG. 6B

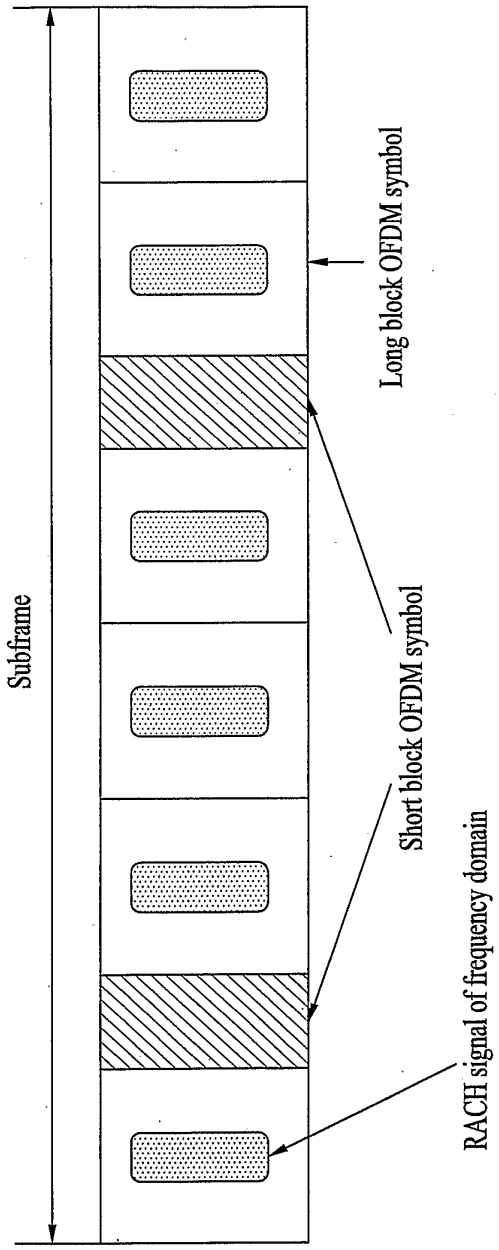

Subframe
Long block OFDM symbol
Short block OFDM symbol
RACH signal of frequency domain

FIG. 7

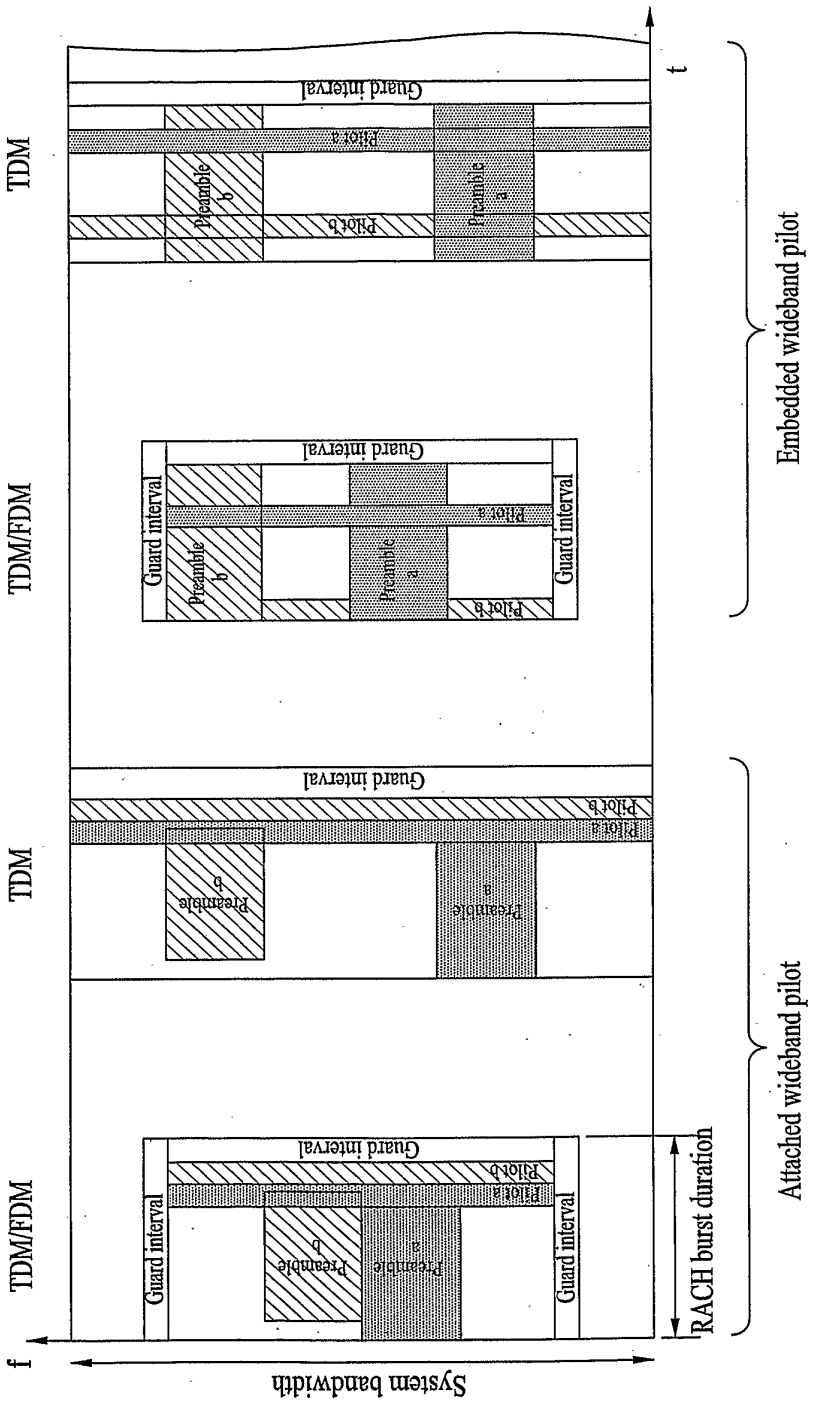

t
f
System bandwidth
TDM
TDM/FDM
TDM
TDM/FDM
Guard interval
Pilot b
Pilot a
Preamble b
Preamble a
Guard interval
Embedded wideband pilot
Attached wideband pilot
RACH burst duration

FIG. 8A

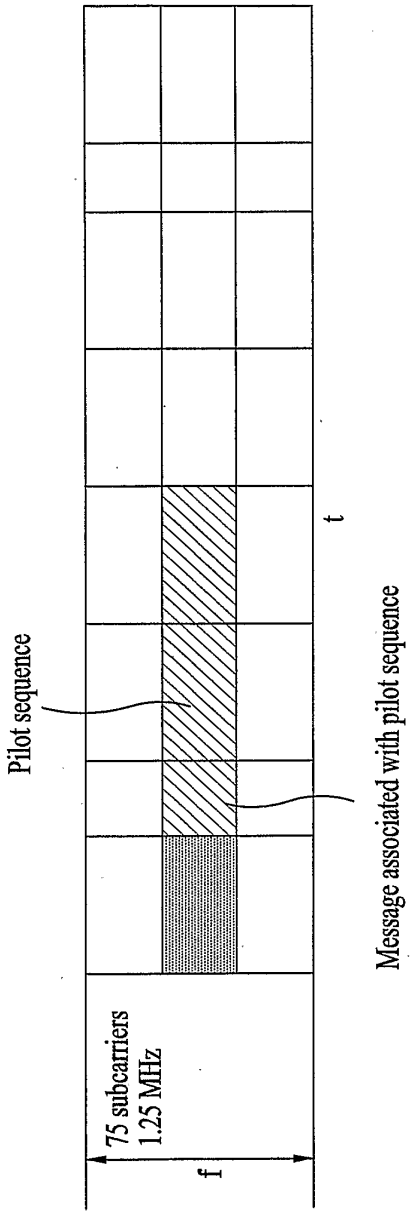

Pilot sequence
Message associated with pilot sequence
t
f
75 subcarriers
1.25 MHz

FIG. 8B

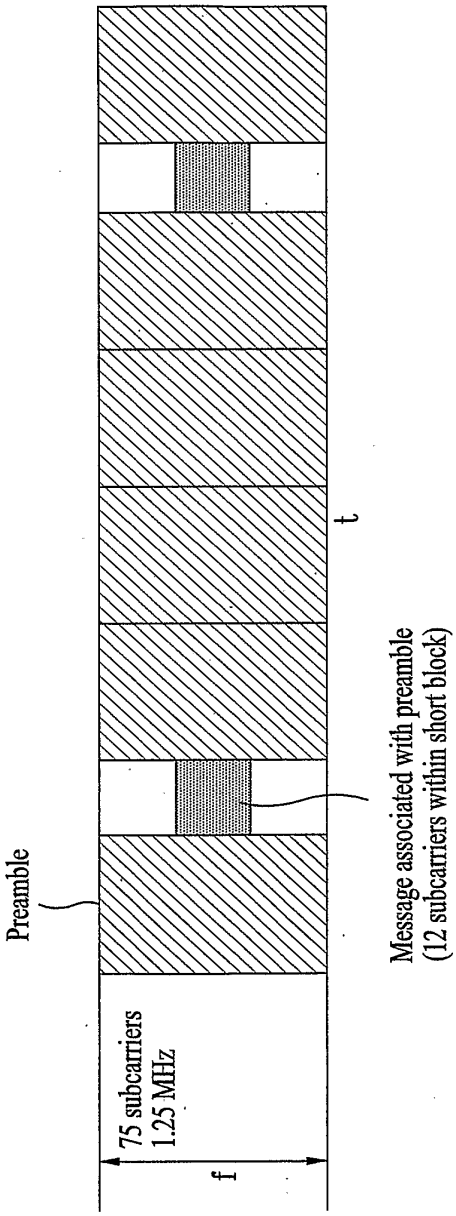

Preamble
Message associated with preamble
(12 subcarriers within short block)
t
75 subcarriers
1.25 MHz
f

FIG. 9

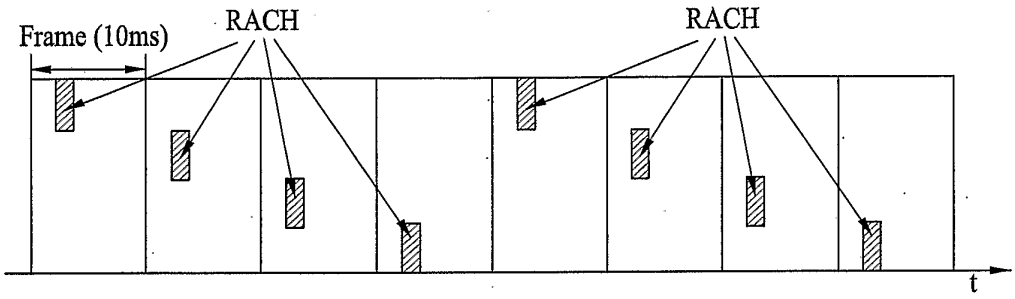


FIG. 10

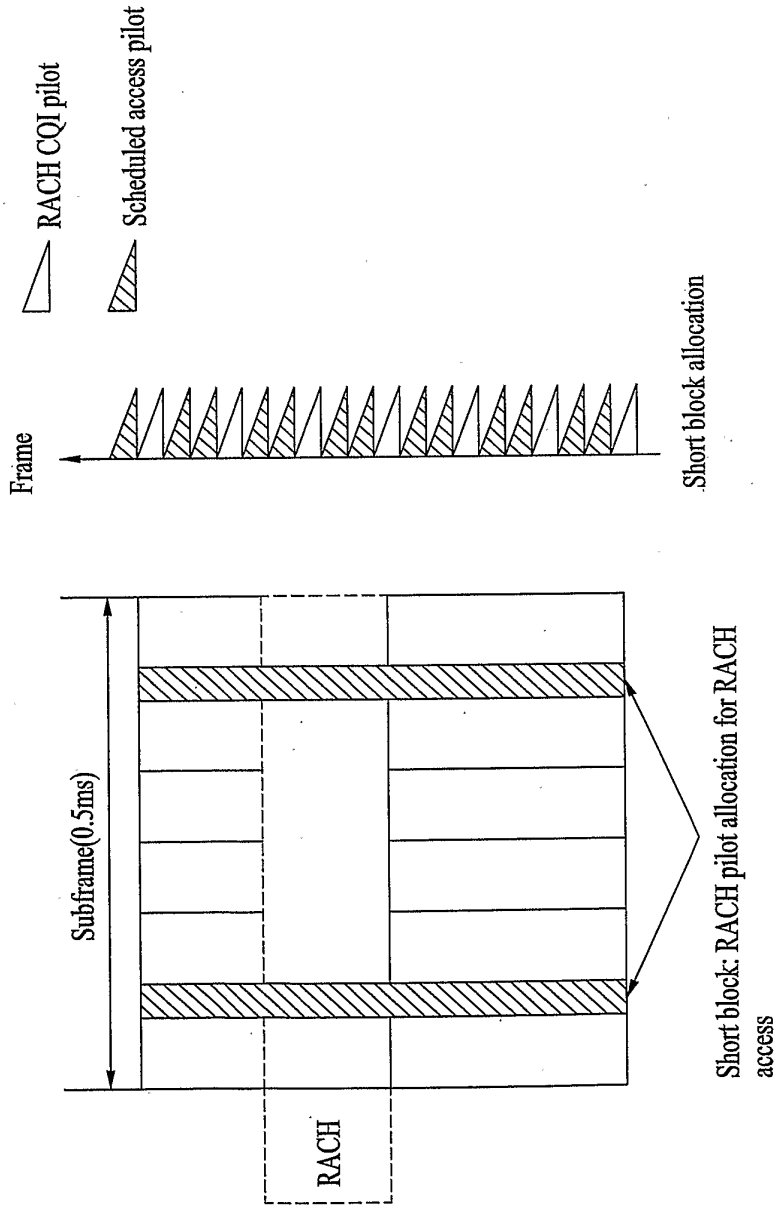

RACH CQI pilot
Scheduled access pilot
Frame
Short block allocation
Subframe(0.5ms)
RACH
Short block: RACH pilot allocation for RACH access

FIG. 11

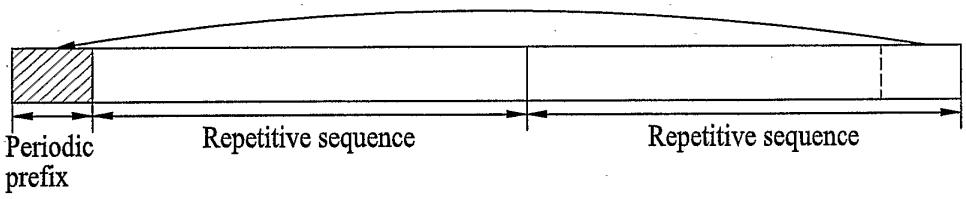

Periodic prefix
Repetitive sequence
Repetitive sequence

FIG. 12

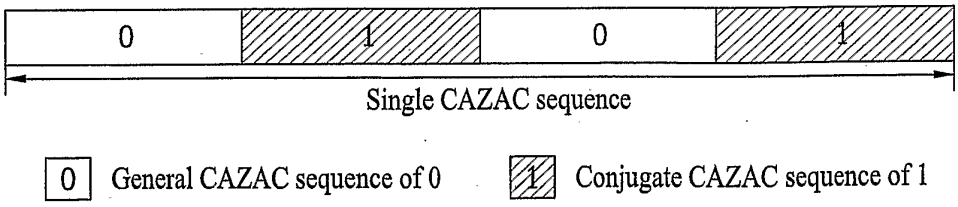

0
1
0
1
Single CAZAC sequence
0 General CAZAC sequence of 0
1 Conjugate CAZAC sequence of 1

FIG. 13

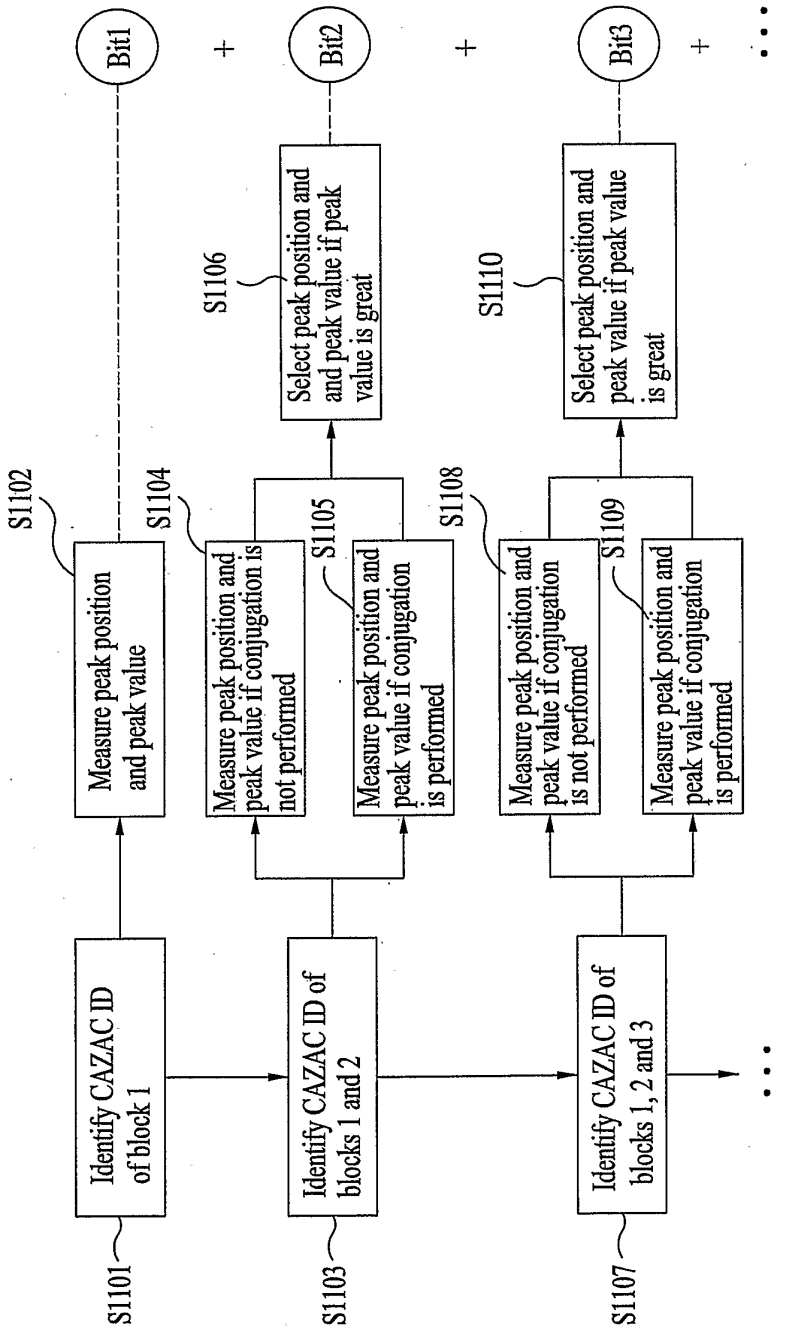

Identify CAZAC ID of block 1
S1101
Measure peak position and peak value
S1102
Bit1
+
Identify CAZAC ID of blocks 1 and 2
S1103
Measure peak position and peak value if conjugation is not performed
S1104
Measure peak position and peak value if conjugation is performed
S1105
Select peak position and and peak value if peak value is great
S1106
Bit2
+
Identify CAZAC ID of blocks 1, 2 and 3
S1107
Measure peak position and peak value if conjugation is not performed
S1108
Measure peak position and peak value if conjugation is performed
S1109
Select peak position and peak value if peak value is great
S1110
Bit3
+
...
...

FIG. 14

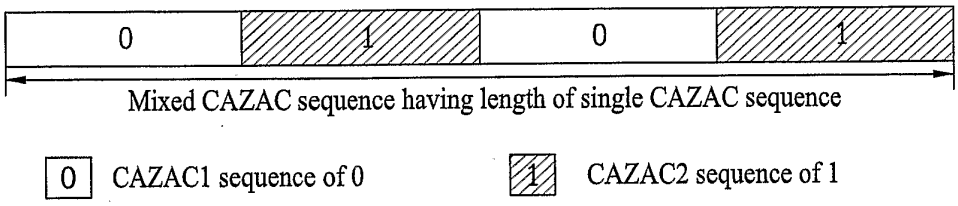

0
1
0
1
Mixed CAZAC sequence having length of single CAZAC sequence
0 CAZAC1 sequence of 0
1 CAZAC2 sequence of 1

FIG. 15

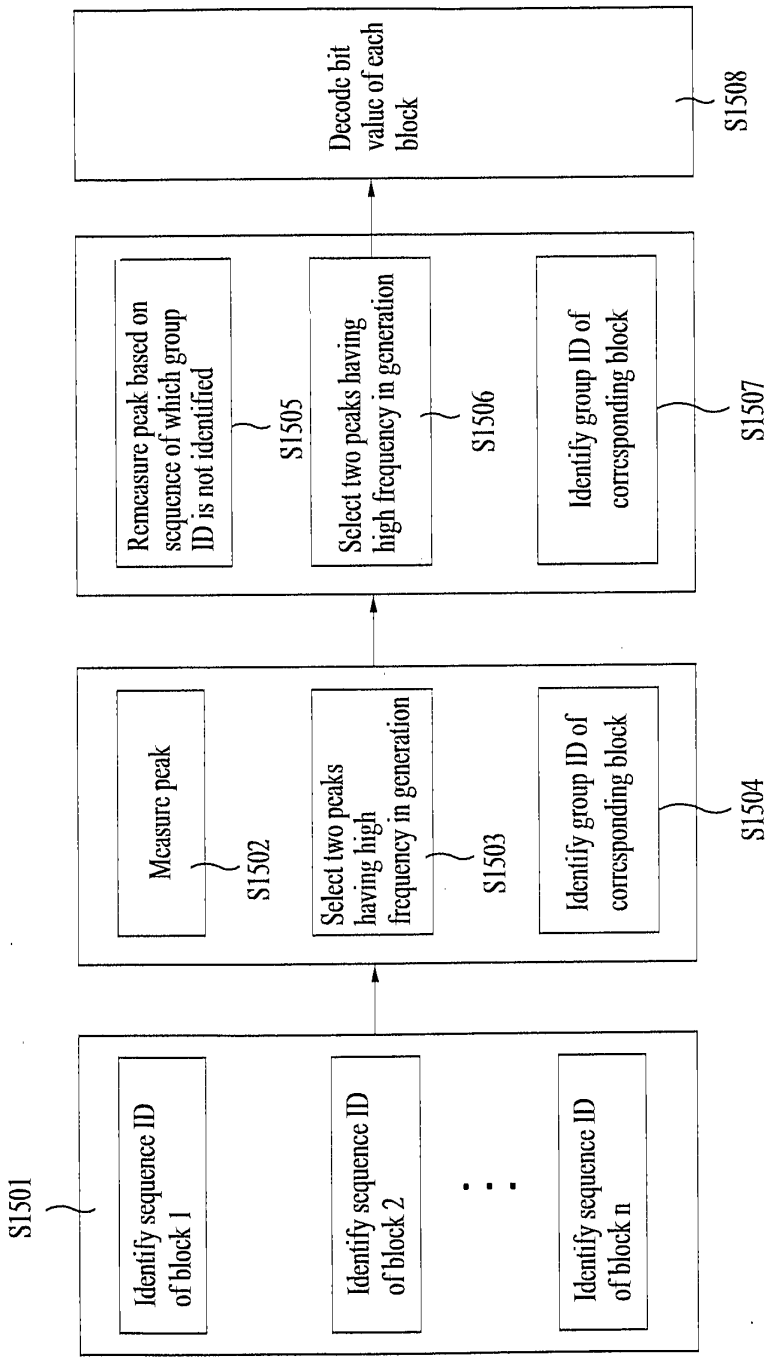

S1501
Identify sequence ID of block 1
Identify sequence ID of block 2
Identify sequence ID of block n
Measure peak
S1502
Select two peaks having high frequency in generation
S1503
Identify group ID of corresponding block
S1504
Remeasure peak based on sequence of which group ID is not identified
S1505
Select two peaks having high frequency in generation
S1506
Identify group ID of corresponding block
S1507
Decode bit value of each block
S1508

FIG. 16

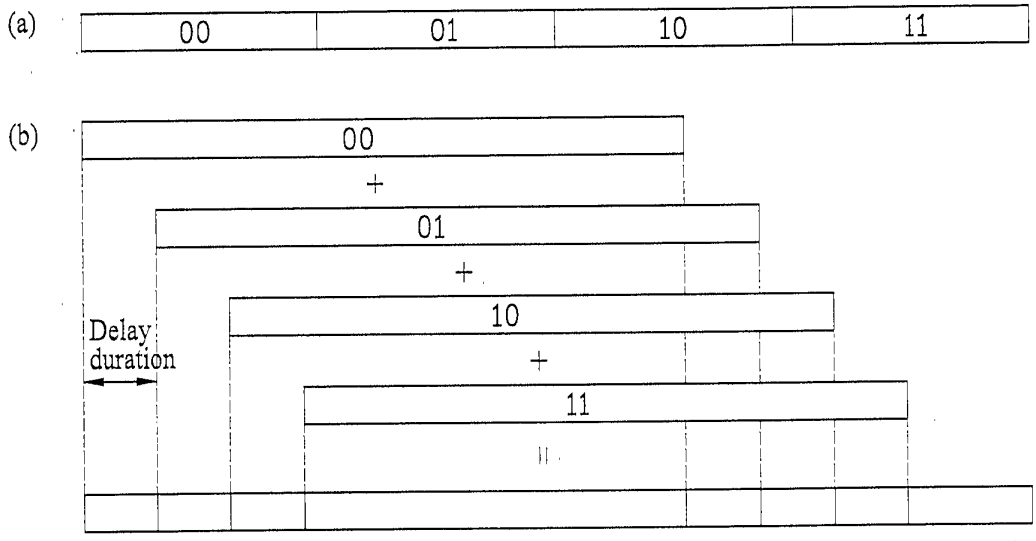


FIG. 17

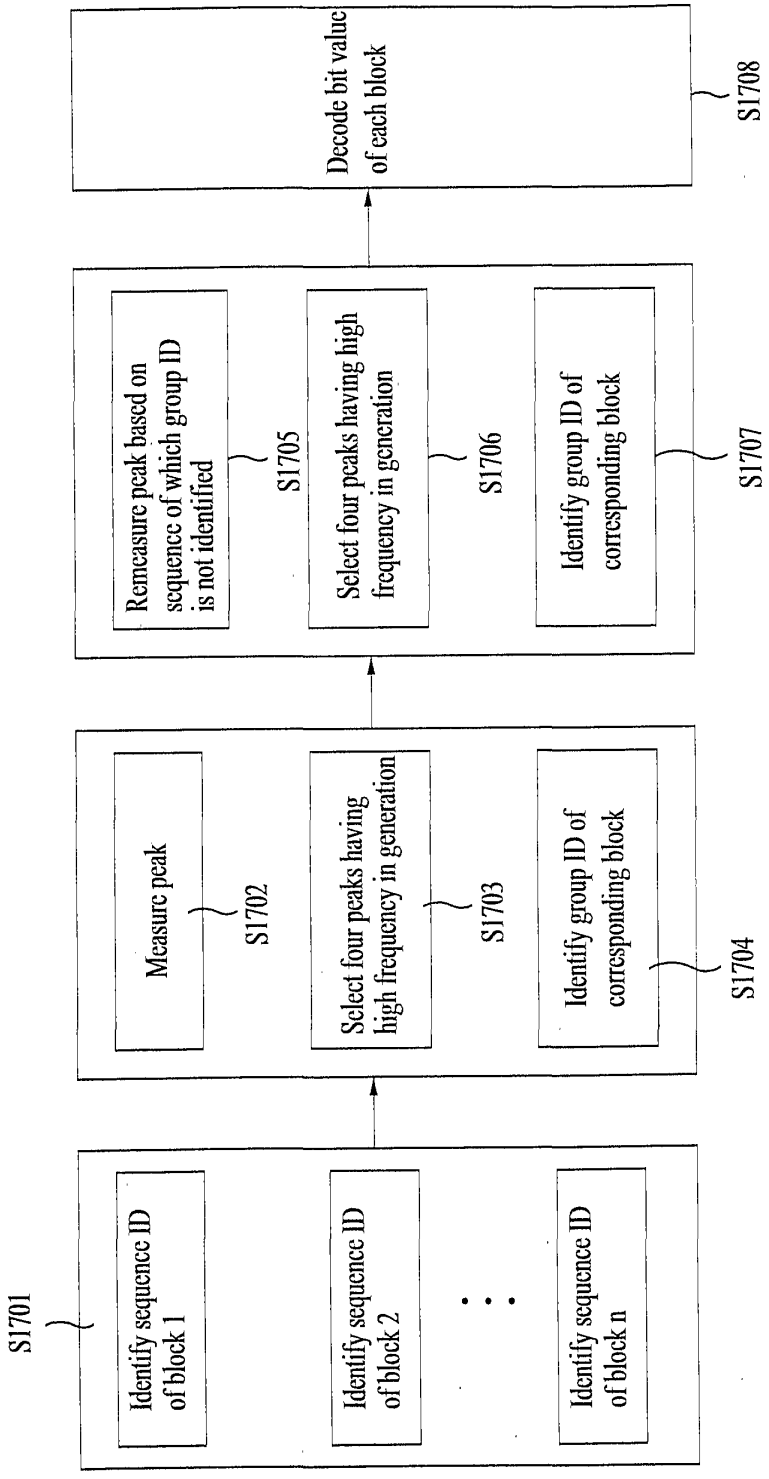

S1701
Identify sequence ID of block 1
Identify sequence ID of block 2
Identify sequence ID of block n
S1702
Measure peak
S1703
Select four peaks having high frequency in generation
S1704
Identify group ID of corresponding block
S1705
Remeasure peak based on sequence of which group ID is not identified
S1706
Select four peaks having high frequency in generation
S1707
Identify group ID of corresponding block
S1708
Decode bit value of each block

FIG. 18

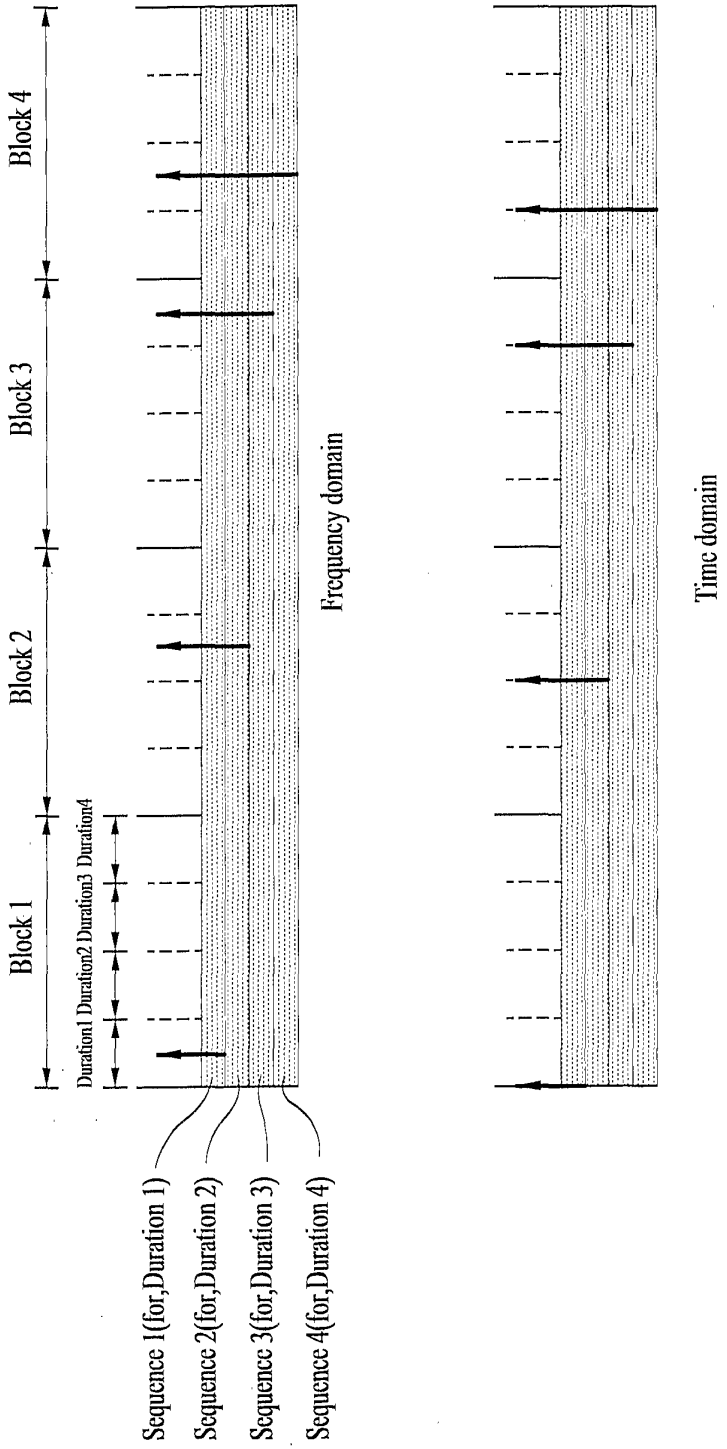

Block 1
Block 2
Block 3
Block 4
Duration1 Duration2 Duration3 Duration4
Frequency domain
Time domain
Sequence 1(for,Duration 1)
Sequence 2(for,Duration 2)
Sequence 3(for,Duration 3)
Sequence 4(for,Duration 4)

FIG. 19

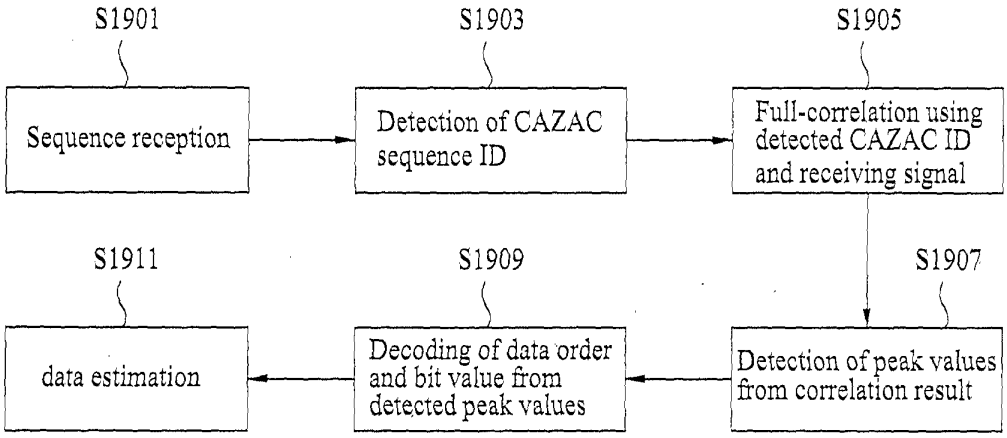

S1901
Sequence reception
S1903
Detection of CAZAC sequence ID
S1905
Full-correlation using detected CAZAC ID and receiving signal
S1907
Detection of peak values from correlation result
S1909
Decoding of data order and bit value from detected peak values
S1911
data estimation

FIG. 20A

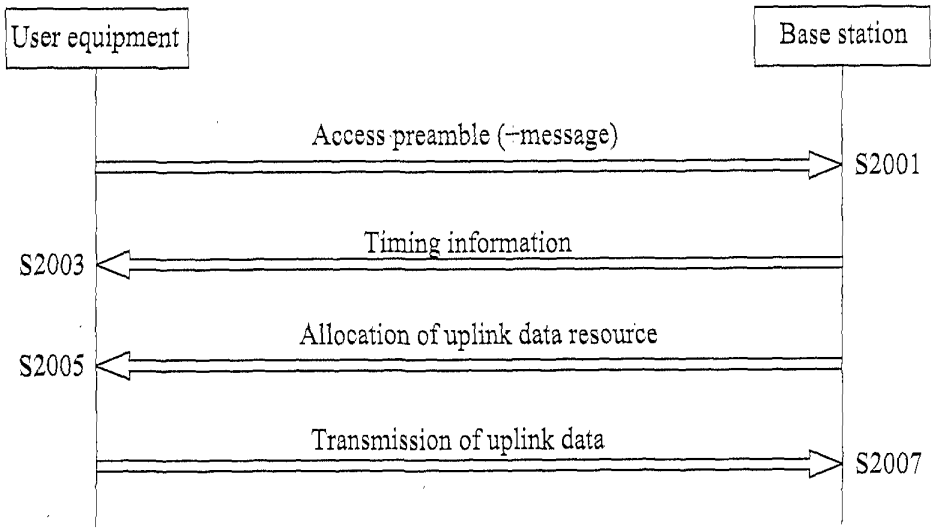


FIG. 20B

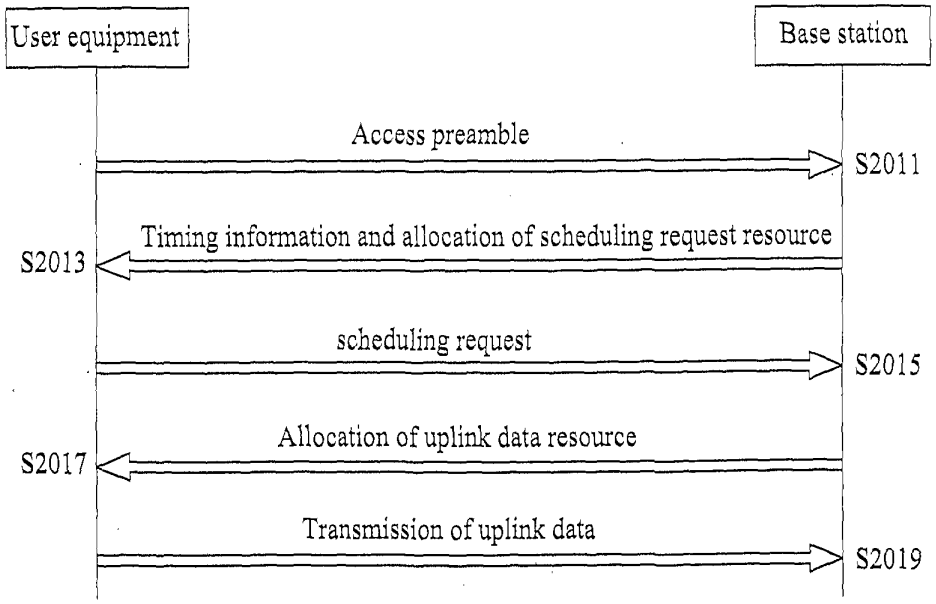


FIG. 21

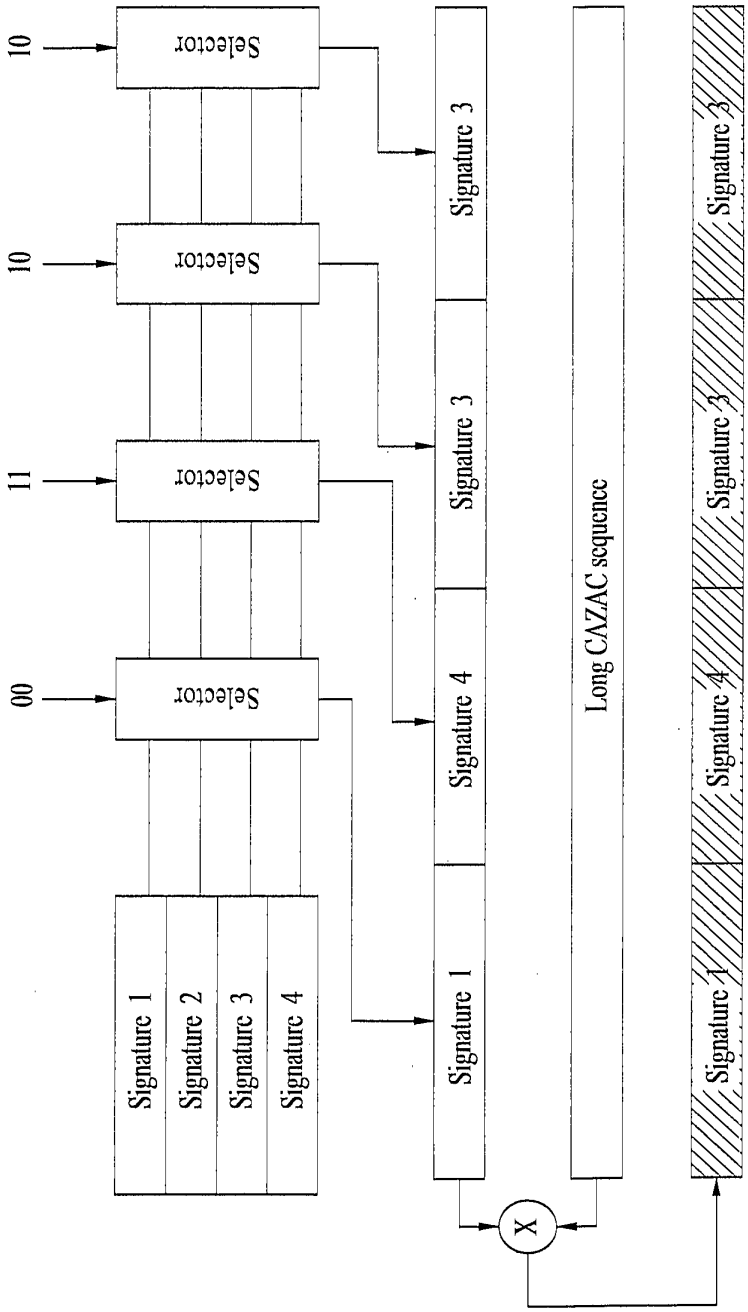
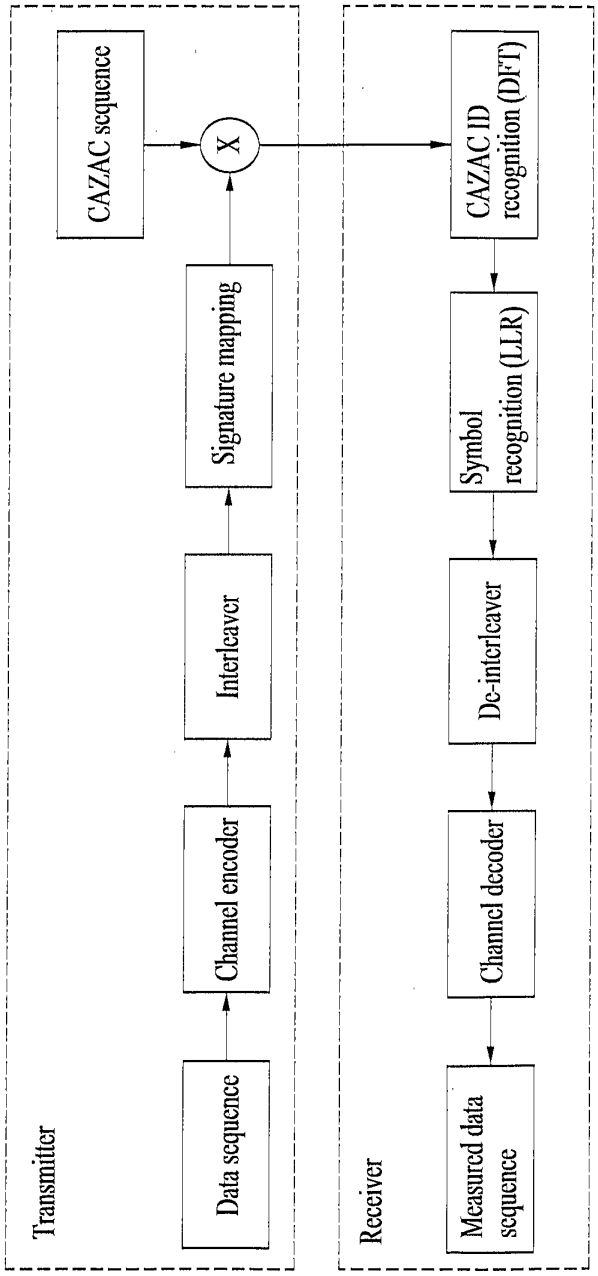

10
10
11
00
Selector
Selector
Selector
Selector
Signature 1
Signature 2
Signature 3
Signature 4
Signature 1
Signature 4
Signature 3
Signature 3
Long CAZAC sequence
Signature 1
Signature 4
Signature 3
Signature 3
X

FIG. 22


Transmitter
Data sequence
Channel encoder
Interleaver
Signature mapping
CAZAC sequence
X
Receiver
Measured data sequence
Channel decoder
De-interleaver
Symbol recognition (LLR)
CAZAC ID recognition (DFT)

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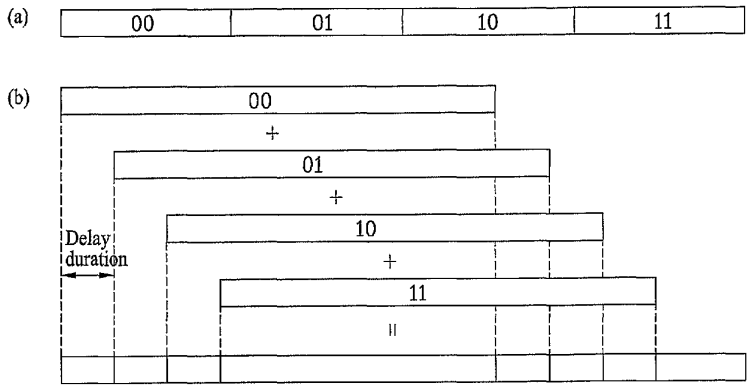
(54) Title: METHOD OF TRANSMITTING DATA IN A MOBILE COMMUNICAITON SYSTEM



(57) Abstract: Disclosed is a data transmission method in a mobile ommunication system. The data transmission method through a code sequence in a mobile communication system includes grouping input data streams into a plurality of blocks consisting of at least one bit so as to map each block to a corresponding signature sequence, multiplying a signature sequence stream, to which the plurality of blocks are mapped, by a specific code sequence, and transmitting the signature sequence stream multiplied by the specific code sequence to a receiver.

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【발명의 영문명칭】 Method for data transferring through Random Access Channel

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【취지】 특허법 제42조의 규정에 의하여 위와 같이 출원합니다.

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대리인 심창섭 (인)

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【기본출원료】	0	면	38,000 원
【가산출원료】	32	면	0 원
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【요약서】

【요약】

랜덤 액세스 채널을 통하여 효율적으로 데이터를 송수신하는 방법이 제공된다. 이를 위한 첫 번째 방법은 다수의 프레임으로 구성되는 역방향 공통 채널 중 랜덤 액세스 채널(Random Access Channel, RACH)을 통해 데이터를 전송하는 방법에 관한 것으로서, 단말이 소정 개수의 프레임을 주기로 각 프레임에 분할 배치된 RACH 중 현재 프레임의 RACH에 접근을 시도하는 단계와, 상기 접근에 성공한 경우 해당 RACH를 통해 프리엠블(preamble) 데이터를 전송하는 단계와, 상기 접근에 실패한 경우 다음 차순의 프레임에 분할 배치된 RACH에 접근을 시도하는 단계를 포함한다. 한편, 두 번째 방법은 시그널링 채널을 통해 수신측에 데이터를 전송하는 방법에 관한 것으로서, 제1 시퀀스(sequence)를 소정 개수의 블럭으로 구획하는 단계와, 상기 구획된 각 블럭에 전송할 데이터에 해당하는 제2 시퀀스를 적용하는 단계와, 상기 제2 시퀀스가 적용된 블럭들의 조합에 제3 시퀀스를 곱하여 수신측에 전송하는 단계를 포함한다.

【대표도】

도 5

【색인어】

RACH, subframe, preamble, sequence, CAZAC, short signature

【명세서】

【발명의 명칭】

랜덤 액세스 채널을 통한 데이터 전송 방법 {Method for data transferring through Random Access Channel}

【도면의 간단한 설명】

<1> 도 1은 종래의 랜덤 액세스 채널 구조에 대한 일 실시예.

<2> 도 2는 종래의 랜덤 액세스 채널 구조에 대한 다른 일 실시예.

<3> 도 3은 상기 도 1 및 도 2에 공통적으로 적용되는 랜덤 액세스 채널 구조를 모식적으로 도시한 것.

<4> 도 4a 내지 도 4b는 각각 시간 영역 및 주파수 영역에서 랜덤 액세스 채널의 신호를 싣는 형태를 모식적으로 도시한 것.

<5> 도 5는 본 발명에 의한 랜덤 액세스 채널의 구조를 모식적으로 도시한 것.

<6> 도 6은 RACH 파일럿이 할당된 서브 프레임의 랜덤 액세스 채널 구조를 모식적으로 도시한 것.

<7> 도 7은 본 발명에 의한 시그널 채널 데이터 전송 방법의 개념도.

<8> 도 8은 본 발명에 의한 시그널 채널 데이터의 전송 방법을 송신측 및 수신측에서 도시한 개념도.

【발명의 상세한 설명】

【발명의 목적】

【발명이 속하는 기술분야 및 그 분야의 종래기술】

<9> 본 발명은 랜덤 액세스 채널을 통하여 효율적으로 데이터를 송수신하는 방법에 관한 것으로서, 이를 위한 첫 번째 방법은 다수의 프레임으로 구성되는 역방향 공통 채널 중 랜덤 액세스 채널(Random Access Channel, RACH)을 통해 데이터를 전송하는 방법에 관한 것이고, 두 번째 방법은 긴 CAZAC 시퀀스 및 짧은 시그너처 시퀀스를 이용하여 모듈링 또는 디모듈링된 시그널링 채널 데이터를 송수신하는 방법에 관한 것이다.

<10> 3GPP LTE(3rd Generation Partnership Project Long Term Evolution) 시스템에서의 채널은 물리채널과 하나 또는 복수의 물리채널 상에 매핑되는 논리채널로 이루어지며, 논리채널은 사용 목적에 따라 다시 제어채널, 공통채널, 전용제어채널 및 트래픽채널 등으로 구분된다. 여기서 역방향 공통채널 중 하나인 랜덤 액세스 채널(Random Access Channel, 이하 'RACH')은 주로 단말기(User Equipment; UE)를 네트워크에 등록하기 위해 또는 셀 간 이동시 위치 등록을 위해 및 초기 호 설정 등의 신호 전송 용도로 사용된다.

<11> 이하에서는 종래에 공개된 각종 RACH 구조를 살펴보고 이들이 공통적으로 지니는 문제점을 짚어보기로 한다.

<12> 도 1은 종래 OFDMA 시스템에서 사용되는 RACH의 구조를 도시한 것이다. 도면에서 보듯, RACH는 셀의 반경에 따라 시간축으로 N개의 서브 프레임(sub-frame)으로 분할되고, 주파수축으로 N개의 주파수 대역으로 분할됨을 알 수 있다. RACH의 생성 빈도는 MAC에서의 QoS 요구 조건에 따라서 정해지는데, 일반적으로 수십 ms

단위로 한 번씩 또는 수백 ms 단위로 한 번씩 채널이 생성된다. 이는 여러 개의 subcarrier 별로 다른 RACH를 설정하여 단말간 충돌을 줄이는 구조이다.

<13> 도 2는 텍사스 인스트루먼트(TI)사에 정의한 RACH의 구조를 도시한 것이다. 도면에서 보듯 PACH에 통상의 프리엠블 외에 파일럿까지 함께 전송할 수 있도록 설계되어 있으며, RACH에 메시지가 추가되는 경우 채널추정을 통해 메시지 복호를 용이하게 하고, 광대역 파일럿을 사용함으로써 RACH의 프리엠블(preamble)이 사용하는 대역 이외의 RACH 총 채널 대역에 대한 채널품질정보(Channel Quality Information, 이하 'CQI')를 획득할 수 있도록 한다. 특히, RACH가 할당되는 시스템 대역에 한하여 파일럿이 할당되는 특징이 있다.

<14> 도 3은 위와 같은 도 1 및 도 2에 공통적으로 적용되는 RACH 구조를 모식적으로 도시한 것이다. 종래의 RACH는 주파수축 및 시간축으로의 구조를 명확하게 제시하지 않고 있으나, 대략적으로는 도 3과 같은 버스트(burst) 형태의 구조로 파악해 볼 수 있다. 이러한 버스트 형태는 단말이 특정 프레임의 RACH에 접근했다가 실패하는 경우 다음 주기의 프레임에 할당된 RACH가 나타날 때까지 상당한 시간을 기다려야 하는 문제점, 즉 단말이 RACH 접근에 실패할 경우 재시도까지의 간격이 길어지는 문제점이 발생한다. 또한, RACH 중에서 선택된 주파수 대역의 채널 특징이 좋지 않을 경우 RACH의 접근 실패가 발생할 확률이 높아지는데 버스트 형태의 RACH는 단말에게 여러 주파수 선택의 기회를 주지 않는 문제가 있다.

<15> 한편, 3GPP LTE 시스템에서 RACH를 통해 소정의 메시지를 전송하는 방법은 크게 두 가지로 구분된다. 즉, 해당 메시지가 프리엠블 시퀀스(Preamble sequenc

e)와 별개로 전송되는 방법과, 해당 메시지가 프리엠블 시퀀스에 함축적으로 포함 되어 전송되는 방법이 있는데, 상기 도 2의 부속된 광대역 파일럿(attached wideband pilot)을 통해 전송되는 방식은 전자에 해당하고 상기 도 2의 임베디드된 광대역 파일럿(embedded wideband pilot)을 통해 전송되는 방식은 후자에 해당한다.

<16> 후자에 있어서, 긴 시퀀스(long sequence)를 그대로 사용하는 경우에는 시퀀스의 길이로 증가함에 따라서 사용할 수 있는 시퀀스 개수는 선형적으로 증가하지만 전달 가능한 메시지의 양으로 보면 $\log_2$의 함수로 증가하기 때문에 사용 가능한 시퀀스의 수가 줄어들어 전송될 수 있는 메시지의 양에 한계가 있다. 반면, 짧은 프리엠블 시퀀스(short preamble sequence)를 사용하는 경우에는 반복되는 짧은 시퀀스에 다른 시퀀스를 덧씌워서 전송하기 때문에 시퀀스 ID의 검출 성능이 저하되는 문제가 있고, 짧은 시퀀스 자체를 모듈레이션하는 경우에는 특정 시퀀스 영역만으로 원본 데이터를 추정해야 하기 때문에 시간/주파수 다이버시티 효과가 경감되는 문제가 있다. 또한 직접 모듈레이션 방법은 채널의 영향에 의하여 그 성능이 절대적으로 악화된다.

【발명이 이루고자 하는 기술적 과제】

<17> 본 발명은 위와 같은 문제점을 해결하기 위해 제안된 것으로서, RACH의 주파수축/시간축 상의 구조를 보다 명확히 제시하는 한편 단말이 RACH에 접근하는 시간을 최소화할 수 있는 방안을 제공하는 데에 그 목적이 있다.

<18> 본 발명의 다른 목적은 단말과 기지국 간에 메시지를 송수신 함에 있어서 가능한 한 긴 시퀀스를 이용하여 메시지를 전달함으로써 시간/주파수 다이버시티를 최대화하는 한편 채널의 영향으로 인한 성능 감쇄 현상을 완화하기 위한 방안을 제공하는 데에 있다.

【발명의 구성】

<19> 위와 같은 목적을 달성하기 위한 본 발명의 일 실시예는 다수의 프레임으로 구성되는 역방향 공통 채널 중 랜덤 액세스 채널(Random Access Channel, RACH)을 통해 데이터를 전송하는 방법에 관한 것으로서, 단말이 소정 개수의 프레임을 주기로 각 프레임에 분할 배치된 RACH 중 현재 프레임의 RACH에 접근을 시도하는 단계와, 상기 접근에 성공한 경우, 해당 RACH를 통해 프리엠블(preamble) 데이터를 전송하는 단계 및 상기 접근에 실패한 경우, 다음 차순의 프레임에 분할 배치된 RACH에 접근을 시도하는 단계를 포함한다.

<20> 여기서, 상기 RACH는 시간-주파수 다이버시티(time-frequency diversity)효과를 얻기 위하여 한 주기를 이루는 각 프레임에 주파수 대역별로 균일하게 분포되도록 분할 배치되는 것이 바람직하고, 상기 RACH는 각 프레임에 배치된 RACH의 간격이 최소가 되도록 주파수 및 시간 대역 중 어느 하나 이상의 위치가 변경될 수 있다.

<21> 또한, 상기 각 프레임의 서브 프레임에는 해당 RACH로 접근한 단말을 위한 RACH 파일럿(RACH pilot)이 할당되어 있는 단블럭(short block)이 하나 이상 포함될 수 있으며, 상기 단블럭에는 하나 이상의 RACH 파일럿(RACH Pilot)과 액세스 파

일럿(Access Pilot)이 소정의 패턴으로 할당될 수 있다.

<22> 위와 같은 목적을 달성하기 위한 본 발명의 다른 일 실시예는 시그널링 채널을 통해 수신측에 데이터를 전송하는 방법에 관한 것으로서, 제1 시퀀스(sequence)를 소정 개수의 블럭으로 구획하는 단계와, 상기 구획된 각 블럭에, 전송할 데이터에 해당하는 제2 시퀀스를 적용하는 단계 및 상기 제2 시퀀스가 적용된 블럭들의 조합에 제3 시퀀스를 곱하여 수신측에 전송하는 단계를 포함한다.

<23> 여기서, 상기 제2 시퀀스로는 소정 패턴의 짧은 시그너처 시퀀스(short signature sequence)가 이용될 수 있으며, 상기 짧은 시그너처 시퀀스는 상기 구획된 블럭 개수의 모듈화값(Modulation values)으로 구성되거나, 상기 구획된 블럭 개수의 지수화 시퀀스(Exponential sequence)로 구성되거나, 상기 구획된 블럭 개수의 왈시 하다마드 시퀀스(Walsh Hadamard sequence)로 구성될 수 있다.

<24> 또한, 상기 제3 시퀀스로 긴 CAZAC 시퀀스(long CAZAC sequence)가 이용될 수 있다.

<25> 한편, 상기 수신측으로의 데이터 전송에 앞서 상기 제3 시퀀스가 곱해진 제1 시퀀스를 채널 코딩(channel coding)하는 단계와, 상기 채널 코딩된 데이터를 인터리빙(interleaving)하는 단계와, 상기 인터리빙된 데이터를 시그너처 맵핑(signature mapping)하는 단계 및 상기 시그너처 맵핑된 데이터에 CAZAC 시퀀스를 곱하는 단계가 더 포함될 수 있으며, 상기 시그너처 맵핑으로 그레이 맵핑(Gray mapping)이 이용될 수 있다.

<26> 위와 같은 목적을 달성하기 위한 본 발명의 다른 일 실시예는 시그널링 채널

을 통해 송신측으로부터 데이터를 수신하는 방법에 관한 것으로서, 상기 수신된 데이터에 제4 시퀀스를 곱하는 단계와, 상기 제4 시퀀스가 곱해진 데이터를 소정 개수의 블럭으로 구획하여 블럭별 제5 시퀀스를 추정하는 단계와, 제6 시퀀스를 상기 개수의 블럭으로 구획하는 단계 및 상기 제6 시퀀스의 각 블럭을 제5 시퀀스의 각 블럭에 역으로 적용하여 최종 데이터 시퀀스를 추정하는 단계를 포함한다.

<27> 상기 제4 시퀀스로 긴 CAZAC 시퀀스(long CAZAC sequence)가 이용될 수 있고, 상기 제5 시퀀스로는 소정 패턴의 짧은 시그너처 시퀀스(short signature sequence)가 이용될 수 있다. 이때, 상기 짧은 시그너처 시퀀스는 상기 구획된 블럭 개수의 모듈화값(Modulation values)으로 구성될 수도 있고, 상기 구획된 블럭 개수의 지수화 시퀀스(Exponential sequence)로 구성될 수도 있으며, 상기 구획된 블럭 개수의 왈시 하다마드 시퀀스(Walsh Hadamard sequence)로 구성될 수도 있다.

<28> 한편, 상기 제1 시퀀스의 곱하기 단계 이전에는 수신된 시그널링 데이터로부터 CAZAC 아이디를 추출하는 단계와, 수신된 시그널링 데이터로부터 로그 유사도비(log-likelihood ratio)를 산출하는 단계와, 수신된 시그널링 데이터를 디인터리빙(Deinterleaving)하는 단계 및 상기 디인터리빙된 데이터를 채널 디코딩(channel decoding)하는 단계를 더 포함할 수 있다.

<29> 이하, 본 발명의 명세서에 첨부된 도면을 참고하여 본 발명의 바람직한 실시예에 대해 설명한다.

<30> 랜덤 액세스 채널(Random Access Channel, 이하 'RACH')은 단말(User Equipment; UE)이 기지국(Node-B)과 업링크(uplink) 동기가 이루어지지 않은 상태

에서 네트워크에 접근하기 위한 통로로 사용된다. 즉, 단말이 다운링크(downlink) 동기화를 이루고 맨 처음 기지국에 접근하는 경우(initial ranging, 초기 접근)와, 네트워크에 접속된 상태로 단말의 필요에 따라서 네트워크에 그때마다 접근하는 경우(periodic ranging, 주기적 접근)에 RACH가 사용된다. 여기서, 전자의 경우는 단말이 네트워크에 접속하면서 동기를 이루고 자신에게 필요한 아이디(ID)를 제공받기 위한 용도로 사용되고, 후자는 전송할 패킷이 존재하거나 기지국으로부터 정보를 수신하기 위해 프로토콜을 초기화(initiation)시키기 위한 용도로 사용된다.

<31> 특히 후자의 경우는 3GPP LTE에 의할 때 다시 두 가지로 구분할 수 있는데, 단말이 RACH에 접근할 때 자신의 업링크(uplink) 신호가 동기 한계 내에 있을 때 사용하는 동기화 접근 모드(synchronized access mode)와, 동기 한계를 벗어났을 때 사용하는 비동기화 접근 모드(non-synchronized access mode)로 구분할 수 있다. 비동기화 접근 모드는 단말이 최초로 기지국에 접근하는 경우나, 동기 과정을 거친 후 동기 갱신(update)가 이루어지지 않았을 경우에 사용되는 방식이다. 이 때, 동기화 접근 모드는 상기 주기적 접근(periodic ranging)과 같은 개념이며, 단말이 기지국에게 자신의 변경사항 통보와 자원할당 요청을 목적으로 RACH에 접근하는 경우에 이용된다.

<32> 이에 비해, 동기화 접근 모드는 단말이 기지국과 업링크(uplink) 동기를 벗어나지 않은 상태라 가정하고 그 가정에 따라 RACH에 있어서 보호 시간(Guard time)의 제한을 완화한다. 이로 인해 더 많은 시간-주파수 자원(time-frequency resource)를 사용할 수 있는데, 3GPP LTE에서는 동기화 접근 모드에서 랜덤 액세스

용 프리엠블 시퀀스(preamble sequence)에 상당한 양의 메시지(24bits 이상)를 더하여 양자를 함께 전송하도록 하고 있다. 따라서, 본 발명에 있어서 새롭게 정의된 RACH 구조에 의해 데이터를 전송하는 방법(제1 실시예)에 대하여는 비동기화 접근 모드 및 동기화 접근 모드가 적용되고, 단말과 기지국 간에 시그널 데이터를 송수신하는 방법(제2 실시예)에 대하여는 제안된 방법 이외의 다른 랜덤 액세스 기법에도 적용될 수 있다.

<33> <제1 실시예>

<34> 일반적으로 RACH의 생성 빈도는 물리 채널(MAC)에서의 QoS(Quality of Service) 요구 조건에 따라 정해지며, 수십 ms 단위 또는 수백 ms 단위로 RACH가 생성된다. 이러한 RACH는 시간 영역 또는 주파수 영역에서 생성될 수 있는데, 시간 영역에서 랜덤 액세스 신호를 생성하는 경우에는 본래의 서브 프레임 구조가 무시되고 단지 시간-주파수 자원(time-frequency resource, TFR) 만으로 신호를 정렬하여 전송한다. 참고로, 도 4a는 시간 영역에서 RACH의 신호를 싣는 형태를 모식적으로 도시하고 있다.

<35> 반면, 주파수 영역에서 랜덤 액세스 신호를 생성하는 경우에는 서브 프레임 구조를 어느 정도 유지하면서 각각 OFDM(Orthogonal Frequency Division Multiflexing) 심벌의 반송파에 상기 생성된 랜덤 액세스 신호를 실어서 전송하므로, 각 블록 사이의 직교성이 유지되고 채널 추정 또한 용이하게 수행되는 장점이 있다. 따라서, 본 실시예에서는 주파수 영역에서 랜덤 액세스 신호가 생성되는 경우에 있어서의 RACH 구조에 촛점을 맞추어 설명하기로 한다. 참고로, 도 4b는 주파

수 영역에서 RACH의 신호를 싣는 형태를 모식적으로 도시한 것이다.

<36> 본 실시예에서는 상기 도 3에서 먼저 설명한 바와 같이 단말이 RACH 접근에 실패할 경우 재시도까지의 간격이 길어지는 단점을 극복하기 위해, RACH의 발생 빈도수와 오버헤드(overhead)의 양이 결정되면 해당 RACH 자원을 한 주기 내의 각 프레임에 분산하여 배치한다. 이때, RACH는 한 주기를 이루는 복수의 프레임에 대하여 주파수 대역별로 균일하게 분포되도록 분할 배치되는 것이 바람직하다. 또한, 각 프레임에 배치된 RACH의 간격이 최소가 되도록 주파수 및 시간 대역 중 어느 하나 이상의 위치가 변경될 수도 있다. 참고로, 도 5는 이와 같은 실시예에 의한 RACH의 구조를 모식적으로 도시한 것이다.

<37> 이제, 이와 같은 RACH 구조에서 단말이 기지국에 업링크 데이터를 전송하는 과정을 살펴보면 다음과 같다. 여기서, 데이터의 전송은 다수의 프레임으로 구성되는 역방향 공통 채널 중에서 특히 RACH을 통해 수행되는 것을 전제로 한다.

<38> 먼저, 단말은 자신의 일정 정보를 기지국에 전달하기 위해 현재 프레임에 포함되어 있는 분산된 RACH에 접근을 시도한다. 여기서, 만약 접근에 성공하면 해당 RACH를 통해 프리엠블(preamble) 데이터를 전송하지만, 접근에 실패하면 다음 차순의 프레임에 분할 배치된 RACH에 접근을 시도한다. 이때, 다음 차순의 프레임에 포함된 RACH는 이전 프레임의 RACH와 상이한 주파수 대역에 배치되는 것이 바람직하다. 또한, 상기와 같은 접근 절차는 접근에 성공할 때까지 다음 차순의 프레임에서 계속적으로 수행된다.

<39> 한편, 각 프레임의 서브 프레임에는 해당 RACH로 접근한 단말을 위한 파일럿

이 할당되어 있는 단블럭(short block)이 포함되는 것이 바람직하다. 이러한 단블럭에는 하나 이상의 RACH 파일럿(RACH Pilot)과 액세스 파일럿(Access Pilot)이 소정의 패턴으로 할당될 수 있다. 즉, RACH로 접근한 단말이 기지국으로부터 채널을 할당받기 위해서는 채널에 대한 정보를 알 수 있어야 하는데. 이와 같은 채널 정보는 업링크 단블럭(uplink short block) 내의 RACH 파일럿에 설정될 수 있다. 기지국은 해당 RACH 파일럿을 통해 단말에게 적절한 채널을 할당해준다. 한편, RACH로 접근하는 단말 입장에서도 상기 RACH 파일럿을 통해서 어떤 채널을 할당받는 것이 좋은지에 대한 채널품질정보를 기지국에 알려줄 수 있다면 스케줄링될 때 단말에 유리한 채널이 할당될 수 있으므로 양질의 통신을 지속시킬 수도 있다는 장점이 있다.

<40> 따라서, RACH가 포함된 서브 프레임에서는 RACH에 접근하는 단말이 사용할 수 있는 RACH 파일럿을 따로 할당해두고, RACH에 접근하는 단말은 해당 RACH를 통해 기지국으로 프리엠블(Preamble)을 보내는 한편, 지정된 RACH 파일럿에 채널품질정보 전송용 파일럿도 함께 보낸다. 상기 RACH 파일럿은 프리엠블(Preamble)에 따라서 정해지는 시퀀스(sequence)이며, 서로 다른 프리엠블 시퀀스(Preamble sequence)를 사용하는 단말은 가능하면 서로 다른 RACH 파일럿 시퀀스를 사용하거나, 다른(또는 일부가 겹치는 형태) 부반송파(subcarrier)의 RACH 파일럿을 선택하는 것이 바람직하다. 참고로, 도 6은 RACH 파일럿이 할당된 서브 프레임의 랜덤 액세스 채널 구조를 모식적으로 도시한 것이다. 여기서 각 서브 프레임에는 하나 이상의 RACH 파일럿(RACH Pilot)과 액세스 파일럿(Access Pilot)이 소정의 패턴으로

할당되어 있는 단블럭(short block)이 하나 이상 포함되어 있는 것을 확인할 수 있다. 이 경우 RACH 파일럿은 할당된 RACH의 주파수 대역에만 존재하는 것이 아니라 그 외의 시스템 대역에서도 존재하게 된다. 본 실시예에서는 할당 패턴에 있어서 하나의 프레임당 2개의 단블럭이 존재하고 그에 RACH 파일럿이 전송되는 경우를 예로 들었지만, 여기에 한정하지 않고 당업자가 자명한 범위 내에서 다양한 변형이 가능하다.

<41> <제2 실시예>

<42> 일반적으로 실제 RACH 채널을 구현하는 데에 있어서 신호의 시작 위치를 검색해야 하는 부담으로 인해 랜덤 액세스 신호가 시간 영역에서 특정 패턴을 가지도록 설계한다. 이를 위해 본래부터 반복적인 패턴을 가지도록 프리엠블 시퀀스(preamble sequence)를 사용할 수도 있고, 주파수 영역에서 반송파 간의 사이를 일정 구간 띄우는 방식으로 시간 영역에서의 반복 특성을 만들어 낼 수도 있다. 따라서, 상기 도 4a 및 도 4b의 접근 방식 모두 시간 영역에서 용이하게 검색되기 위한 특징이 있어야 하며, 이를 위해 CAZAC(Constant Amplitude Zero AutoCorrelation) 시퀀스가 사용된다. CAZAC 시퀀스는 크게 GCL 시퀀스(수식 1)와 Zadoff-Chu 시퀀스(수식 2)로 구분할 수 있다.

【수학식 1】

<43>
$$c(k;N,M)=\exp\left(-\frac{j\pi Mk(k+1)}{N}\right) \quad \text{for odd N}$$

<44> $$c(k;N,M)=\exp\left(-\frac{j\pi M k^2}{N}\right)$$ for even N

【수학식 2】

<45> $$c(k;N,M)=\exp\left(\frac{j\pi Mk(k+1)}{N}\right)$$ for odd N

<46> $$c(k;N,M)=\exp\left(\frac{j\pi M k^2}{N}\right)$$ for even N

<47> 한편, RACH(Random Access Channel)나 SCH(Syncronization Channel)에서 접근 단말 또는 기지국의 고유(unique) 정보를 전달하기 위해 원칙적으로 긴 특정 sequence를 사용하는 것이 바람직하다. 왜냐하면, 시퀀스의 길이가 길면 수신단에서 해당 ID를 검출하기 용이할 뿐 아니라, 더 많은 종류의 시퀀스를 사용할 수 있으므로 시스템 설계에 편리함을 제공하기 때문이다.

<48> 그러나, 시퀀스의 길이를 길게 하여 해당 ID로 메시지를 전달할 경우 메시지의 양은 $\log_2$ 함수로 증가하므로 시퀀스가 일정 길이 이상이 되면 ID만으로 메시지를 전달하는 데에 한계가 있다. 따라서, 본 실시예에서는 시퀀스를 몇 개의 단블록(short block)으로 구획하고, 자체에 컨쥬데이트(conjugate) 또는 니게이션(negation) 등의 특정한 조작을 가하기보다는 시퀀스의 각 블록에 전송하고자 하는 데이터에 해당하는 짧은 시그너처 시퀀스(short signature sequence)를 적용하기로 한다. 참고로, 도 6은 본 발명에 의한 시그널 채널 데이터의 전송 방법을 도시한

개념도이다.

<49> 본 실시예에 따라 시그널링 채널을 통해 수신측에 데이터를 전송하는 방법을 도 7을 참고로 좀더 상세하게 설명하면 다음과 같다.

<50> 먼저, 시퀀스(sequence)를 소정 개수의 블럭으로 구획하고 그 구획된 각 블럭에, 전송할 데이터에 해당하는 짧은 시그너처 시퀀스(short signature sequence)를 적용한다. 그리고, 상기 짧은 시그너처 시퀀스가 적용된 블럭들의 조합에 긴 CAZAC 시퀀스(long CAZAC sequence)를 곱하여 수신측에 전송할 최종적인 데이터 시퀀스를 완성한다.

<51> 여기서, 상기 짧은 시그너처 시퀀스가 4개의 시그너처로 이루어진다고 가정할 때 아래와 같은 시그너처 세트들이 사용될 수 있다. 또한, 시그너처 세트를 구성하는 각 데이터 간에 차별성이 있다면 그 외에 어떤 시그너처 세트라도 사용이 가능하다.

<52> 1) 모듈레이션 값(Modulation values): {1+j, 1-j, -1-j, -1+j}

<53> 2) 지수적 시퀀스(Exponential sequence): {[exp(jw_0 n)], [exp(jw_1 n)], [exp(jw_2n)], [exp(jw_3n)]} 여기서 n=0...Ns이고, Ns는 각 블록의 길이

<54> 3) 왈시 하마다드 시퀀스(Walsh Hadamard sequence): {[1111], [1-11-1], [11-1-1], [1-1-11]} 여기서, 블록의 길이 Ns가 4보다 길면 각 sequence를 반복시켜서 길이를 맞춤.

<55> 이상과 같이 긴 CAZAC 시퀀스에 데이터 송수신을 위한 짧은 시그너처 시퀀스

를 사용하는 방식은 종래 기술에 있어서 곧바로 전송 데이터를 변조하는 방식에 비해 채널의 영향이 적다는 장점이 있으며, 하나의 시그너처를 구성하는 비트 수를 늘리더라도 성능의 감소가 크지 않은 특징이 있다.

<56> 상기 방식을 이용하여 RACH 또는 SCH에 프리엠블(preamble)과 데이터를 전송하기 위한 송신측 구성 및 수신측 구성을 도 8을 참고로 살펴보면 다음과 같다.

<57> 송신단에 있어서, 상기와 같은 경우 시그너처 증가에 따른 비트 수 증가가 가능하기 때문에 채널 코딩이 적용 가능하며, 채널 코딩을 수행하는 경우 다시 인터리버를 통해서 시간/주파수 다이버시티를 얻을 수 있다. 또한, 비트 에러율을 최소화하기 위해서 비트 -> 시그너처 맵핑을 수행할 수 있으며, 이 경우 특히 그레이 맵핑(Gray mapping)을 이용할 수 있다. 이와 같은 과정을 거친 시퀀스는 최종적으로 CAZAC으로 믹싱되어 송신된다.

<58> 수신단에서는 CAZAC에 대한 ID를 검출하고, 그 다음 각 bit들에 대해서 로그 유사도비(log-likelihood ratio, LLR)를 계산한다. 그런 다음 채널 디코더를 통해서 전송 데이터를 복호화 한다. 도 8과 같은 구성의 수신단에서 시퀀스 검색에 따른 복잡도(complexity)를 고려하면, 전송단에서 시그너처 시퀀스로 지수적 시퀀스(exponential sequence)를 사용하는 것이 적절하다. 이러한 경우 수신단에서는 위상차 푸리에 변환(phase difference Fourier Transform)을 통해서 CAZAC ID 검색을 간단하게 수행할 수 있으며, 이후 시그너처로부터 다시 LLR을 계산하는 경우에도 푸리에 변환(Fourier Transform)을 통해 간단하게 구현할 수 있다.

<59> 이상에서 설명한 본 발명은, 본 발명이 속하는 기술분야에서 통상의 지식을

가진 자에 있어 본 발명의 기술적 사상을 벗어나지 않는 범위 내에서 여러 가지 치환, 변형 및 변경이 가능하므로 전술한 실시예 및 첨부된 도면에 의해 한정되는 것이 아니다.

【발명의 효과】

<60> 본 발명에 의하면 RACH의 주파수축/시간축 상의 구조를 보다 명확하게 파악할 수 있고, RACH 자원이 프레임별로 균일하게 분할 분포되어 특정 RACH에의 접근이 실패하더라도 곧바로 다음 프레임의 RACH로 접근할 수 있으므로 기지국으로의 접근성이 향상되며, QoS(Quality of Service) 조건이 까다로운 트래픽 영역에서도 RACH로의 접근을 용이하게 할 수 있다.

<61> 또한, 본 발명에 의하면 단말과 기지국 간에 긴 시퀀스를 이용하여 메시지를 송수신하므로 시간/주파수 다이버시티를 최대화할 수 있고, 시그너처 방식을 통해 채널의 영향에 의한 성능 감쇄 현상을 완화할 수 있다.

【특허청구범위】

【청구항 1】

다수의 프레임으로 구성되는 역방향 공통 채널 중 랜덤 액세스 채널(Random Access Channel, RACH)을 통해 데이터를 전송하는 방법에 있어서,

단말이 소정 개수의 프레임을 주기로 각 프레임에 분할 배치된 RACH 중 현재 프레임의 RACH에 접근을 시도하는 단계;

상기 접근에 성공한 경우, 해당 RACH를 통해 프리엠블(preamble) 데이터를 전송하는 단계; 및

상기 접근에 실패한 경우, 다음 차순의 프레임에 분할 배치된 RACH에 접근을 시도하는 단계

를 포함하는 랜덤 액세스 채널을 통한 데이터 전송 방법.

【청구항 2】

제1항에 있어서,

상기 RACH는 한 주기를 이루는 각 프레임에 주파수 대역별로 균일하게 분포되도록 분할 배치되는 랜덤 액세스 채널을 통한 데이터 전송 방법.

【청구항 3】

제2항에 있어서,

상기 RACH는 각 프레임에 배치된 RACH의 간격이 최소가 되도록 주파수 및 시간 대역 중 어느 하나 이상의 위치가 변경되는 랜덤 액세스 채널을 통한 데이터 전

송 방법.

【청구항 4】

제1항 내지 제3항 중 어느 한 항에 있어서,

상기 각 프레임의 서브 프레임에는 해당 RACH로 접근한 단말을 위한 파일럿(pilot)이 할당되어 있는 단블럭(short block)이 하나 이상 포함되어 있는 랜덤 액세스 채널을 통한 데이터 전송 방법.

【청구항 5】

제4항에 있어서,

상기 단블럭에는 하나 이상의 RACH 파일럿(RACH Pilot)과 액세스 파일럿(Access Pilot)이 소정의 패턴으로 할당되어 있는 랜덤 액세스 채널을 통한 데이터 전송 방법.

【청구항 6】

시그널링 채널을 통해 수신측에 데이터를 전송하는 방법에 있어서,

제1 시퀀스(sequence)를 소정 개수의 블럭으로 구획하는 단계;

상기 구획된 각 블럭에, 전송할 데이터에 해당하는 제2 시퀀스를 적용하는 단계; 및

상기 제2 시퀀스가 적용된 블럭들의 조합에 제3 시퀀스를 곱하여 수신측에 전송하는 단계

를 포함하는 시그널링 데이터 전송 방법.

【청구항 7】

제6항에 있어서,

상기 제2 시퀀스로 소정 패턴의 짧은 시그너처 시퀀스(short signature sequence)가 이용되는 시그널링 데이터 전송 방법.

【청구항 8】

제7항에 있어서,

상기 짧은 시그너처 시퀀스는 상기 구획된 블럭 개수의 모듈화값(Modulation values)으로 구성되는 시그널링 데이터 전송 방법.

【청구항 9】

제7항에 있어서,

상기 짧은 시그너처 시퀀스는 상기 구획된 블럭 개수의 지수화 시퀀스(Exponential sequence)로 구성되는 시그널링 데이터 전송 방법.

【청구항 10】

제7항에 있어서,

상기 짧은 시그너처 시퀀스는 상기 구획된 블럭 개수의 왈시 하다마드 시퀀스(Walsh Hadamard sequence)로 구성되는 시그널링 데이터 전송 방법.

【청구항 11】

제6항 내지 제10항 중 어느 한 항에 있어서,

상기 제3 시퀀스로 긴 CAZAC 시퀀스(long CAZAC sequence)가 이용되는 시그

널링 데이터 전송 방법.

【청구항 12】

제6항에 있어서, 상기 수신측으로의 데이터 전송에 앞서

상기 제3 시퀀스가 곱해진 제1 시퀀스를 채널 코딩(channel coding)하는 단계;

상기 채널 코딩된 데이터를 인터리빙(interleaving)하는 단계;

상기 인터리빙된 데이터를 시그너처 맵핑(signature mapping)하는 단계; 및

상기 시그너처 맵핑된 데이터에 CAZAC 시퀀스를 곱하는 단계

가 더 포함되는 시그널링 데이터 전송 방법.

【청구항 13】

제12항에 있어서,

상기 시그너처 맵핑으로 그레이 맵핑(Gray mapping)이 이용되는 시그널링 데이터 전송 방법.

【청구항 14】

시그널링 채널을 통해 송신측으로부터 데이터를 수신하는 방법에 있어서,

상기 수신된 데이터에 제1 시퀀스를 곱하는 단계;

상기 제1 시퀀스가 곱해진 데이터를 소정 개수의 블럭으로 구획하여 블럭별 제2 시퀀스를 추정하는 단계;

제3 시퀀스를 상기 개수의 블럭으로 구획하는 단계; 및

상기 제3 시퀀스의 각 블럭을 제2 시퀀스의 각 블럭에 역으로 적용하여 최종 데이터 시퀀스를 추정하는 단계;

를 포함하는 시그널링 데이터 전송 방법.

【청구항 15】

제14항에 있어서,

상기 제1 시퀀스로 긴 CAZAC 시퀀스(long CAZAC sequence)가 이용되는 시그널링 데이터 전송 방법.

【청구항 16】

제14항 또는 제15항에 있어서,

상기 제2 시퀀스로 소정 패턴의 짧은 시그너처 시퀀스(short signature sequence)가 이용되는 시그널링 데이터 전송 방법.

【청구항 17】

제16항에 있어서,

상기 짧은 시그너처 시퀀스는 상기 구획된 블럭 개수의 모듈화값(Modulation values)으로 구성되는 시그널링 데이터 전송 방법.

【청구항 18】

제16항에 있어서,

상기 짧은 시그너처 시퀀스는 상기 구획된 블럭 개수의 지수화 시퀀스(Exponential sequence)로 구성되는 시그널링 데이터 전송 방법.

【청구항 19】

제16항에 있어서,

상기 짧은 시그너처 시퀀스는 상기 구획된 블럭 개수의 왈시 하다마드 시퀀스(Walsh Hadamard sequence)로 구성되는 시그널링 데이터 전송 방법.

【청구항 20】

제14항에 있어서, 상기 제1 시퀀스의 곱하기 단계 이전에

수신된 시그널링 데이터로부터 CAZAC 아이디를 추출하는 단계;

수신된 시그널링 데이터로부터 로그 유사도비(log-likelihood ratio)를 산출하는 단계;

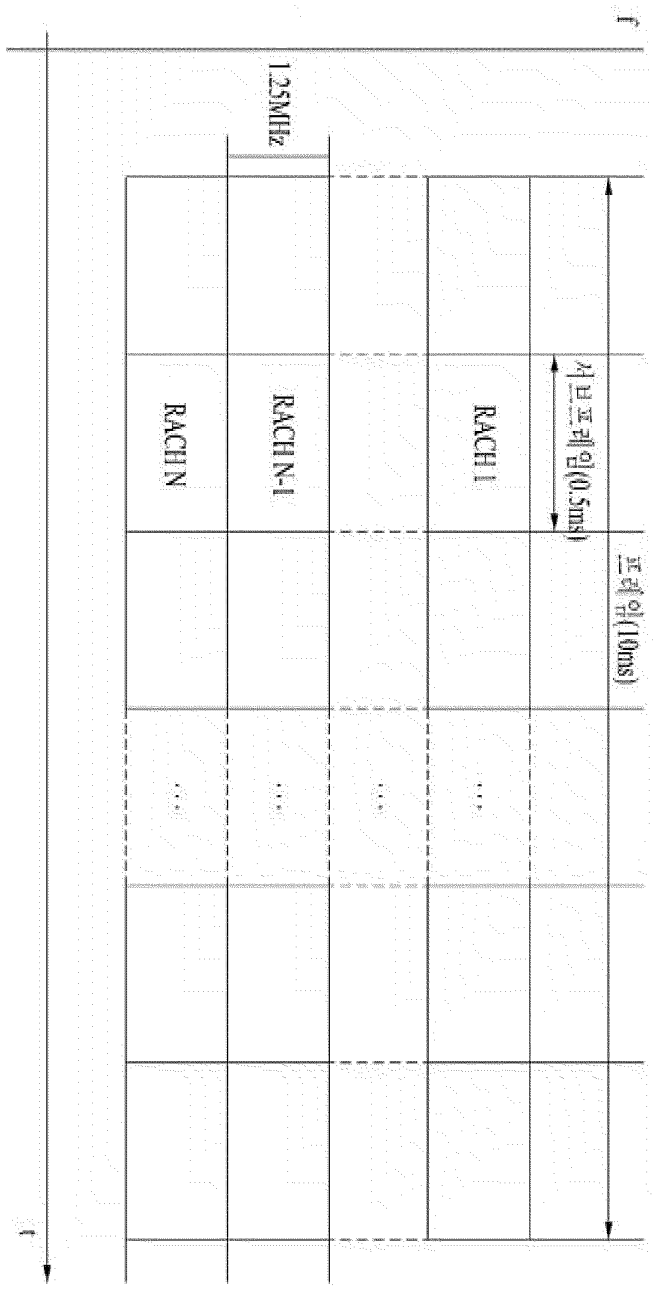
수신된 시그널링 데이터를 디인터리빙(Deinterleaving)하는 단계; 및

상기 디인터리빙된 데이터를 채널 디코딩(channel decoding)하는 단계;

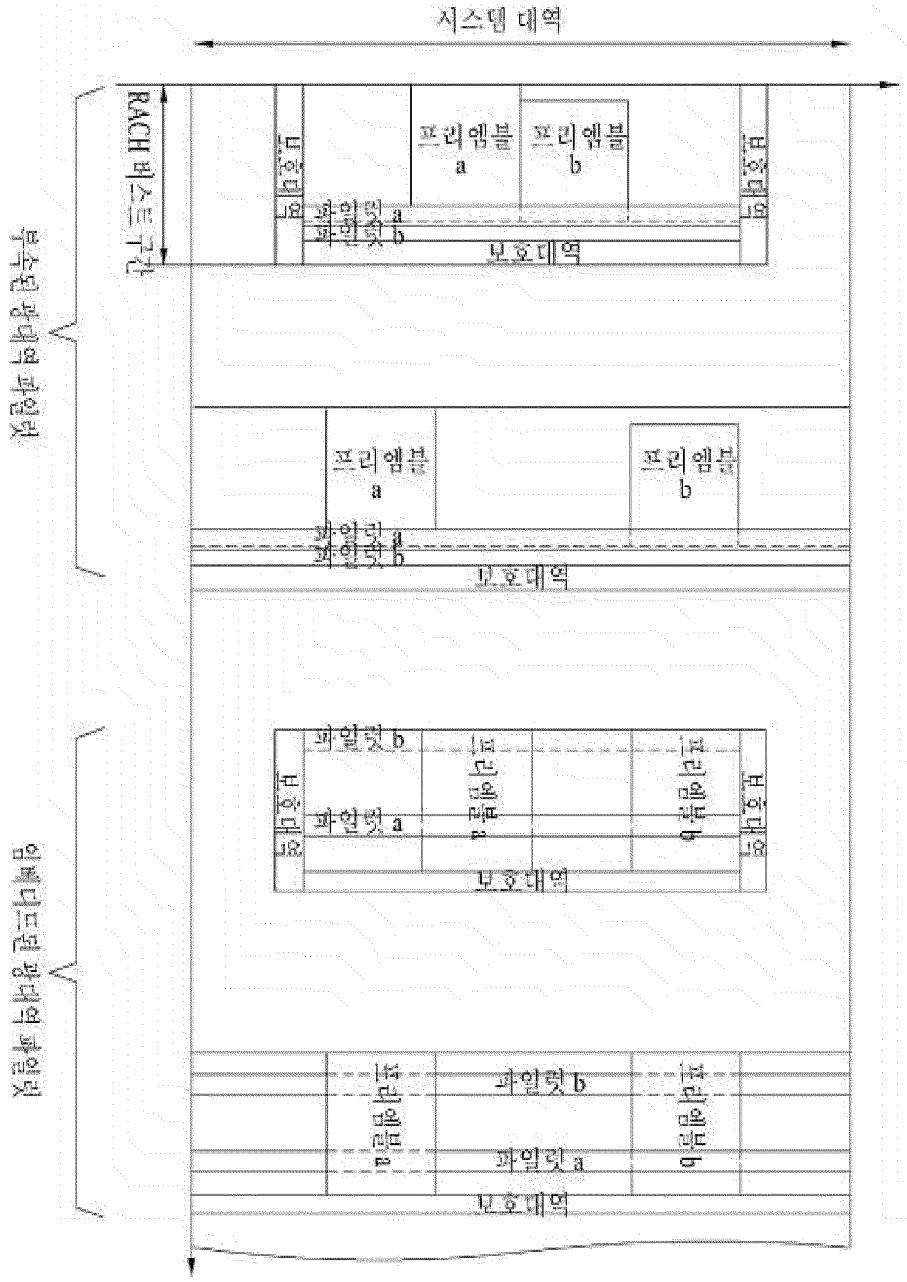
를 더 포함하는 시그널링 데이터 전송 방법.

【도면】

【도 1】



【도 2】


시스템 대역
RACH 비스크 구간
보호대역
프리엠블 a
프리엠블 b
과일럿 a
과일럿 b
보호대역
프리엠블 a
프리엠블 b
과일럿 a
과일럿 b
보호대역
과일럿 b
과일럿 a
보호대역
과일럿 b
과일럿 a
보호대역
보호대역
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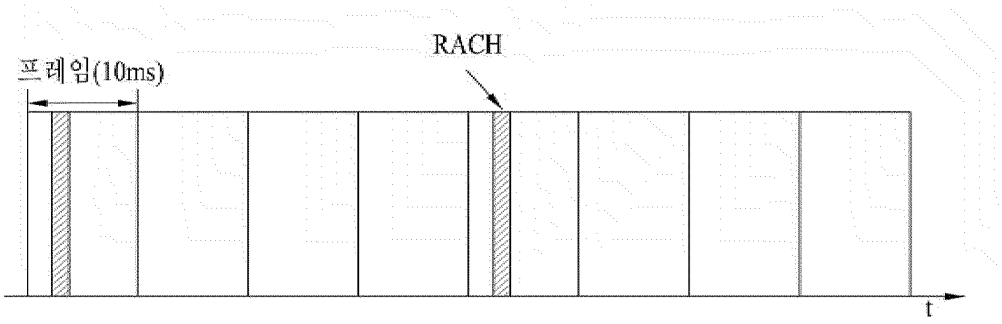
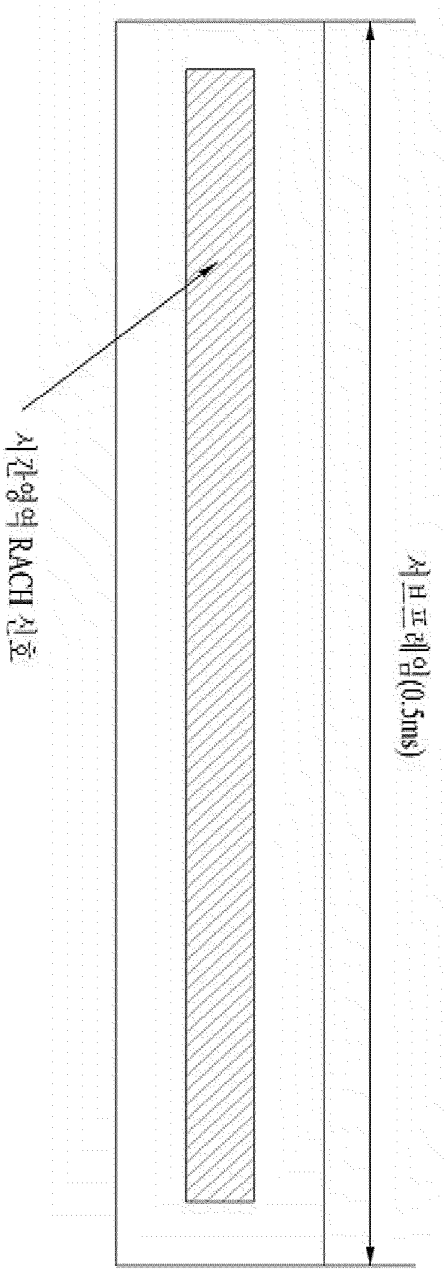
보호대역

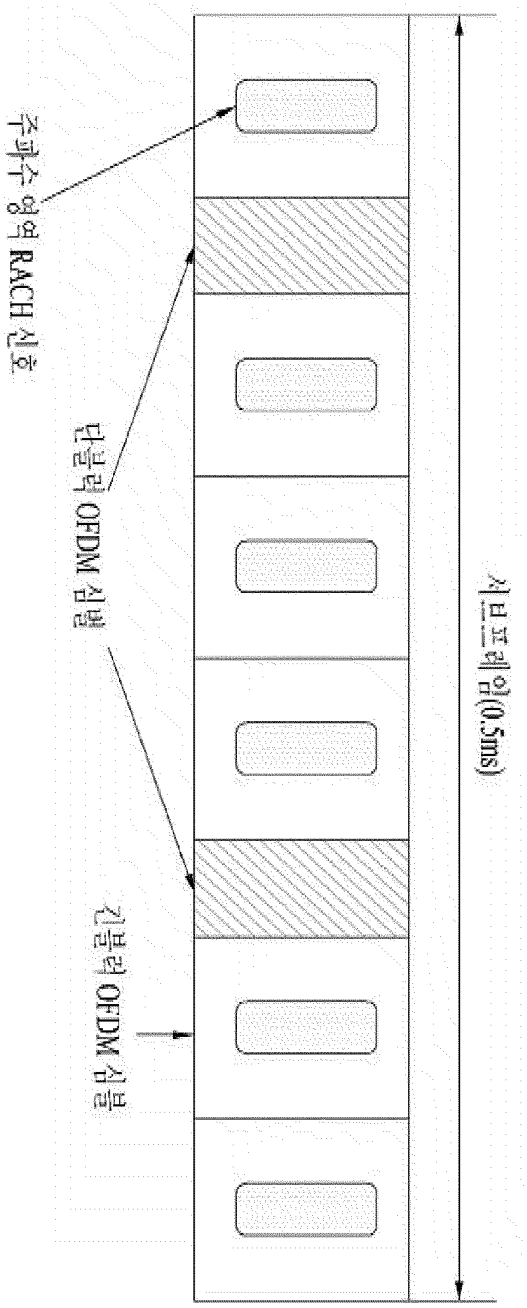
【도 3】



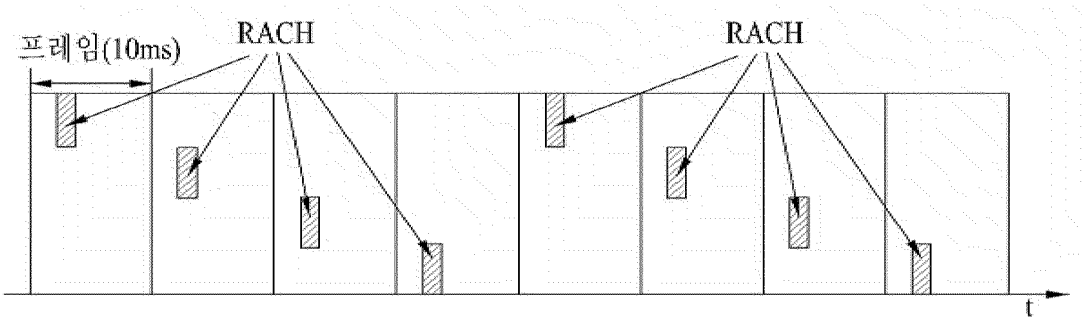
【도 4a】



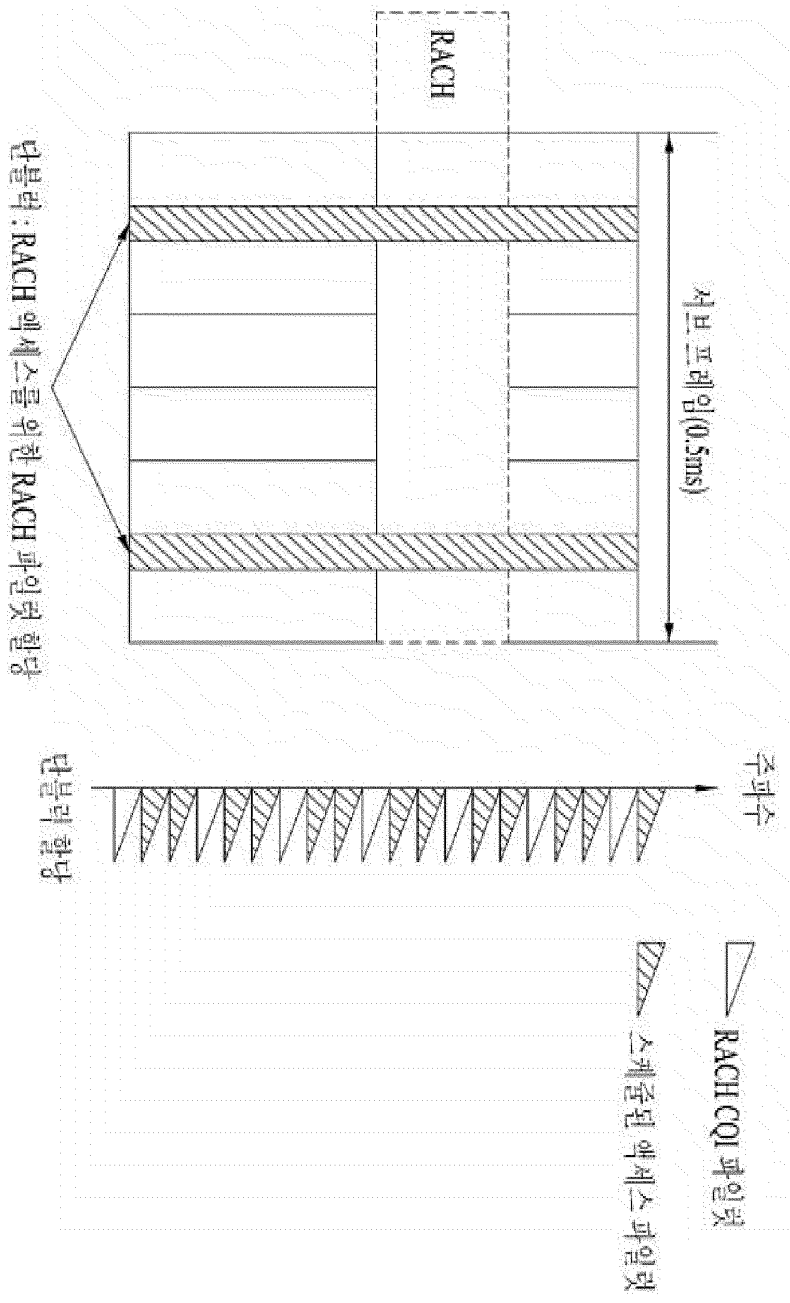
【도 4b】



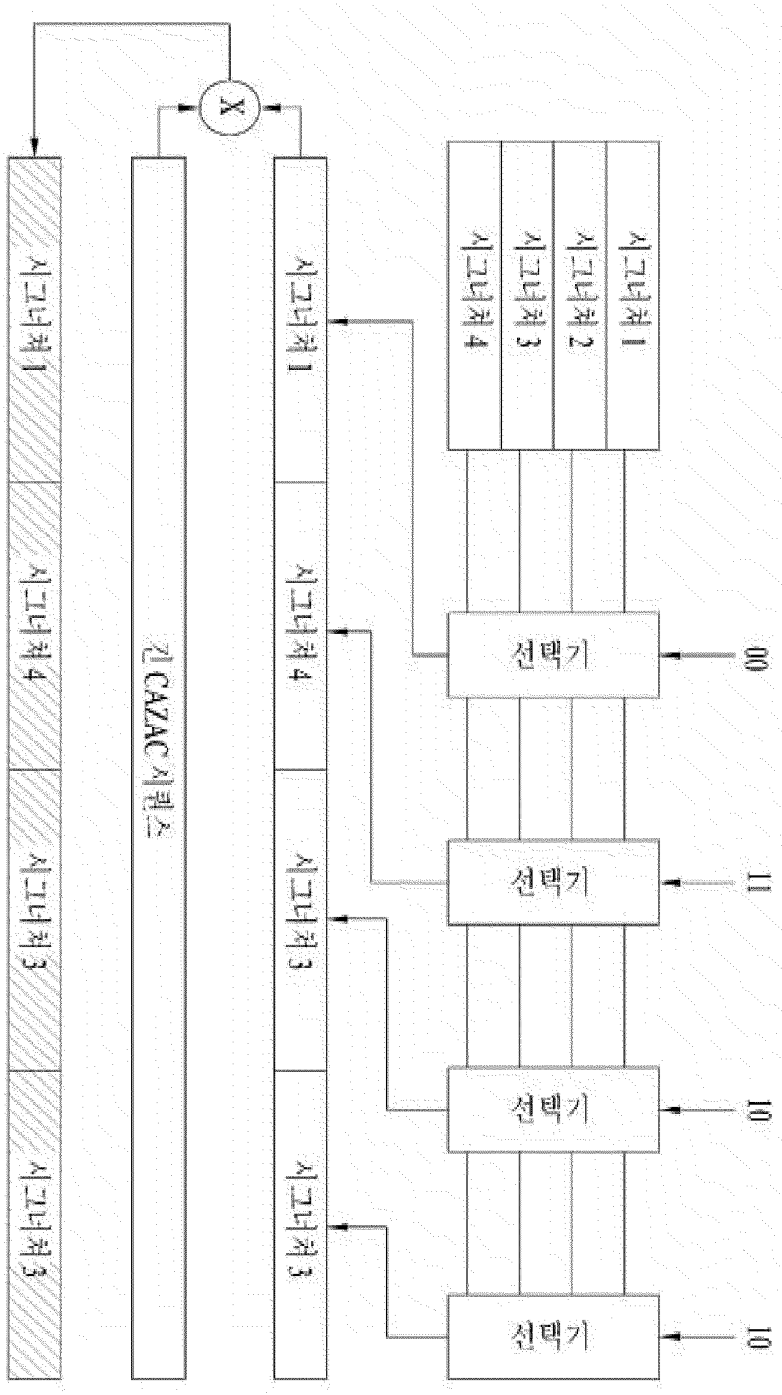
【도 5】



【도 6】

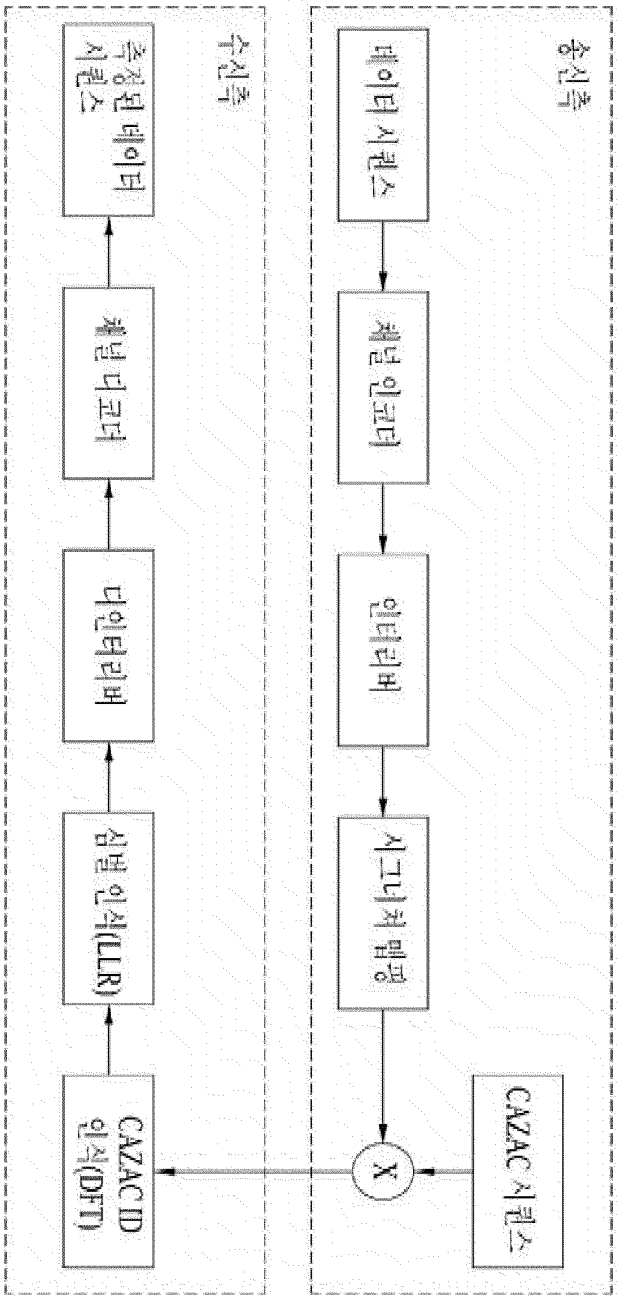

RACH
서브 프레임(0.5ms)
단말#1 : RACH 엑세스를 위한 RACH 파일럿 할당
단말#n 할당
주파수
RACH CQI 파일럿
스케줄된 엑세스 파일럿

【도 7】


X
시그너처 1
시그너처 4
시그너처 3
시그너처 2
긴 CAZAC 시퀀스
시그너처 1
시그너처 4
시그너처 3
시그너처 2
시그너처 3
시그너처 4
시그너처 3
시그너처 2
시그너처 1
선택기
선택기
선택기
선택기
00
11
10
10

35-34

【도 8】


송신측
데이터 시퀀스
채널 인코더
인터리버
시그너쳐 맵핑
CAZAC 시퀀스
X
수신측
CAZAC ID 인식(DFT)
심벌 인식(LLR)
디인터리버
채널 디코더
측정된 데이터 시퀀스

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별첨 사본은 아래 출원의 원본과 동일함을 증명함.

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

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출 원 인 : 엘지전자 주식회사
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2007 년 07 월 03 일

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COMMISSIONER

【서지사항】

【서류명】 특허출원서

【권리구분】 특허

【수신처】 특허청장

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【제출일자】 2006.06.26

【국제특허분류】 H04B

【발명의 국문명칭】 랜덤 액세스 채널을 통한 데이터 송수신 방법

【발명의 영문명칭】 Method for data transferring through Random Access Channel

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【출원인코드】 1-2002-012840-3

【대리인】

【성명】 김용인

【대리인코드】 9-1998-000022-1

【포괄위임등록번호】 2006-037573-8

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【대리인코드】 9-1998-000279-9

【포괄위임등록번호】 2006-037574-5

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【성명의 영문표기】 KWON,Yeong Hyeon

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【우편번호】 440-824

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【성명의 영문표기】 HAN,Seung Hee

【주민등록번호】 761128-1261917

【우편번호】 122-899

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【주민등록번호】 800803-2357323

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【성명의 영문표기】 KIM,Dong Cheol

【주민등록번호】 781009-1632216

【우편번호】 437-080

【주소】 경기 의왕시 내손동 763 대명 스위트빌 401호

【국적】 KR

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【성명】 이현우

【성명의 영문표기】 LEE,Hyun Woo

【주민등록번호】 770601-1063313

【우편번호】 431-080

【주소】 경기 안양시 동안구 호계동 1103-3 네오빌 204호

【국적】 KR

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【성명의 영문표기】 NOH,Min Seok

【주민등록번호】 770911-1558611

【우편번호】 152-053

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【국적】 KR

【취지】 특허법 제42조의 규정에 의하여 위와 같이 출원합니다.

대리인 김용인 (인)

대리인 심창섭 (인)

【수수료】

【기본출원료】	0	면	38,000 원
【가산출원료】	55	면	0 원
【우선권주장료】	0	건	0 원
【심사청구료】	0	항	0 원
【합계】	38,000 원		

【요약서】

【요약】

랜덤 액세스 채널에서 코드 시퀀스를 확장하여 데이터를 전송하는 방법들이 제공된다. 프리앰블 시퀀스로 CAZAC 시퀀스를 사용한다고 가정하는 경우, 첫 번째 방법은 CAZAC 시퀀스에 소정의 지수 시퀀스를 곱하여 전송에 이용할 수 있는 CAZAC 시퀀스의 비트수를 확장하는 것이고, 두 번째 방법은 전송 데이터의 블록값에 따라 해당 CAZAC 시퀀스에 켤레화(conjugation)를 수행하여 블록간 위상차를 크게 만드는 것이며, 세 번째 방법은 두 종류의 시퀀스를 하나의 그룹으로 하는 CAZAC 시퀀스를 적용하고 이 두 종류의 시퀀스를 이용하여 데이터를 표시하는 것이고, 네 번째 방법은 전송 데이터의 각 블록에 상응하는 CAZAC 시퀀스 간에 딜레이를 주어 중첩시키되 각 CAZAC 시퀀스의 길이를 길게 설계하는 것이며, 다섯 번째 방법은 전송 데이터의 각 블록에 상응하는 CAZAC 시퀀스에 순환지연을 적용하여 하나의 시퀀스에 다양한 데이터 값을 적용할 수 있다.

【대표도】

도 16

【색인어】

RACH, CAZAC, conjugate, code sequence, preamble

【명세서】

【발명의 명칭】

랜덤 액세스 채널을 통한 데이터 송수신 방법 {Method for data transferring through Random Access Channel}

【도면의 간단한 설명】

<1> 도 1은 OFDMA 시스템에서 RACH를 통한 종래 데이터 전송 방법의 일실시예.

<2> 도 2는 OFDMA 시스템에서 RACH를 통한 종래 데이터 전송 방법의 다른 일실시예.

<3> 도 3a 및 도 3b는 OFDMA 시스템에서 RACH를 통한 종래 데이터 전송 방법의 또 다른 일실시예.

<4> 도 4a 및 도 4b는 OFDMA 시스템에서 RACH를 통한 종래 데이터 전송 방법의 또 다른 일실시예.

<5> 도 5는 OFDMA 시스템에서 사용되는 종래 RACH 구조의 일 실시예.

<6> 도 6a 및 도 6b는 도 5의 RACH 구조를 전제로 시간 영역 또는 주파수 영역에서 RACH 신호를 싣기 위한 실시예들.

<7> 도 7은 OFDMA 시스템에서 사용되는 종래 RACH 구조의 다른 일 실시예.

<8> 도 8a 및 도 8b는 OFDMA 시스템에서 사용되는 종래 RACH 구조의 또 다른 일실시예.

<9> 도 9는 본 발명에서 사용되는 프리앰블의 반복 구조를 도시한 것.

<10> 도 10은 켤레화를 통해 확장된 코드 시퀀스로 데이터를 전송하는 본 발명의 일실시예를 설명하기 위한 단위 데이터의 구조도.

<11> 도 11은 켤레화를 통해 확장된 코드 시퀀스로 전송되어 온 데이터를 수신하여 복호화하는 과정을 설명한 플로우챠트.

<12> 도 12는 그룹화를 통해 확장된 코드 시퀀스로 데이터를 전송하는 본 발명의 일실시예를 설명하기 위한 단위 데이터의 구조도.

<13> 도 13은 그룹화를 통해 확장된 코드 시퀀스로 전송되어 온 데이터를 수신하여 복호화하는 과정을 설명한 플로우챠트.

<14> 도 14는 딜레이 처리와 그룹화를 통해 확장된 코드 시퀀스로 데이터를 전송하는 본 발명의 일실시예를 설명하기 위한 단위 데이터의 구조도.

<15> 도 15는 딜레이 처리와 그룹화를 통해 확장된 코드 시퀀스로 전송되어 온 데이터를 수신하여 복호화하는 과정을 설명한 플로우챠트.

<16> 도 16은 PPM 변조를 통해 확장된 코드 시퀀스로 데이터를 전송하는 본 발명의 일실시예를 설명하기 위한 단위 데이터의 구조도.

<17> 도 17은 PPM 변조를 통해 확장된 코드 시퀀스로 전송되어 온 데이터를 수신하여 복호화하는 과정을 설명한 플로우챠트.

<18> 도 18a 및 도 18b는 본 발명의 데이터 전송 방법에 의해 RACH에서 동기화가 수행되는 과정을 도시한 플로우챠트.

【발명의 상세한 설명】

【발명의 목적】

【발명이 속하는 기술분야 및 그 분야의 종래기술】

<19> 본 발명은 랜덤 액세스 채널에서 코드 시퀀스를 확장하여 데이터를 전송하는 방법들에 관한 것이다.

<20> 랜덤 액세스 채널(Random Access Channel, RACH)은 단말이 기지국과 업링크(uplink) 동기가 이루어지지 않은 상태에서 네트워크에 접근하기 위해 사용된다. 이와 같은 랜덤 액세스 채널에서는 수신측에서 전송 신호의 시작 위치를 용이하게 검색할 수 있도록 시간 영역에서 반복 특성을 가지는 신호가 사용되는데, 일반적으로 프리앰블(preamble)을 반복적으로 전송함으로써 반복 특성을 구현한다.

<21> 상기 프리앰블을 구현하기 위한 대표적인 시퀀스로 CAZAC(Constant Amplitude Zero AutoCorrelation) 시퀀스를 들 수 있다. CAZAC 시퀀스는 자기상관(auto-correlation)의 경우 디락-델타(Dirac-Delta) 함수로 표현되고, 교차상관(cross-correlation)의 경우 상수값을 가지므로 우수한 전송 특성을 가지는 것으로 평가받고 있다. 그러나, 길이 N의 시퀀스에 대하여 최대 N-1개의 시퀀스만을 사용할 수 있다는 한계가 있어 상기의 우수한 특성을 그대로 유지하면서 시퀀스의 사용 가능 비트수를 늘리기 위한 방안이 요구되고 있다.

<22> 한편, CAZAC 시퀀스를 이용하여 랜덤 액세스 채널에서 데이터를 전송하기 위해 다양한 방법들이 제시되고 있다. 이를 위한 제1방법은 CAZAC 시퀀스 ID를 곧바로 메시지 정보로 해석하는 것이다. 그러나, 제1방법에 있어서 전송하고자 하는 데이터가 프리앰블이라 할 때 프리앰블로 사용될 수 있는 시퀀스의 수가 충분히 많은

경우라면 추가적인 조작 없이 CAZAC 시퀀스 ID만으로 메시지를 전달할 수 있으나, 실제 RACH에서는 최대 24bit까지 고려해야 하므로 충분한 수의 CAZAC 시퀀스 집합을 구현하는 데에 어려움이 있고, 수신측에서 검출에 소요되는 비용 역시 상당하다는 문제가 있다.

<23> 제2방법은 CAZAC 시퀀스와 왈시(Walsh) 시퀀스를 코드분할 다중화(code division multiplexing, CDM) 방식으로 동시에 전송하는 것으로서, CAZAC 시퀀스 ID는 단말 구분 정보로 활용하고 CDM 방식으로 전송된 시퀀스는 메시지 정보로 해석한다. 도 1은 제2방법을 구현하기 위한 송신측에서의 데이터 진행 절차를 블록으로 도시하고 있다. 그러나, 제2방법은 CAZAC 시퀀스에 왈시 시퀀스가 더해져도 추가로 확보할 수 있는 메시지의 비트수는 왈시 시퀀스의 길이가 N일 때 $\log_2 N$ 비트(bit)에 불과하다는 한계가 있다.

<24> 제3방법은 CAZAC 시퀀스에 왈시 시퀀스를 믹싱하여 전송하는 것으로서, CAZAC 시퀀스 ID는 단말 구분 정보로 활용하고 왈시 시퀀스는 메시지 정보로 해석한다. 도 2는 3방법을 구현하기 위한 송신측에서의 데이터 진행 절차를 블록으로 도시하고 있다. 그러나, 제3방법은 왈시 시퀀스가 CAZAC 시퀀스의 검출에 잡음으로 작용하여 시퀀스 ID의 검출에 어려움이 발생하므로 이를 방지하기 위해 반드시 반복 시퀀스로 전송되어야 하는 한계가 있다.

<25> 제4방법은 CAZAC 시퀀스에 지수(exponential) 텀을 곱하여 해당 시퀀스를 구성하는 블록 간에 직교성을 부여하거나, DPSK,DQPSK, D8PSK 등의 데이터 변조를 직접 적용하는 것으로서, CAZAC 시퀀스 ID는 단말 구분 정보로 활용하고 변조된 시퀀

스를 복조하여 메시지 정보로 활용한다. 도 3a는 전자의 방법에 의한 데이터 변조를 도시하고 있고, 도 3b는 후자의 방법에 의한 데이터 변조를 도시하고 있다.

<26> 또한, 제5방법은 CAZAC 시퀀스에 메시지 부분을 덧붙여서 전송하는 것으로서, 도 4a는 프리앰블로 이용되는 CAZAC 시퀀스에 메시지(코딩된 비트)가 덧붙여진 경우를 도시하고 있고, 도 4b는 직교성이 부여된 소정 개수의 블록으로 구성되는 시퀀스에 메시지(코딩된 비트)가 덧붙여진 경우를 도시하고 있다.

<27> 그러나, 상기 제4방법 및 제5방법은 공히 채널 여건의 변화에 민감하다는 문제가 있다.

【발명이 이루고자 하는 기술적 과제】

<28> 본 발명은 위와 같은 문제점을 해결하기 위해 제안된 것으로서, 랜덤 액세스 채널에서 데이터를 전송하는데 있어서 코드 시퀀스의 전체 길이를 모두 활용할 수 있도록 하는 코드 시퀀스의 데이터 처리 방법을 제공하는 데에 그 목적이 있다.

<29> 본 발명의 다른 목적은 랜덤 액세스 채널에서 데이터를 전송함에 있어서 전송할 정보량이 증대되거나 전송 데이터가 노이즈나 채널에 강해지도록 하는 코드 시퀀스의 데이터 처리 방법을 제공하는 데에 있다.

【발명의 구성】

<30> 상기 첫 번째 목적을 달성하기 위한 본 발명은 코드 시퀀스를 확장하여 데이터를 전송하는 방법에 관한 것으로서, 데이터 전송에 사용 가능한 코드 수가 추가되도록 상기 코드 시퀀스를 데이터 처리하는 단계와, 상기 데이터 처리된 코드 시퀀스로 데이터를 수신측에 전송하는 단계를 포함하여 이루어지며, 상기 데이터 처

리는 상기 CAZAC 시퀀스에 소정의 지수(exponential) 시퀀스를 곱함으로써 수행된다.

<31> 상기 두 번째 목적을 달성하기 위한 본 발명의 일 실시예는 데이터 전송을 위한 코드 시퀀스를 확장하는 방법에 관한 것으로서, 상기 데이터를 구성하는 각 블록의 비트값에 따라 해당 블록에 상응하는 코드 시퀀스에 소정의 데이터 처리를 수행하는 단계와, 상기 데이터 처리된 코드 시퀀스를 수신측에 전송하는 단계를 포함하여 이루어지며, 상기 코드 시퀀스의 데이터 처리는 상기 데이터를 구성하는 특정 블록의 비트값이 1인 경우, 해당 블록에 상응하는 CAZAC 시퀀스를 켤레화(conjugation)하는 것이다.

<32> 이와 같이, 전송 데이터를 구성하는 각 블록의 비트값에 따라 해당 코드 시퀀스를 켤레화(conjugation)가 수행되어 전송된 코드 시퀀스를 수신측에서 복호화하는 방법은, 수신된 데이터에 있어서, 첫 번째 블록에 대한 초기 피크(peak)를 추정하는 제1단계와, 피크 추정이 수행된 블록과 다음 순번의 블록에 대해 피크(peak)를 추정하는 제2단계와, 마지막 순번의 블록에 이르기까지 상기 제2단계를 반복하는 제3단계를 포함하여 이루어진다. 여기서, 상기 첫 번째 블록은 항상 0으로 설정되어 수신되어야 하며, 상기 제2단계는 피크 추정이 수행된 블록과 다음 순번의 블록에 대해 켤레화(conjugation)되었음을 전제로 제1피크(peak)를 추정하는 제2-1단계와, 동일한 블록들에 대해 켤레화(conjugation)가 되지 않았음을 전제로 제2피크(peak)를 추정하는 제2-2단계 및 상기 제1피크와 제2피크 중 큰 쪽을 해당 블록들의 피크로 결정하는 제2-3단계를 포함한다.

<33> 상기 두 번째 목적을 달성하기 위한 본 발명의 다른 일 실시예는 데이터 전송을 위한 코드 시퀀스를 확장하는 방법에 관한 것으로서, 상기 데이터를 구성하는 각 블록의 값에 따라 특정 시퀀스가 선택되는 단계와, 상기 선택된 시퀀스들로 이루어진 코드 시퀀스를 수신측에 전송하는 단계를 포함하여 이루어진다.

<34> 여기서, 상기 코드 시퀀스는 상기 데이터를 구성하는 각 블록의 비트수 n(n=1, 2, 3...)에 따라 2^n개의 서로 다른 시퀀스를 포함하는 그룹으로 이루어지며, 상기 특정 시퀀스의 선택은 각 블록의 비트값에 상응하는 특정 시퀀스를 상기 그룹에서 선택하는 것일 수 있다.

<35> 또한, 상기 선택된 각 시퀀스가 서로 독립성을 유지하면서 중첩되도록 데이터 처리하는 단계를 더 포함할 수 있는데, 이 경우 상기 선택된 각 시퀀스는 소정 간격의 딜레이를 두고 순차적으로 중첩되도록 데이터 처리되는 것이 바람직하다.

<36> 또한, 상기 그룹에 포함되는 시퀀스는 전체 블록 길이의 단일 CAZAC 시퀀스가 사용될 수도 있고, 상기 그룹에 포함되는 시퀀스는 단일 블록 길이의 짧은 CAZAC 시퀀스가 사용될 수도 있다.

<37> 이와 같이, 그룹화된 시퀀스 중 특정 시퀀스의 선택를 통해 확장되는 코드 시퀀스를 이용하여 전송된 데이터를 복호화하는 방법은, 수신된 데이터의 블록별 시퀀스 ID(sequence ID)를 파악하는 단계와, 상기 파악된 코드 시퀀스 ID의 세트로부터 각 블록의 그룹 ID(group ID)를 파악하는 단계와, 상기 파악된 그룹 ID로부터 데이터값을 복호화하는 단계를 포함한다.

<38> 여기서, 상기 그룹 ID 파악 단계는 각 코드 시퀀스 ID에 해당하는 블록에 대하여 피크(peak)를 추정하는 단계와, 상기 추정된 피크 중 발생 빈도가 높은 2개의 피크로부터 각 블록의 그룹 ID를 파악하는 단계를 포함하며, 그룹 ID가 파악되지 않은 블록에 대하여 상기 피크 추정 단계를 반복함으로써 그룹 ID를 재파악하는 단계를 더 포함될 수 있다.

<39> 또한, 상기 그룹 ID 파악 단계는 각 코드 시퀀스 ID에 해당하는 블록에 대하여 피크(peak)를 추정하는 단계와, 상기 추정된 피크 중 발생 빈도가 높은 2^n(n=1,2,3...)개의 피크로부터 각 블록의 그룹 ID를 파악하는 단계를 포함하여 이루어질 수도 있으며, 이 경우에도 그룹 ID가 파악되지 않은 블록에 대하여 상기 피크 추정 단계를 반복함으로써 그룹 ID를 재파악하는 단계를 더 포함할 수 있다.

<40> 상기 두 번째 목적을 달성하기 위한 본 발명의 또 다른 일 실시예는 데이터 전송을 위한 코드 시퀀스를 확장하는 방법에 관한 것으로서, 상기 데이터를 구성하는 각 블록에 상응하는 시퀀스들이 해당 블록의 값을 표시하도록 각각의 시퀀스를 데이터 처리하는 단계와, 상기 데이터 처리된 각 시퀀스를 중첩하여 수신측으로 전송하는 단계를 포함하여 이루어진다.

<41> 이때, 상기 전송 데이터를 구성하는 각 블록은 해당 블록의 비트수 n(n=1, 2, 3...)에 따라 2^n개의 구간으로 구분되고, 상기 데이터 처리는 특정 블록의 특정 구간이 시작점이 되도록 해당 블록에 상응하는 시퀀스를 변조(modulation)하는 것인데, 상기 변조 방법으로 PPM(Pulse Position Modulation)이 이용되는 것이 바람

직하다.

<42> 이와 같이 전송 데이터를 구성하는 블록에 대한 시퀀스 각각에 대해 PPM을 수행하여 중첩시킨 데이터를 수신하고 이를 복호화하는 방법은, 수신된 데이터에 대한 시퀀스 ID를 검출하는 단계와, 상기 검출된 시퀀스 ID에 해당하는 미리 준비된 시퀀스를 이용하여 수신 데이터를 코릴레이션(correlation) 하는 단계와, 상기 코릴레이션된 데이터로부터 해당 데이터를 구성하는 블록 개수만큼의 피크(peak)를 측정하는 단계 및 상기 측정된 피크를 이용하여 각 블록에 대한 데이터값을 복호화하는 단계를 포함하여 이루어지며, 상기 데이터값 복호화 단계는 측정된 각 피크가 어떤 블록의 어떤 구간에 속하는지를 판독함으로써 데이터 비트의 순서와 데이터 비트의 내용을 복호화한다.

<43> 한편, 상기 실시예들에 공통적으로 사용되는 코드 시퀀스는 CAZAC(Constant Amplitude Zero Autocorrelation) 시퀀스가 될 수 있다.

<44> 이하, 본 발명에 첨부된 도면을 참고하여 본 발명의 바람직한 실시예에 대해 상세하게 살펴보기로 한다.

<45> 랜덤 액세스 채널(Random Access Channel, RACH)은 단말이 기지국과 업링크(uplink) 동기가 이루어지지 않은 상태에서 네트워크에 접근하기 위해 사용되는 것으로서, 네트워크에의 접근 방식에 따라 단말이 다운링크 동기를 잡고 맨 처음 기지국에 접근하는 방식(initial ranging)과, 네트워크에 접속된 상태로 단말의 필요에 따라 네트워크에 그때마다 접근하는 방식(periodic ranging)으로 구분할 수 있다. 여기서, 전자의 경우는 단말이 네트워크에 접속하면서 동기를 이루고 자신에게

필요한 아이디(ID)를 제공받기 위한 용도로 사용되고, 후자는 전송할 패킷이 존재하거나 기지국으로부터 정보를 수신하기 위해 프로토콜을 초기화(initiation)시키기 위한 용도로 사용된다.

<46> 특히 후자의 경우는 3GPP LTE에 의할 때 다시 두 가지로 구분할 수 있는데, 단말이 RACH에 접근할 때 자신의 업링크(uplink) 신호가 동기 한계 내에 있을 때 사용하는 동기화 접근 모드(synchronized access mode)와, 동기 한계를 벗어났을 때 사용하는 비동기화 접근 모드(non-synchronized access mode)로 구분할 수 있다. 비동기화 접근 모드는 단말이 최초로 기지국에 접근하는 경우나, 동기 과정을 거친 후 동기 갱신(update)가 이루어지지 않았을 경우에 사용되는 방식이다. 이때, 동기화 접근 모드는 상기 주기적 접근(periodic ranging)과 같은 개념이며, 단말이 기지국에게 자신의 변경사항 통보와 자원할당 요청을 목적으로 RACH에 접근하는 경우에 이용된다.

<47> 그에 비해, 동기화 접근 모드는 단말이 기지국과 업링크(uplink) 동기를 벗어나지 않은 상태라 가정하고 그 가정에 따라 RACH에 있어서 보호 시간(Guard time)의 제한을 완화한다. 이로 인해 더 많은 시간-주파수 자원(time-frequency resource)를 사용할 수 있는데, 3GPP LTE에서는 동기화 접근 모드에서 랜덤 액세스용 프리앰블 시퀀스(preamble sequence)에 상당한 양의 메시지(24bits 이상)를 더하여 양자를 함께 전송하도록 하고 있다.

<48> 이상과 같은 동기 및 비동기 접근 모드를 만족하면서 RACH의 고유의 역할을 수행하기 위한 종래의 RACH 구조를 살펴보면 다음과 같다.

<49> 도 5는 종래 OFDMA 시스템에서 사용되는 RACH 구조의 일실시예를 도시한 것이다. 도면에서 보듯, RACH는 셀의 반경에 따라 시간축으로 N개의 서브 프레임(subframe)으로 분할되고, 주파수축으로 N개의 주파수 대역으로 분할됨을 알 수 있다. RACH의 생성 빈도는 MAC에서의 QoS 요구 조건에 따라서 정해지는데, 일반적으로 수십 ms 단위로 한 번씩 또는 수백 ms 단위로 한 번씩 채널이 생성된다. 이는 여러 개의 subcarrier 별로 다른 RACH를 설정하여 단말간 충돌을 줄이는 구조이다.

<50> 도 5와 같은 RACH 구조에서 임의의 서브 프레임은 시간-주파수 자원(Time-Frequency Resource, TFR)이라 하여 데이터 전송의 기본 단위가 된다. 도 6a는 이와 같은 TFR에 시간 영역에서 랜덤 액세스 신호를 싣는 형태를 도시하고 있고, 도 6b는 주파수 영역에서 RACH 신호를 싣는 형태를 도시하고 있다.

<51> 도 6a에서 보듯 시간 영역에서 랜덤 액세스 신호를 생성하는 경우에는 본래의 서브 프레임 구조가 무시되고 단지 TFR만을 통해 신호를 정렬하여 전송한다. 반면, 도 6b에서 보듯 주파수 영역에서는 서브 프레임 구조를 어느 정도 유지하면서 각 OFDM 심볼의 부반송파에 전송하고자 하는 랜덤 액세스 신호를 생성한다. 따라서 TFR을 이루는 각 블록 사이에 직교성이 유지되고, 채널 추정 또한 용이하게 수행될 수 있다.

<52> 도 7은 종래 OFDMA 시스템에서 사용되는 RACH 구조의 다른 일실시예를 도시한 것이다. 도면에서 보듯, 첨부된 광대역 파일럿(attached wideband pilot)의 RACH 버스트 구간(RACH burst duration) 중 TDM/FDM 방식 및 TDM 방식에서 공히 프리앰블 b와 파일럿 a가 일부 중복되도록 전송됨을 알 수 있고, 임베디드된 광대역

파일럿(embedded wideband pilot)에서는 TDM/FDM 방식 및 TDM 방식에서 공히 파일럿 a, 파일럿 b 각각이 프리앰블 a 및 프리앰블 b에 동시에 중복되도록 전송됨을 알 수 있다. 다시 말해, RACH를 통해 프리앰블과 파일럿을 함께 전송할 수 있도록 설계함으로써 RACH에 메시지가 추가되는 경우 채널추정을 통해 메시지 복호를 용이하게 하거나, 광대역 파일럿을 사용함으로써 RACH의 프리앰블(preamble)이 사용하는 대역 이외의 RACH 총 채널 대역에 대한 채널품질정보(Channel Quality Information, 이하 'CQI')를 획득할 수 있도록 한다.

<53> 도 8a 및 도 8b는 종래 OFDMA 시스템에서 사용되는 RACH 구조의 또 다른 일 실시예를 도시한 것이다.

<54> 도 8a에서 보듯 본 실시예에서 전체 시스템 대역이 75개의 부반송파로 이루어진다고 할 때, 전체 주파수 대역을 통해 소정 시간 동안 프리앰블을 전송하되 일정 주기로 단블록(short block) 구간을 두어 해당 단블록에 프리앰블을 복호화하기 위한 파일럿을 전송한다. 이때, 상기 파일럿 전송을 전체 주파수 대역 중 일부 대역을 통해 수행함으로써(이를테면 전체 75개의 부반송파 중 중간 대역의 25개 부반송파에를 통해 전송) 멀티 접속 환경에서 특정 단말에 대해서 파일럿을 전송할 수 있다.

<55> 또한, 도 8b에서 보듯 전송하고자 하는 메시지와 이를 복호화하기 위한 파일럿을 멀티플렉싱(multiplexing)하여 지속적으로 전송하되, 전체 주파수 대역 중 선택된 일부 주파수 대역(이를테면 전체 75개의 부반송파 대역 중 중간의 25개 부반송파 대역)을 통해 전송한다. 따라서, 일부 주파수 대역을 다른 주파수로 할당함으

로써 멀티 접속을 하는 각 사용자 단말을 구별할 수 있다.

<56> 이상에서, 다양한 구조의 RACH를 통해 프리앰블(preamble)과, 파일럿 정보(pilot)를 위시한 동기 타이밍 정보(timimg information), 업링크 자원 할당 정보(uplink resource allocation information) 및 업링크 데이터(uplink data) 등의 메시지가 전송될 수 있음을 살펴보았다.

<57> 한편, RACH를 통해 상기 프리앰블과 메시지는 별개로 전송될 수도 있고, 프리앰블에 메시지가 함축적으로 포함되어 전달될 수도 있다. 본 발명은 특히 후자의 방식을 통해 프리앰블을 전송하는 방법에 관한 것이며, 효과적인 프리앰블의 전송을 위해 종래에 비해 확장된 개념의 코드 시퀀스를 사용하는 것을 특징으로 한다. 이하에서는 프리앰블을 위한 코드 시퀀스로서 CAZAC 시퀀스가 유력한 이유를 알아보고, 이어서 효과적인 프리앰블 전송을 위한 본 발명의 CAZAC 시퀀스 개선 방안(제1 실시예)을 설명하기로 한다.

<58> 랜덤 액세스 채널에서는 수신측이 전송 신호의 시작 위치를 검색해 내야 하는 부담이 있으므로 전송 신호가 시간 영역에서 특정한 패턴을 가지도록 설계하는 것이 일반적이다. 이를 위해 프리앰블(preamble)을 반복적으로 전송하거나, 주파수 영역에서 부반송파(subcarrier)의 사이에 일정한 간격을 둠으로써 시간 영역에서 반복 특성을 구현되도록 하고, 이로부터 시간 동기를 알아내도록 하고 있다.

<59> 여기서, 전자의 프리앰블(preamble)은 통신 시스템에서 초기 동기 설정, 셀 탐색, 주파수 오프셋 및 채널 추정 등의 목적으로 사용되는 기준 신호(reference signal)를 가리키며, 셀룰러(cellular) 이동통신 시스템에서는 프리앰블의 반복 전

송을 위해 상호상관 특성이 좋은 시퀀스가 사용되는 것이 바람직하다. 이를 위해 이진 하다마드 코드(binary hardamard code)나 다위상(poly-phase) CAZAC(Constant Amplitude Zero Auto-Correlation) 시퀀스가 사용될 수 있으며, 이 중 특히 CAZAC 시퀀스는 자기상관(auto-correlation)의 경우 디락-델타(Dirac-Delta) 함수로 표현되고 교차상관(cross-correlation)의 경우 상수값을 가지므로 전송 특성이 우수한 것으로 평가받고 있다.

<60> CAZAC 시퀀스는 다음과 같이 크게 GCL 시퀀스(수식 1)와 Zadoff-Chu 시퀀스(수식 2)로 구분할 수 있다.

【수학식 1】

<61>
$$c(k;N,M)=\exp\left(-\frac{j\pi Mk(k+1)}{N}\right) \quad \text{for odd N}$$

<62>
$$c(k;N,M)=\exp\left(-\frac{j\pi Mk^2}{N}\right) \quad \text{for even N}$$

【수학식 2】

<63>
$$c(k;N,M)=\exp\left(\frac{j\pi Mk(k+1)}{N}\right) \quad \text{for odd N}$$

<64>
$$c(k;N,M)=\exp\left(\frac{j\pi Mk^2}{N}\right) \quad \text{for even N}$$

<65> 상기 수식들로 부터 CAZAC 시퀀스는 그 길이가 N인 경우 실제로 사용할 수

있는 시퀀스는 N-1개에 한정된다는 것을 알 수 있다.

<66> <제1 실시예>

<67> 따라서, 본 실시예에서는 CAZAC 시퀀스 c(k)에 소정의 모듈레이션 시퀀스 m(k)를 곱하는 방식으로 개선된 CAZAC 시퀀스 p(k)를 제공함으로써 실제로 사용 가능한 시퀀스의 개수를 1만큼 확장한다. 즉, CAZAC 시퀀스로 Zadoff-Chu 시퀀스가 사용된다고 가정하면 CAZAC 시퀀스 c(k), 모듈레이션 시퀀스 m(k) 및 개선된 CAZAC 시퀀스 p(k)는 다음의 수식 3, 수식 4 및 수식 5로 각각 정의될 수 있다.

【수학식 3】

<68> CAZAC 시퀀스 :

<69>
$$c(k;N,M)=\exp\left(\frac{j\pi Mk(k+1)}{N}\right)$$

【수학식 4】

<70> 모듈레이션 시퀀스(modulation sequence) :

<71>
$$m(k)=\exp\left(\frac{j2\pi\delta}{N}k\right)$$

【수학식 5】

<72> 개선된 CAZAC 시퀀스(또는 개선된 프리앰블) :

<73>
$$p(k)=c(k)*m(k)=\exp\left(\frac{j\pi M}{N}k(k+1)+\frac{j2\pi\delta}{N}k\right)$$

<74> 개선된 CAZAC 시퀀스 p(k)는 CAZAC 시퀀스의 자기상관(auto-correlation)과 상호상관(cross-correlation) 특성을 그대로 유지한다. 다음의 수식 6은 p(k)의 자기상관 특성을 보여주고 있으며 최종 결과가 디락-델타(Dirac-delta) 함수인 것을 알 수 있다. 특히 모듈레이션 시퀀스 m(k)가 일정한 위상(phase)을 가지는 시퀀스인 경우 언제나 상기 자기상관 특성이 유지된다는 데에 특징이 있다.

【수학식 6】

$$ad(d) = \sum_k \exp\left(\frac{j\pi M}{N}(k+d)(k+d+1) + \frac{j2\pi\delta}{N}(k+d)\right)$$

$$\exp\left(-\frac{j\pi M}{N}k(k+1) - \frac{j2\pi\delta}{N}k\right)$$

$$= \sum_k \exp\left(\frac{j2\pi M}{N}(2dk + d(d+1)) + \frac{j2\pi\delta}{N}d\right)$$

$$= exp\left(\frac{j2\pi\delta}{N}d\right)\sum_k \exp\left(\frac{j\pi M}{N}(2dk + d(d+1))\right) = \begin{cases} 1 & d = 0 \\ 0 & d \neq 0 \end{cases}$$

<75>

<76> 또한, 다음의 수식 7은 p(k)의 상호상관 특성을 보여주고 있다.

【수학식 7】

$$cc(d) = \sum_k \exp\left(\frac{j\pi(M+x)}{N}(k+d)(k+d+1) + \frac{j2\pi\delta}{N}(k+d)\right)$$
$$\exp\left(-\frac{j\pi M}{N}k(k+1) - \frac{j2\pi\delta}{N}k\right)$$

$$= \sum_k \exp\left(\frac{j\pi x}{N}(k+d)(k+d+1)\right)$$
$$\exp\left(\frac{j\pi M}{N}(k+d)(k+d+1) + \frac{j2\pi\delta}{N}(k+d)\right)$$
$$\exp\left(-\frac{j\pi M}{N}k(k+1) - \frac{j2\pi\delta}{N}k\right)$$

$$= \sum_k \exp\left(\frac{j\pi x}{N}(k+d)(k+d+1)\right)$$
$$\exp\left(\frac{j\pi M}{N}(2dk + d(d+1)) + \frac{j2\pi\delta}{N}d\right)$$

$$= exp\left(\frac{j\pi M}{N}d(d+1)\right)\sum_k \exp\left(\frac{j\pi x}{N}(k+d)(k+d+1)\right)$$
$$\exp\left(\frac{j2\pi dM}{N}k\right)$$

<77>

<78> 여기서 수식 7은 수식 6과 유사한 것으로 보이나, 서메이션(summation) 항을 살펴보면 자기상관의 경우 단순한 지수(exponential) 합으로 나타나는 데 비해, 상호상관의 경우에는 두 시퀀스의 곱으로 나타나는 것을 알 수 있다. 그 중에서 첫 번째 항은 시드(seed) 값이 x인 또 다른 CAZAC 시퀀스이고, 두 번째 항은 단순한 지수 함수이다. 이로부터 두 시퀀스의 곱의 합은 지수 함수의 계수를 구하는 것과

같고, 그 값은 시드 값이 x인 CAZAC 시퀀스를 주파수 영역으로 변환하고 그 중에서 지수의 주파수 위치에서 값을 추출하는 것과 동일하다.

<79> CAZAC 시퀀스는 자기상관이 디락=델타(Dirac-delta) 특성을 가지고 있기 때문에 퓨리에 변환을 거치면 변환된 영역에서도 상수 크기(constant amplitude)에 디락-델타의 자기상관 특성을 유지한다. 이로 인해 주파수 영역에서 특정 위치의 값을 추출하는 경우 그 크기는 1로서 동일하고 위상만이 상이하게 된다. 따라서, 수식 7에 이와 같은 내용을 추가하여 상호상관을 구하면 다음의 도 8과 같이 간략하게 표현할 수 있다.

【수학식 8】

$$cc(d) = exp\left(\frac{j\pi M}{N}d(d+1) + \frac{j2\pi\delta}{N}d\right)\sum_{k}\exp\left(\frac{j\pi x}{N}(k+d)(k+d+1)\right)$$

$$\exp\left(\frac{j2\pi dM}{N}k\right)$$

$$= exp\left(\frac{j\pi M}{N}d(d+1) + \frac{j2\pi\delta}{N}d\right)C(dM/N;x)$$

<80>

<81> 여기서, C(dM/N;x)는 크기가 언제나 1이고 지수 텀(exponential)도 크기가 1이기 때문에 상호상관은 항상 1로 고정됨을 알 수 있다.

<82> 결국, 수식 5와 같이 생성된 시퀀스는 종래 CAZAC 시퀀스의 특성을 그대로 유지하면서 코드의 개수가 늘어나는 효과를 가지게 된다. 이는 지수 텀을 곱하는 영역에서의 결과는 퓨리에 변환된 영역에서 순환지연(circular shift)을 적용한 것

과 동일하며, 이는 곧 시간 영역에서 지수 시퀀스(exponential sequence)를 곱하는 것이 주파수 영역에서 순환지연을 수행하는 것과 동일함을 의미한다.

<83> 즉, 시드 값이 동일한 두 시퀀스 p(k;M,N,d1)과 p(k;M,N,d2)의 상관성(correlation)을 구해보면, 상호상관에 있어서 딜레이 d가 d1-d2가 되는 지점에서 임펄스(impulse)가 발생함을 알 수 있다. 이와 같은 개선된 시퀀스의 설계는 CAZAC 시퀀스를 순환지연(circular shift)한 것과 동일한 결과를 가지나, 이를 위해 퓨리에 변환 및 순환지연을 적용하고 다시 퓨리에 역변환을 수행할 필요 없이 두 개의 지수식(exponential)을 곱하는 간단한 절차만으로 구현할 수 있다는 점에서 본 실시예의 의미가 있다.

<84> 이하에서는 종래의 코드 시퀀스에 소정의 데이터 처리를 가하여 프리앰블의 데이터 전송 신뢰도를 높이는 방법(제2, 3 실시예) 및 데이터가 동시에 전송될 때 코드 시퀀스의 길이 자체를 확장하는 방법(제4, 5 실시예)에 대해 살펴보기로 한다. 여기서, 상기 코드 시퀀스로 CAZAC 시퀀스가 사용되는 경우 제2 내지 제5 실시예에는 제1 실시예에 의해 확장된 CAZAC 시퀀스가 사용되는 것이 바람직하나, 반드시 이에 한하는 것은 아니며 종래의 CAZAC 시퀀스가 그대로 적용될 수도 있다.

<85> 우선, 제2 실시예 내지 제5 실시예에서 공통적으로 적용되는 전송 데이터 즉, 프리앰블의 구조를 살펴보기로 한다.

<86> 3GPP LTE에서 논의되는 통신 시스템에서는 수신측이 전송 데이터를 용이하게 검출할 수 있도록 동일한 시퀀스를 두 번 이상 반복하여 전송한다. 따라서, 수신측에서는 전송받은 시퀀스의 종류에 상관없이 반복 패턴만을 검출하면 되므로 RACH에

접근하는 단말의 시간 위치를 간단하게 알아낼 수 있다.

<87> 또한, 직교주파수분할 전송방식에서는 신호의 전송에 있어서 다중경로(Multipath)에 대한 보상을 위해 OFDM 심볼의 마지막 부분을 복제하여 OFDM 심볼의 앞에 붙이는 CP(Cyclic prefix)를 사용한다. 따라서, 상기 OFDM 심볼이 반복되는 두 개의 프리앰블로 이루어지는 경우 후위에 있는 프리앰블의 일부를 심볼의 맨 처음 부분에 CP로 복제함으로써 해당 프리앰블에 대하여 다중경로의 보상이 이루어지도록 할 수 있다. 이와 같은 프리앰블의 구조를 도 9에서 확인할 수 있다.

<88> 여기서, 시퀀스를 반복 전송하지 아니하고 단일 시퀀스에 CP를 첨부하여 전송하더라도 심벌간 간섭(Inter-Symbol Interference)은 발생하지 않으므로 주파수 영역에서 소정의 수신 알고리즘을 구현하는 데에는 지장이 없다. 그러나, 반복 전송도 하지 아니하고 CP마저 첨부하지 않는 채 수신측에서 시간 영역에서 수신 알고리즘을 구현하는 경우, RACH에 접근하는 단말을 구별하기 위해서는 모든 종류의 코드 시퀀스를 검색해야 하는 부담이 있으므로 본 발명의 프리앰블은 되도록 반복 패턴의 구조로 구현되는 것이 바람직하다.

<89> 아래의 제2 내지 제5 실시예는 도 9의 프리앰블 구조를 이루는 반복 시퀀스 하나에 대한 데이터 처리 방법을 논의하고 있다. 이들 실시예에서 수신측에 전송하는 데이터는 상기 도 9의 프리앰블 구조가 될 수도 있고 일부가 생략되는(반복 전송을 하지 않거나, CP가 첨부되지 않은) 구조가 될 수도 있다. 또한, 데이터 전송에 이용되는 코드 시퀀스로서 CAZAC 시퀀스를 가정하였으나 반드시 이에 한하는 것은 아니며, 이진 하다마드 코드, 골드 코드 등과 같이 전송 특성이 우수한 시퀀스

라면 어느 것이든지 상기 코드 시퀀스로 사용될 수 있다.

<90> <제2 실시예>

<91> 일반적으로 데이터를 전송하기 위해서는 데이터를 구성하는 전송 신호에 식별 가능한 표식을 남겨야 하는데, 본 실시예에서는 그러한 표식으로 켤레화(conjugation)을 이용한다. 켤레화된 전송 신호와 다른 전송 신호는 서로간에 위상의 변화폭이 매우 크므로 전송 신호간 간섭의 영향이 덜하여 채널의 영향에도 불구하고 데이터 전송의 신뢰성을 높일 수 있다. 상기 켤레화를 도 10을 참고로 설명하면 다음과 같다.

<92> 도면에서 보듯, 전송할 데이터를 전송 신호의 종류에 따라 소정 개수(이를테면 4개)의 블록으로 구분하는 경우, 1의 값을 가지는 블록에 대해 해당 CAZAC 시퀀스를 켤레화하여 전송하고 나머지 0의 값을 가지는 블록은 그대로 전송한다. 이때, 상기 CAZAC 시퀀스에서 켤레화되는 부분은 전송 데이터의 길이에 상응하는 긴 길이의 단일 CAZAC 시퀀스 중에서 1의 값을 가지는 특정 블록에 해당하는 일부가 켤레화될 수도 있고, 전송 데이터의 각 블록 길이에 상응하는 짧은 길이의 다수의 CAZAC 시퀀스 중에서 1의 값을 가지는 특정 블록에 해당하는 CAZAC 시퀀스가 켤레화될 수도 있다.

<93> 한편, 수신측에서는 전송받은 전체 시퀀스에 켤레화된 부분이 없도록 변환하여 원본 데이터를 복호화한다. 구체적인 수신 과정을 도 11을 참고로 설명하면 다음과 같다.

<94> 송신측에서는 전송 데이터의 1번 블록에 대하여 차후 레퍼런스로 이용될 수

있도록 항상 0의 값을 할당한다. 따라서, 수신측에서는 수신된 1번 블록에 대하여 시퀀스 ID를 파악한 후(S1101), 해당 블록만을 가지고 피크(peak)를 측정한다(S1102). 다음으로, 1번 및 2번 블록에 대한 시퀀스 ID를 파악한 후(S1103), 1번 블록과 2번 블록을 함께 사용하여 피크를 측정하는데, 이때 2번 블록의 시퀀스가 컬레화된 상태인지 불명하므로 해당 블록에 대해 컬레화가 수행된 경우(S1104) 및 컬레화가 수행되지 않은 경우(S1105) 각각에 대해 피크를 측정하여 두 피크 중 큰 쪽을 채택한다(S1106). 다음으로, 1번 내지 3번 블록에 대한 시퀀스 ID를 파악한 후(S1107), 1번 블록 내지 3번 블록을 함께 사용하여 피크를 측정하는데, 이 경우 역시 3번 블록의 시퀀스가 컬레화된 상태인지가 불명하므로 해당 블록에 대해 컬레화가 수행된 경우(S1108) 및 컬레화가 수행되지 않은 경우(S1109)에 대해 각각 피크를 측정하여 두 피크 중 큰 쪽을 채택한다(S1110). 이와 같은 방식으로 마지막 블록에까지 복호화를 수행하면 최종적인 원본 데이터가 복호화된다.

<95> <제3 실시예>

<96> 제2 실시예에서는 시퀀스 자체에 변형을 가하여 데이터를 전송하지만, 본 실시예에서는 하나의 블록을 표시하기 위한 시퀀스의 종류를 블록값 '0'에 대한 시퀀스(제1 시퀀스) 및 블록값 '1'을 위한 시퀀스(제2 시퀀스) 두 가지로 구분하고, 제1 시퀀스와 제2 시퀀스를 묶어 그룹으로 취급한다. 이 경우, 수신측에서는 각 블록에 대해 유일한 시퀀스 ID(제1 시퀀스의 ID 또는 제2 시퀀스의 ID)를 검색하기 때문에 상기 제2 실시예에 비해 노이즈나 채널의 영향을 덜 받는 특징이 있다. 이와 같이 그룹화된 시퀀스를 이용하여 데이터를 전송하는 과정을 도 12를 참고로 설명

하면 다음과 같다.

<97> 즉, 모든 시퀀스는 두 개의 서브 시퀀스(제1 시퀀스 및 제2 시퀀스)를 묶어서 하나의 그룹 "{$c_0(k;M_i)$, $c_1(k;M_j)$}"으로 표시된다(i와 j는 서로 다른 정수). 여기서, $c_0(k;M_i)$는 블록값(또는 비트값) 0을 위한 제1 시퀀스이며, $c_1(k;M_j)$는 블록값 1을 위한 제2 시퀀스이다. 이때, 상기 그룹을 이루는 각 서브 시퀀스는 전송 데이터의 길이에 상응하는 긴 길이의 CAZAC 시퀀스가 사용될 수도 있고, 전송 데이터의 각 블록 길이에 상응하는 짧은 길이의 CAZAC 시퀀스가 사용될 수도 있다.

<98> 한편, 수신측에서는 각 블록의 시퀀스 ID를 파악하고, 파악된 시퀀스 ID들로 이루어진 시퀀스 ID 세트로부터 각 블록에 대한 시퀀스의 종류(제1 시퀀스인지 제2 시퀀스인지)를 파악한다. 이때, 상기 각 블록에 대한 시퀀스의 종류를 그룹 ID로 표현할 수 있다. 즉, 본 실시예에서는 각 블록의 코드값으로 0, 1을 표현할 수 있다고 가정하였으므로 각 블록에 대한 시퀀스의 종류 또는 그룹 ID의 종류는 2가지가 된다. 그룹 ID를 통해 각 블록의 코드값을 복원해 낼 수 있다. 이와 같은 복호화 과정을 도 13을 참고로 상세하게 설명하면 다음과 같다.

<99> 수신측에서는 시퀀스가 수신되면 해당 시퀀스를 구성하는 각 블록들의 시퀀스 ID를 파악하고(S1301), 이렇게 파악된 시퀀스 ID들로 구성되는 시퀀스 ID 세트에 대해 피크(peak)를 측정한다(S1302). 여기서, 발생 빈도가 높은 두 피크를 선택하여(S1303) 해당 피크를 발생시키는 시퀀스를 각각 상기 그룹을 구성하는 제1 시퀀스 및 제2 시퀀스로 파악한다. 이때, 제1 시퀀스 및 제2 시퀀스를 각각 소정의

그룹 ID로 표현하면, 코드값 0을 가리키는 제1 그룹 ID와 코드값 1을 가리키는 제2 그룹 ID로 구분할 수 있다. 결국, 상기 S1303 단계를 통해 각 블록의 그룹 ID를 파악할 수 있고(S1304), 이를 통해 각 블록의 코드값을 찾아낼 수 있게 된다(S1308).

<100> 만약, 복호화 과정에서 오류가 발생하여 그룹 ID를 파악할 수 없는 시퀀스 ID들이 존재하는 경우, 해당 시퀀스 ID들의 세트에 대하여만 다시 피크를 탐색하고(S1305) 그 중 유력한 두 피크를 검색하여(S1306) 그로부터 그룹 ID를 다시 파악한다(S1307). 이어서, 파악된 그룹 ID들로 부터 해당 블록의 코드값을 찾아낼 수 있다(S1308).

<101> <제4 실시예>

<102> 제3 실시예를 좀 더 확장하면 하나의 그룹을 통해 전달할 수 있는 데이터의 총비트수를 증가시킬 수 있다. 예를 들어 제3 실시예에서와 같이 2개의 시퀀스를 하나의 그룹으로 정하는 경우 블록당 1비트의 데이터를 전송할 수 있고, 4개의 시퀀스를 하나의 그룹으로 정하는 경우 블록당 2비트의 데이터를 전송할 수 있으며, 8개의 시퀀스를 하나의 그룹으로 정하는 경우라면 블록당 3비트의 데이터를 전송할 수 있다. 다만, 다수의 시퀀스를 그룹 지어서 하나의 세트로 정의하기 때문에 각 시퀀스의 길이가 짧다면 그에 비례하여 선택 가능한 그룹의 수도 줄어들게 되는 문제점이 있다.

<103> 따라서, 선택 가능한 그룹을 늘리기 위해 시퀀스의 길이를 확장시킬 필요성이 있으며 이를 위해 본 실시예에서는 각 블록에 대한 시퀀스의 길이를 확장시키되 각 시퀀스들을 다중으로 중첩시켜 전송하고, 또한 중첩되는 각각의 시퀀스 사이에

전송 딜레이를 두어 독립성이 유지되도록 한다. 이와 같은 딜레이 전송 방식을 도 14를 참조하여 설명하면 다음과 같다.

<104> 도 14에서는 각 블록에 2비트의 데이터값이 주어지는 경우를 특히 예시하고 있다. 따라서, 각 블록에 대한 시퀀스 그룹은 서로 다른 4개의 CAZAC 시퀀스로 구성된다. 여기서 상기 시퀀스 그룹을 구성하는 각 CAZAC 시퀀스는 4가지 경우의 값을 구별시켜야 하므로 그에 따라 그룹 크기도 커져야 하지만, 그 경우 각 기지국이 사용할 수 있는 그룹의 개수가 줄어드는 문제가 발생한다. 따라서, 도 14에서 보듯이 각 CAZAC 시퀀스의 길이를 필요한 만큼 확장시키되, 데이터 전송시에 각각의 CAZAC 시퀀스에 소정의 딜레이를 가하여 전송함으로써 각 CAZAC 시퀀스 간에 독립성을 유지시킨다.

<105> 한편, 수신측에서는 각 CAZAC 시퀀스가 시간/주파수 영역에서 나타나는 순서에 근거하여 해당 블록의 ID를 파악하며, 해당 블록 ID로부터 코드값을 복호해 내는 방법은 제3 실시예와 대동소이하다. 이하, 도 15를 참고로 수신측에서의 데이터 복호화 과정을 상세히 설명하기로 한다.

<106> 수신측에서는 시퀀스가 수신되면 해당 시퀀스를 구성하는 각 블록들의 시퀀스 ID를 파악하고(S1501), 이렇게 파악된 시퀀스 ID들로 구성되는 시퀀스 ID 세트에 대해 피크(peak)를 측정한다(S1502). 본 실시예에서는 하나의 블록이 표현하는 비트수가 2개이므로 00,01,10,11를 표현하기 위한 제1 시퀀스, 제2 시퀀스, 제3 시퀀스, 제4 시퀀스가 하나의 그룹을 형성하므로, 상기 측정 결과 발생 빈도가 높은 4개의 피크를 선택하여야 한다(S1503). 여기서, 선택된 각 피크들은 시간/주파수

영역에서 나타나는 순서에 따라 각각 제1 시퀀스, 제2 시퀀스, 제3 시퀀스, 제4 시퀀스로 매핑된다. 또한, 제1 시퀀스 내지 제4 시퀀스를 각각 소정의 그룹 ID로 표현하면, 코드값 00을 가리키는 제1 그룹 ID, 코드값 01을 가리키는 제2 그룹 ID, 코드값 10을 가리키는 제3 그룹 ID, 코드값 11을 가리키는 제4 그룹 ID로 구분할 수 있다. 결국, 상기 S1503 단계를 통해 각 블록의 그룹 ID를 파악할 수 있고(S154), 이를 통해 각 블록의 코드값을 찾아낼 수 있게 된다(S1508).

<107> 만약, 복호화 과정에서 오류가 발생하여 그룹 ID를 파악할 수 없는 시퀀스 ID들이 존재하는 경우, 해당 시퀀스 ID들의 세트에 대하여만 다시 피크를 탐색하고(S1505) 그 중 유력한 4개의 피크를 검색하여(S1506) 그로부터 그룹 ID를 다시 파악한다(S1507). 이어서, 파악된 그룹 ID들로 부터 해당 블록의 코드값을 찾아낼 수 있다(S1508).

<108> <제5 실시예>

<109> 제3 실시예 및 제4 실시예를 한층 더 확장하면 PPM(Pulse Position Modulation)을 통해 신호의 위치를 변화시킴으로써 시퀀스의 길이를 논리적으로 확장할 수 있다. 본래 PPM은 상대적인 펄스의 지연을 가지면서 데이터를 전송하는 기법이지만 시퀀스의 시작 위치를 기반으로 PPM을 적용한다. 본 실시예를 도 16을 참고하여 설명하면 다음과 같다.

<110> 기지국은 전송될 데이터의 비트수가 결정되면, 해당 데이터의 전송에 사용할 시퀀스를 선택하고 해당 시퀀스에 PPM을 적용하기 위한 블록의 길이 및 각 블록을 구성하는 구간의 길이를 결정한다. 원칙적으로 프리앰블을 생성할 때는 각 블록에

해당하는 시퀀스를 각각 별도로 생성해야 하지만, 본 실시예에서는 동일한 시퀀스에 대하여 해당 시퀀스를 구성하는 특정 블록 내의 특정 구간까지의 길이만큼 순환지연(circular shift)이 적용되므로, 각 시퀀스는 본래 동일한 것임에도 불구하고 상기 순환지연에 의해 서로 구분된다는 점에 특징이 있다.

<111> 예를 들어, 하나의 시퀀스를 4개의 블록(블록1~블록4)으로 구분하고 각 블록별로 2bit를 표현한다고 가정하면 "00, 01, 10, 11"의 값을 표현하기 위해 각 블록은 다시 4개의 구간(구간1~구간4)으로 나누어져야 한다. 이때, 하나의 블록에 포함된 4개의 구간은 해당 블록에 상응하는 시퀀스에 대한 순환지연의 시작 구분 위치로 이용된다. 만약, 전송할 프리앰블의 총 길이가 256 이라 하면, 블록1은 0~63, 블록2는 64~127, 블록3은 128~195, 블록4는 196~255까지의 순환지연 값을 가질 수 있다. 상기 프리앰블의 전송에 사용할 특정 시퀀스가 결정되고 블록1을 통해 "0 0"을 전송하는 경우 블록1의 구간1(0~15)에 시작 위치가 오도록 시퀀스1을 순환지연시키고, 블록2에 "1 0"을 전송하는 경우 블록2의 구간3(96~111)에 시작 위치가 오도록 시퀀스2를 순환지연시킨다. 이런 식으로 나머지 블럭에 대해서도 순환지연을 적용한 후 각 시퀀스(시퀀스1~시퀀스4)를 하나로 취합하여 하나의 프리앰블을 생성한다.

<112> 한편, 수신측에서는 전송받은 시퀀스를 데이터 처리하여 해당 시퀀스를 구성하는 각각의 서브 시퀀스(시퀀스1~시퀀스4)를 구분해내고 구분된 각 시퀀스에 대한 시작 위치를 찾아냄으로써 데이터를 복호화한다. 이를 도 17을 참고로 상세히 설명하면 다음과 같다.

<113> 수신측에 시퀀스가 수신되면(S1701) 해당 시퀀스의 ID를 검출하고(S1703), 검출된 결과를 이용하여 수신 신호(수신된 시퀀스) 전체에 대해 소정의 데이터 처리로 코럴레이션(correlation)을 수행한다(full correlation)(S1705). 이때, 상기 시퀀스 ID의 검출을 위해 전체 검색(full search) 알고리즘 또는 차이값 검색(differential search) 알고리즘이 사용될 수 있다.

<114> 수신된 신호는 송신측에서 다수의 시퀀스를 취합한 것이기 때문에 상기 코럴레이션(correlation) 과정을 거친 신호는 다수의 피크를 포함한다. 본 실시예에서는 4개의 피크가 검출되는데, 이와 같이 검출된 각 피크에 대하여 블록1~블록4 중 어떤 블록에 해당하는지, 그리고 해당 블록의 어떤 구간에 해당하는지를 판독함으로써(S1709) 원본 데이터의 비트 순서와 비트값을 복호화할 수 있다(S1711).

<115> 이상, RACH를 통해 프리앰블 시퀀스와 메시지를 효과적으로 전송하는 방법에 대해 살펴보았다. 마지막으로, 사용자 단말(User Equipment, UE)이 기지국(Node-B)에 프리앰블을 전송하여 양자 간에 동기화를 수행하는 과정을 두 가지 실시예로 구분하여 살펴보기로 한다. 이와 같은 두 가지 실시예에서 기지국으로 전송되는 프리앰블은 상기에서 설명한 제2 실시예 내지 제5 실시예 중 어느 하나의 방법을 통해 전송될 수 있으며, 여기에 제1 실시예가 선택적으로 더 적용될 수 있다.

<116> 첫 번째는 사용자 단말이 기지국에 한 번의 접근으로 동기화되는 방식이다. 즉, 사용자 단말이 기지국으로 프리앰블과 동기화에 필요한 정보를 포함하는 메시지를 전송하면(S1801), 기지국은 사용자 단말로 타이밍 정보를 전송함(S1803)과 동시에 업링크 데이터 전송을 위한 자원을 할당하고(S1805), 사용자 단말은 할당된

자원을 통해 업링크 데이터를 기지국에 전송한다(S1807).

<117> 두 번째는 동기화를 위해 사용자 단말이 기지국에 두 번 접근하는 방식이다. 즉, 사용자 단말이 기지국으로 프리앰블을 전송하면(S1811), 그에 따라 기지국은 사용자 단말로 타이밍 정보를 전송함과 동시에 스케줄링 요청을 위한 자원을 할당한다(S1813). 사용자 단말은 상기 할당받은 자원을 통해 기지국에 스케줄링 요청을 위한 메시지를 전송하고(S1815), 이를 접수한 기지국은 다시 사용자 단말에 업링크 데이터 전송을 위한 자원을 할당한다(S1817). 이와 같이 두 번째로 할당된 자원을 통해 사용자 단말은 기지국으로 업링크 데이터를 전송한다(S1819).

<118> 이상에서 설명한 본 발명은, 본 발명이 속하는 기술분야에서 통상의 지식을 가진 자에 있어 본 발명의 기술적 사상을 벗어나지 않는 범위 내에서 여러 가지 치환, 변형 및 변경이 가능하므로 전술한 실시예 및 첨부된 도면에 의해 한정되는 것이 아니다.

【발명의 효과】

<119> 본 발명에 의하면, 랜덤 액세스 채널에서 코드 시퀀스의 종래 장점을 그대로 유지하면서 해당 시퀀스의 전체 길이를 모두 활용할 수 있으므로 데이터 전송을 보다 효율적으로 수행할 수 있다. 또한, 코드 시퀀스에 소정의 데이터 처리를 가함으로써 전송할 정보량을 증대시키는 한편 노이즈나 채널에 강해지도록 할 수 있다.

【특허청구범위】

【청구항 1】

코드 시퀀스를 확장하여 데이터를 전송하는 방법에 있어서,

데이터 전송에 사용 가능한 코드 수가 추가되도록 상기 코드 시퀀스를 데이터 처리하는 단계; 및

상기 데이터 처리된 코드 시퀀스로 데이터를 수신측에 전송하는 단계

를 포함하는 랜덤 액세스 채널을 통한 데이터 송신 방법.

【청구항 2】

제1항에 있어서,

상기 코드 시퀀스는 CAZAC(Constant Amplitude Zero Autocorrelation) 시퀀스인 것을 특징으로 하는 랜덤 액세스 채널을 통한 데이터 송신 방법.

【청구항 3】

제2항에 있어서,

상기 데이터 처리는 상기 CAZAC 시퀀스에 소정의 지수(exponential) 시퀀스를 곱함으로써 수행되는 것을 특징으로 하는 랜덤 액세스 채널을 통한 데이터 송신 방법.

【청구항 4】

제3항에 있어서,

상기 데이터 처리는 해당 코드 시퀀스가 자기상관성(auto-correlation) 및

상호상관성(cross-correlation)을 그대로 유지하도록 수행되는 것을 특징으로 하는 랜덤 액세스 채널을 통한 데이터 송신 방법.

【청구항 5】

제1항 내지 제4항 중 어느 한 항에 있어서,

상기 코드 시퀀스는 프리앰블(preamble)로 이용되는 것을 특징으로 하는 랜덤 액세스 채널을 통한 데이터 송신 방법.

【청구항 6】

데이터 전송을 위한 코드 시퀀스를 확장하는 방법에 있어서,

상기 데이터를 구성하는 각 블록의 비트값에 따라 해당 블록에 상응하는 코드 시퀀스에 소정의 데이터 처리를 수행하는 단계; 및

상기 데이터 처리된 코드 시퀀스를 수신측에 전송하는 단계

를 포함하는 랜덤 액세스 채널을 통한 데이터 송신 방법.

【청구항 7】

제6항에 있어서,

상기 코드 시퀀스로 CAZAC(Constant Amplitude Zero Autocorrelation) 시퀀스가 이용되는 것을 특징으로 하는 랜덤 액세스 채널을 통한 데이터 송신 방법.

【청구항 8】

제7항에 있어서, 상기 코드 시퀀스의 데이터 처리는

상기 데이터를 구성하는 특정 블록의 비트값이 1인 경우, 해당 블록에 상응

하는 CAZAC 시퀀스를 켤레화(conjugation)하는 것임을 특징으로 하는 랜덤 액세스 채널을 통한 데이터 송신 방법.

【청구항 9】

제8항에 있어서,

긴 길이의 단일 CAZAC 시퀀스에 있어서 비트값이 1인 블록에 상응하는 일부분이 켤레화(conjugation)되는 것임을 특징으로 하는 랜덤 액세스 채널을 통한 데이터 송신 방법.

【청구항 10】

제8항에 있어서,

짧은 길이의 다수의 CAZAC 시퀀스 중에서 비트값이 1인 블록에 상응하는 특정 CAZAC 시퀀스가 켤레화(conjugation)되는 것임을 특징으로 하는 랜덤 액세스 채널을 통한 데이터 송신 방법.

【청구항 11】

전송 데이터를 구성하는 각 블록의 비트값에 따라 켤레화(conjugation)가 수행되어 전송된 코드 시퀀스를 복호화하는 방법에 있어서,

수신된 데이터에 있어서, 첫 번째 블록에 대한 초기 피크(peak)를 추정하는 제1단계;

피크 추정이 수행된 블록과 다음 순번의 블록에 대해 피크(peak)를 추정하는 제2단계;

마지막 순번의 블록에 이르기까지 상기 제2단계를 반복하는 제3단계

를 포함하는 랜덤 액세스 채널을 통한 데이터 수신 방법.

【청구항 12】

제11항에 있어서,

상기 첫 번째 블록은 항상 0으로 설정되어 수신되는 것을 특징으로 하는 랜덤 액세스 채널을 통한 데이터 수신 방법.

【청구항 13】

제12항에 있어서, 상기 제2단계는

피크 추정이 수행된 블록과 다음 순번의 블록에 대해 켤레화(conjugation)되었음을 전제로 제1피크(peak)를 추정하는 제2-1단계;

동일한 블록들에 대해 켤레화(conjugation)가 되지 않았음을 전제로 제2피크(peak)를 추정하는 제2-2단계; 및

상기 제1피크와 제2피크 중 큰 쪽을 해당 블록들의 피크로 결정하는 제2-3단계를 포함하는 랜덤 액세스 채널을 통한 데이터 수신 방법.

【청구항 14】

데이터 전송을 위한 코드 시퀀스를 확장하는 방법에 있어서,

상기 데이터를 구성하는 각 블록의 값에 따라 특정 시퀀스가 선택되는 단계; 및

상기 선택된 시퀀스들로 이루어진 코드 시퀀스를 수신측에 전송하는 단계

를 포함하는 랜덤 액세스 채널을 통한 데이터 송신 방법.

【청구항 15】

제14항에 있어서,

상기 코드 시퀀스로 CAZAC(Constant Amplitude Zero Autocorrelation) 시퀀스가 이용되는 것을 특징으로 하는 랜덤 액세스 채널을 통한 데이터 송신 방법.

【청구항 16】

제15항에 있어서,

상기 코드 시퀀스는 상기 데이터를 구성하는 각 블록의 비트수 n(n=1, 2, 3...)에 따라 2^n개의 서로 다른 시퀀스를 포함하는 그룹으로 이루어지며,

상기 특정 시퀀스의 선택은 각 블록의 비트값에 상응하는 특정 시퀀스를 상기 그룹에서 선택하는 것임을 특징으로 하는 랜덤 액세스 채널을 통한 데이터 송신 방법.

【청구항 17】

제16항에 있어서,

상기 선택된 각 시퀀스가 서로 독립성을 유지하면서 중첩되도록 데이터 처리를 수행하는 단계를 더 포함하는 랜덤 액세스 채널을 통한 데이터 송신 방법.

【청구항 18】

제17항에 있어서,

상기 선택된 각 시퀀스는 소정 간격의 딜레이를 두고 순차적으로 중첩되도록

데이터 처리되는 것을 특징으로 하는 랜덤 액세스 채널을 통한 데이터 송신 방법.

【청구항 19】

제16항 또는 제17항에 있어서,

상기 그룹에 포함되는 시퀀스는 전체 블록 길이의 단일 CAZAC 시퀀스가 사용되는 것을 특징으로 하는 랜덤 액세스 채널을 통한 데이터 송신 방법.

【청구항 20】

제16항 또는 제17항에 있어서,

상기 그룹에 포함되는 시퀀스는 단일 블록 길이의 짧은 CAZAC 시퀀스가 사용되는 것을 특징으로 하는 랜덤 액세스 채널을 통한 데이터 송신 방법.

【청구항 21】

그룹화된 시퀀스 중 특정 시퀀스의 선택를 통해 확장되는 코드 시퀀스를 이용하여 전송된 데이터를 복호화하는 방법에 있어서,

수신된 데이터의 블록별 시퀀스 ID(sequence ID)를 파악하는 단계;

상기 파악된 코드 시퀀스 ID들의 세트로부터 각 블록의 그룹 ID(group ID)를 파악하는 단계; 및

상기 파악된 그룹 ID로부터 데이터값을 복호화하는 단계

를 포함하는 랜덤 액세스 채널을 통한 데이터 수신 방법.

【청구항 22】

제21항에 있어서, 상기 그룹 ID 파악 단계는

상기 파악된 코드 시퀀스 ID들의 세트로부터 피크(peak)를 측정하는 단계; 및

상기 측정된 피크 중 발생 빈도가 높은 2개의 피크로부터 각 블록의 그룹 ID를 파악하는 단계

를 포함하는 랜덤 액세스 채널을 통한 데이터 수신 방법.

【청구항 23】

제22항에 있어서,

그룹 ID가 파악되지 않은 코드 시퀀스 ID들의 세트에 대하여 상기 피크 추정 단계를 반복함으로써 그룹 ID를 재파악하는 단계를 더 포함하는 랜덤 액세스 채널을 통한 데이터 수신 방법.

【청구항 24】

제21항에 있어서, 상기 그룹 ID 파악 단계는

각 코드 시퀀스 ID들의 세트에 대하여 피크(peak)를 추정하는 단계; 및

상기 추정된 피크 중 발생 빈도가 높은 2^n(n=1,2,3...)개의 피크로부터 각 블록의 그룹 ID를 파악하는 단계

를 포함하는 랜덤 액세스 채널을 통한 데이터 수신 방법.

【청구항 25】

제24항에 있어서,

그룹 ID가 파악되지 않은 코드 시퀀스 ID들의 세트에 대하여 상기 피크 추정

단계를 반복함으로써 그룹 ID를 재파악하는 단계를 더 포함하는 랜덤 액세스 채널을 통한 데이터 수신 방법.

【청구항 26】

데이터 전송을 위한 코드 시퀀스를 확장하는 방법에 있어서,

상기 데이터를 구성하는 각 블록에 상응하는 시퀀스들이 해당 블록의 값을 표시하도록 각각의 시퀀스를 데이터 처리하는 단계; 및

상기 데이터 처리된 각 시퀀스를 중첩하여 수신측으로 전송하는 단계

를 포함하는 랜덤 액세스 채널을 통한 데이터 송신 방법.

【청구항 27】

제26항에 있어서,

상기 코드 시퀀스로 CAZAC(Constant Amplitude Zero Autocorrelation) 시퀀스가 이용되는 것을 특징으로 하는 랜덤 액세스 채널을 통한 데이터 송신 방법.

【청구항 28】

제27항에 있어서,

상기 전송 데이터를 구성하는 각 블록은 해당 블록의 비트수 n(n=1, 2, 3...)에 따라 2^n개의 구간으로 구분되고,

상기 데이터 처리는 특정 블록의 특정 구간이 시작점이 되도록 해당 블록에 상응하는 시퀀스를 변조(modulation)하는 것임을 특징으로 하는

【청구항 29】

제28항에 있어서,

상기 변조 방법으로 PPM(Pulse Position Modulation)이 이용되는 것을 특징으로 하는 랜덤 액세스 채널을 통한 데이터 송신 방법.

【청구항 30】

전송 데이터를 구성하는 블록에 대한 시퀀스 각각에 대해 PPM을 수행하여 중첩시킨 데이터를 수신하고 이를 복호화하는 방법에 있어서,

수신된 데이터에 대한 시퀀스 ID를 검출하는 단계;

상기 검출된 시퀀스 ID에 해당하는 미리 준비된 시퀀스를 이용하여 수신 데이터를 코럴레이션(correlation) 하는 단계;

상기 코럴레이션된 데이터로부터 해당 데이터를 구성하는 블록 개수만큼의 피크(peak)를 측정하는 단계; 및

상기 측정된 피크를 이용하여 각 블록에 대한 데이터값을 복호화하는 단계

를 포함하는 랜덤 액세스 채널을 통한 데이터 수신 방법.

【청구항 31】

제30항에 있어서,

상기 시퀀스로 CAZAC(Constant Amplitude Zero Autocorrelation) 시퀀스가 이용되는 것을 특징으로 하는 랜덤 액세스 채널을 통한 데이터 송신 방법.

【청구항 32】

제30항 또는 제31항에 있어서, 상기 데이터값 복호화 단계는

측정된 각 피크가 어떤 블록의 어떤 구간에 속하는지를 판독함으로써 데이터 비트의 순서와 데이터 비트의 내용을 복호화하는 것을 특징으로 하는 랜덤 액세스 채널을 통한 데이터 송신 방법.

【도면】

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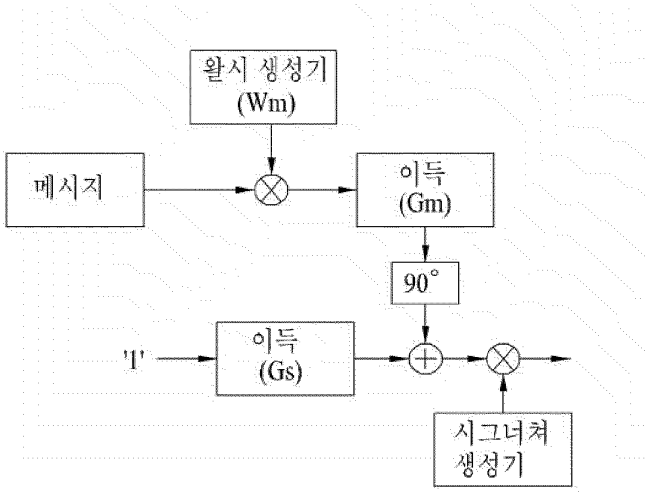

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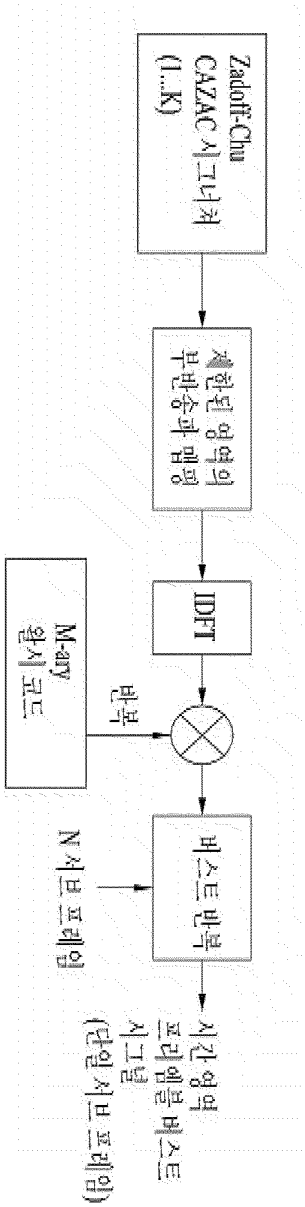
Zadoff-Chu
CAZAC 시그너쳐
(1...K)
제한된 영역의
부반송파 맵핑
IDFT
M-ary
왈시 코드
반복
버스트 반복
N 서브 프레임
시간 영역
프리앰블 버스트
시그널
(단일 서브 프레임)

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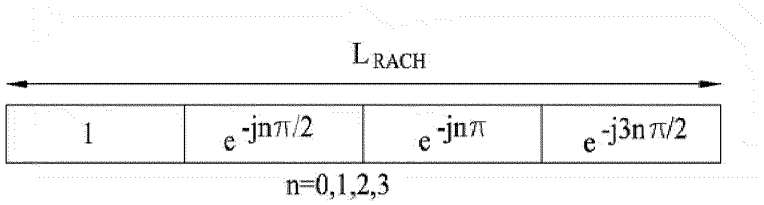

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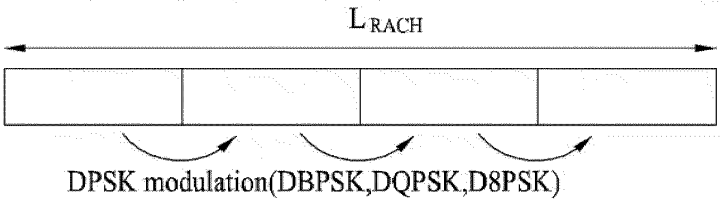

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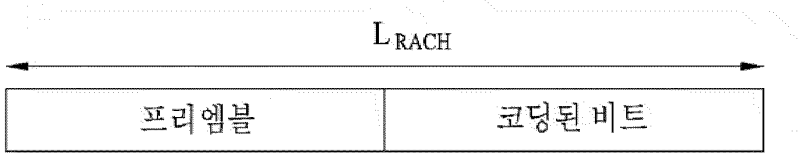

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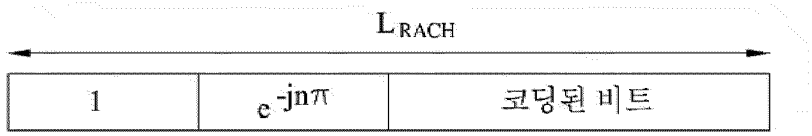

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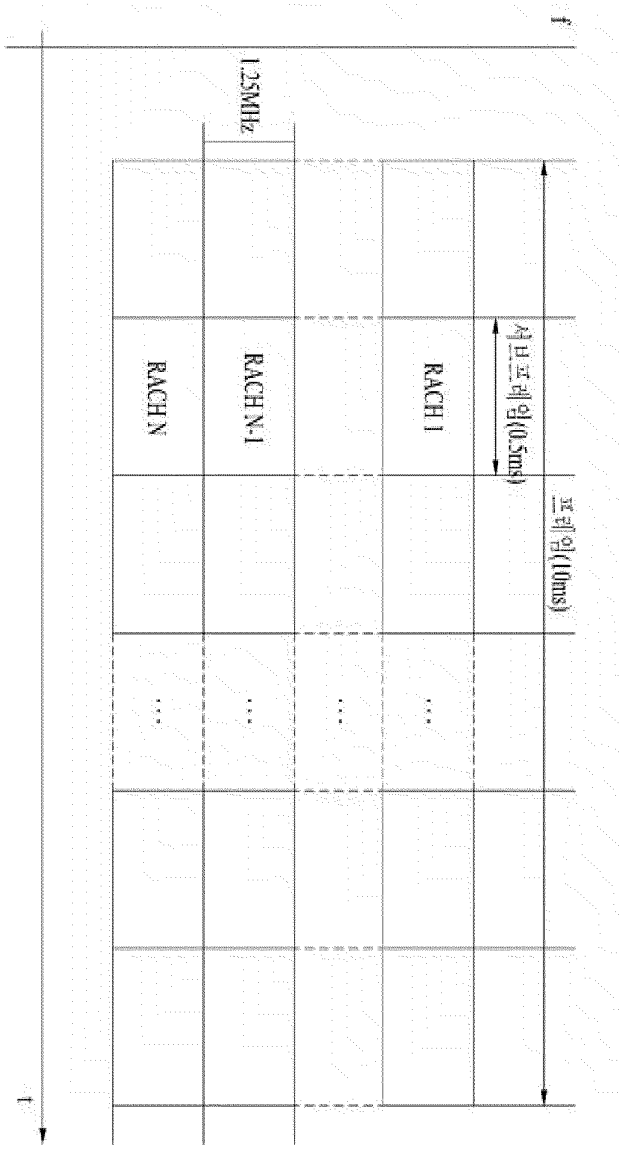

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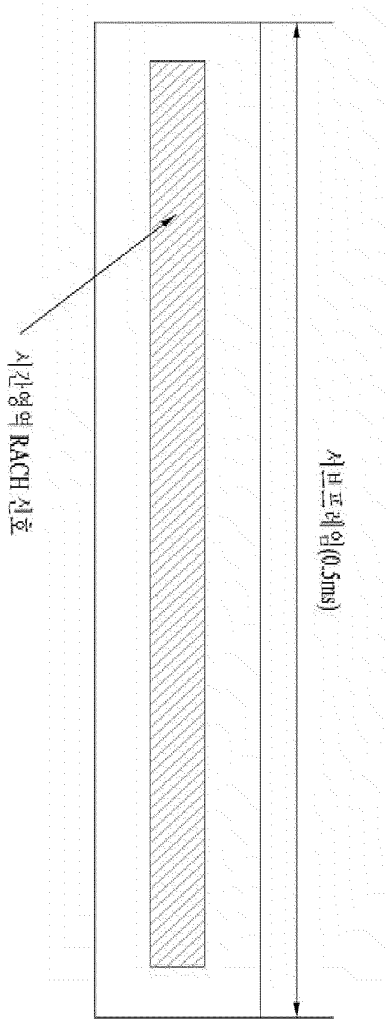

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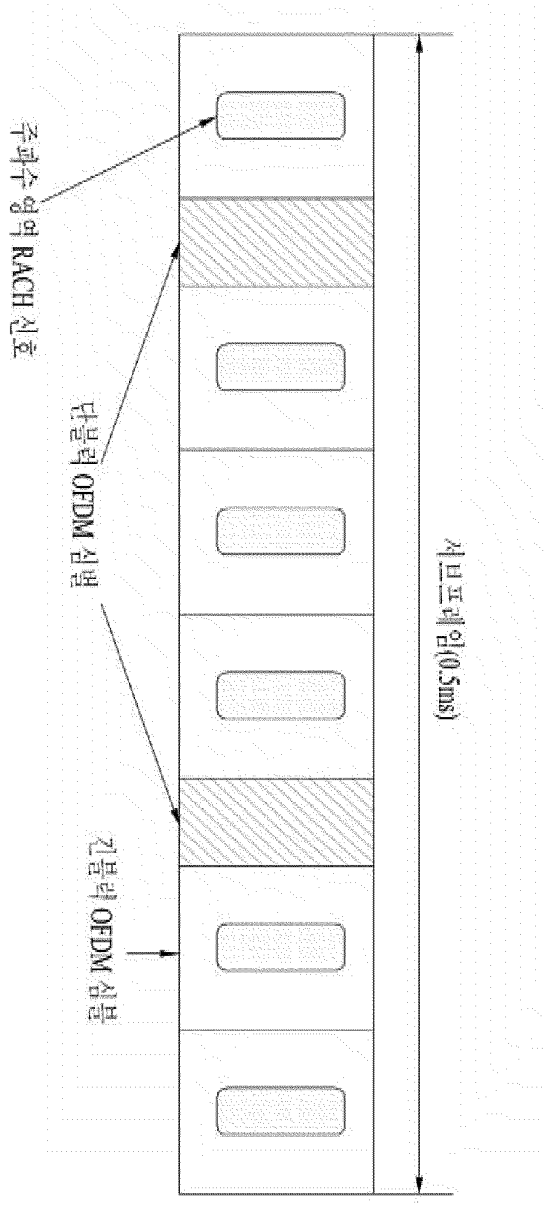

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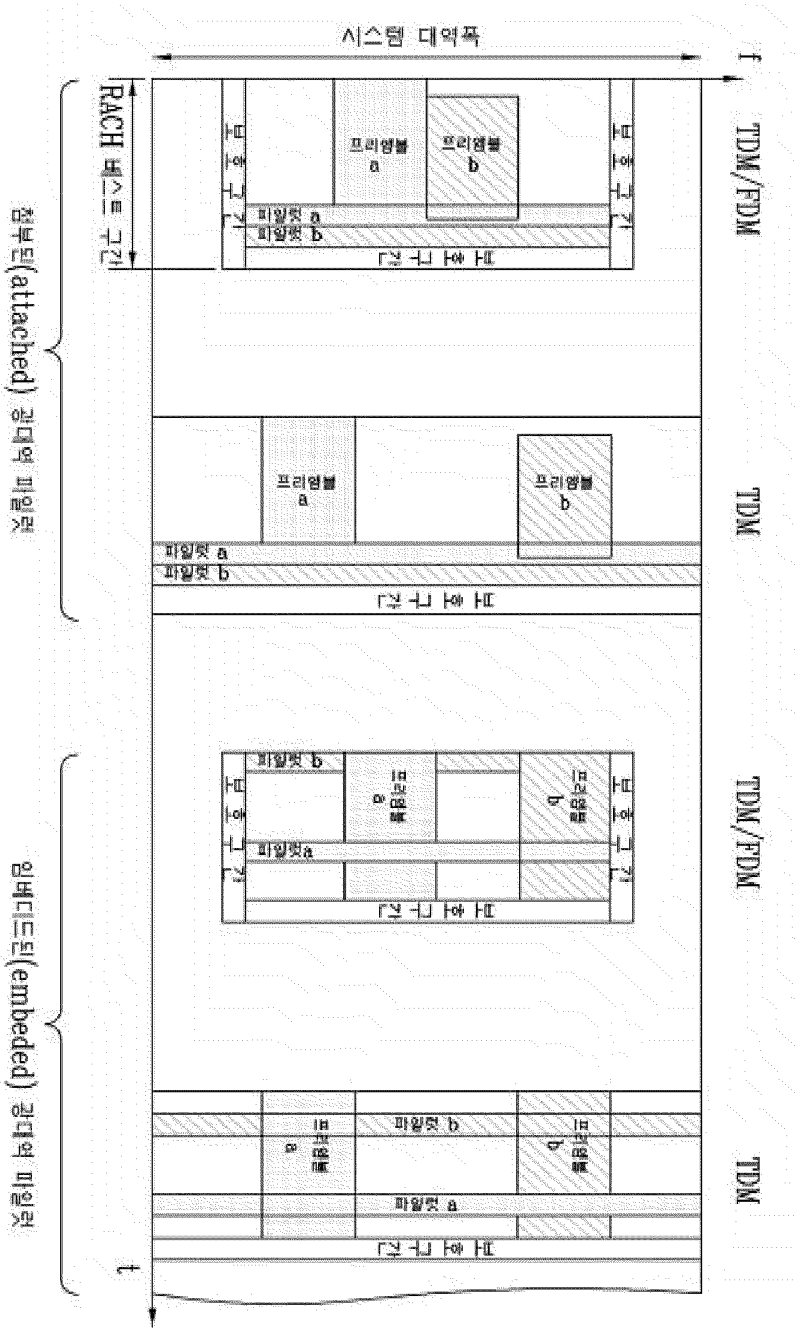
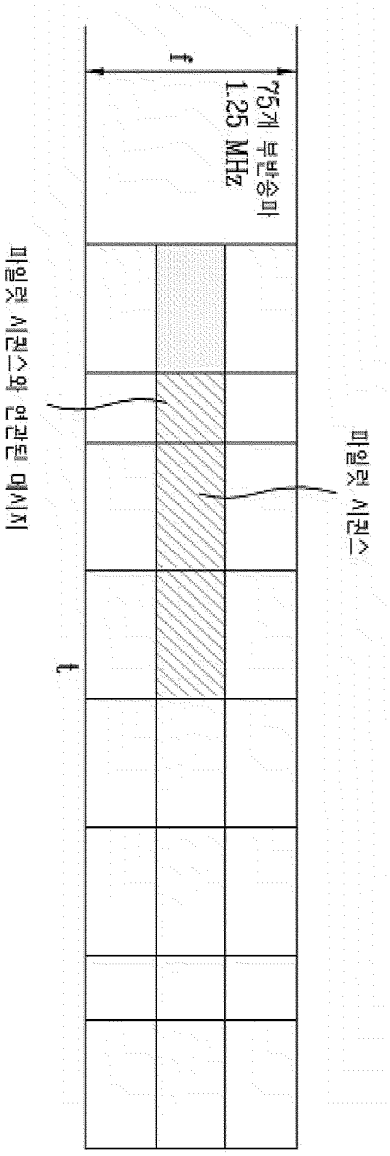
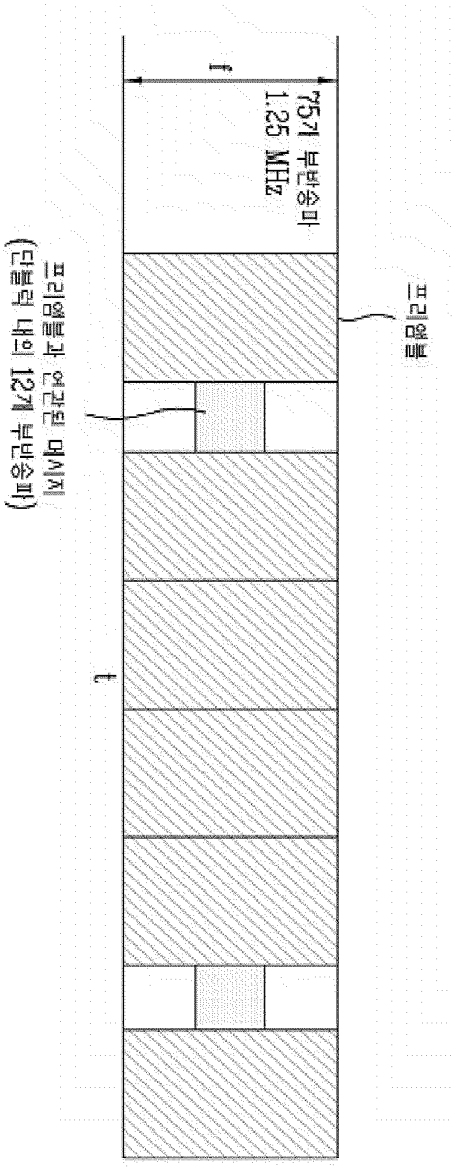

시스템 대역폭
f
t
RACH 채널 구간
프리앰블 a
프리앰블 b
파일럿 a
파일럿 b
보호구간
데이터 구간
TDM/FDM
TDM
TDM/FDM
TDM
첨부된(attached) 광대역 파일럿
임베디드(embeded) 광대역 파일럿

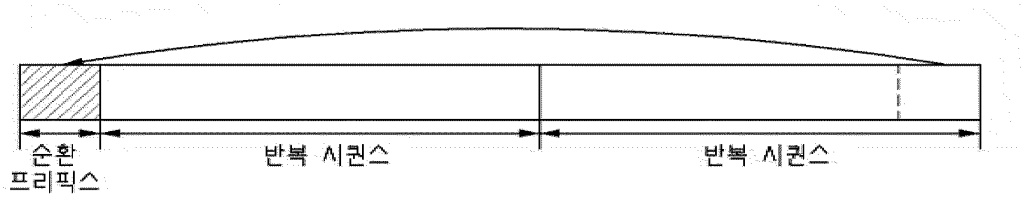
【도 8a】



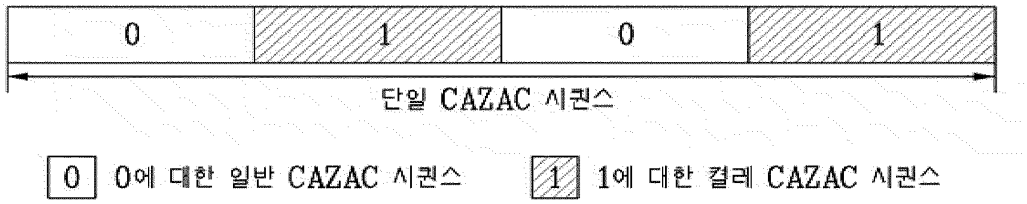
【도 8b】



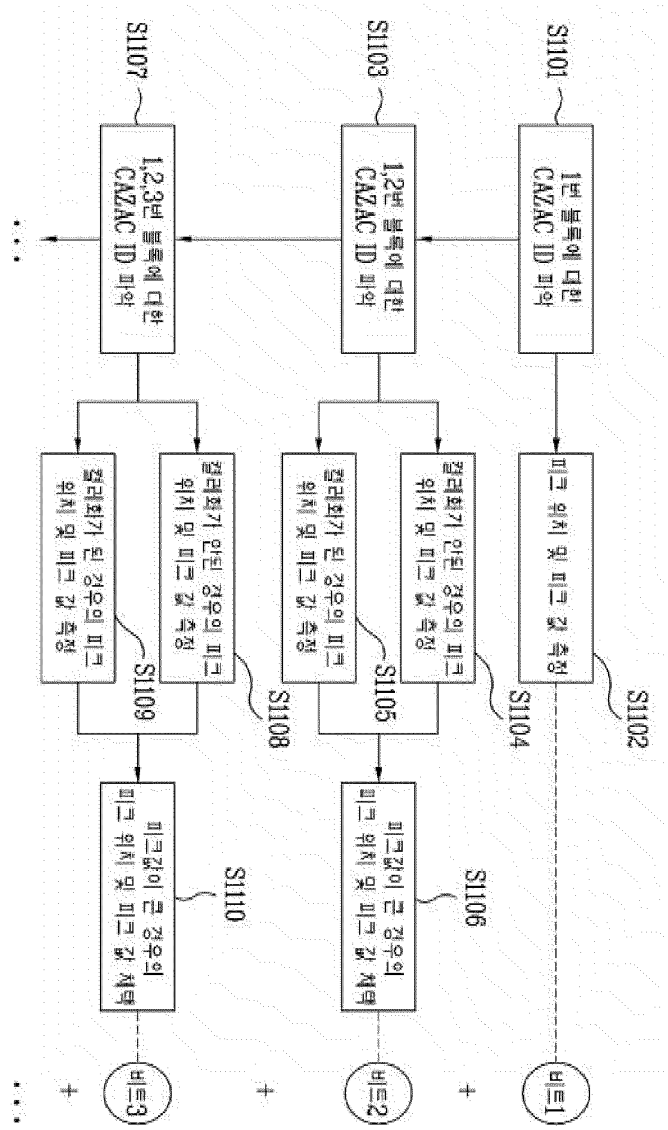
【도 9】


순환
프리픽스
반복 시퀀스
반복 시퀀스

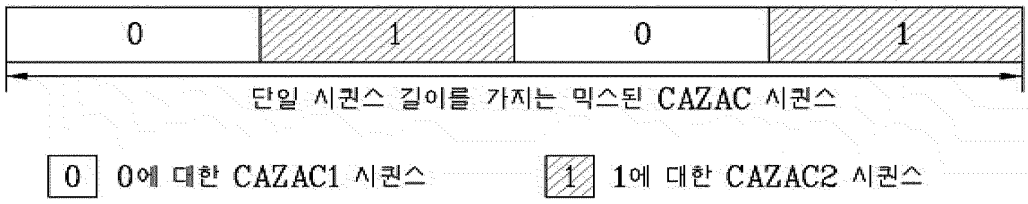
【도 10】


0
1
0
1
단일 CAZAC 시퀀스
0 0에 대한 일반 CAZAC 시퀀스
1 1에 대한 컬레 CAZAC 시퀀스

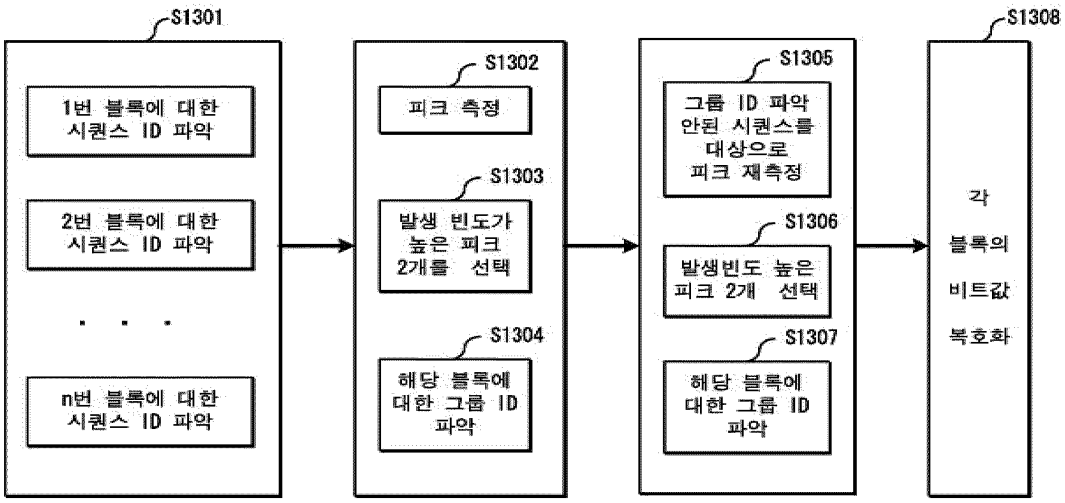
【도 11】


S1101
1번 블록에 대한 CAZAC ID 파악
S1103
1,2번 블록에 대한 CAZAC ID 파악
S1107
1,2,3번 블록에 대한 CAZAC ID 파악
피크 위치 및 피크 값 측정
S1102
컬러화기 안된 경우의 피크 위치 및 피크 값 측정
S1104
컬러화기 된 경우의 피크 위치 및 피크 값 측정
S1105
컬러화기 안된 경우의 피크 위치 및 피크 값 측정
S1108
컬러화기 된 경우의 피크 위치 및 피크 값 측정
S1109
비트1
비트2
비트3
피크값이 큰 경우의 피크 위치 및 피크 값 저장
S1106
피크값이 큰 경우의 피크 위치 및 피크 값 저장
S1110

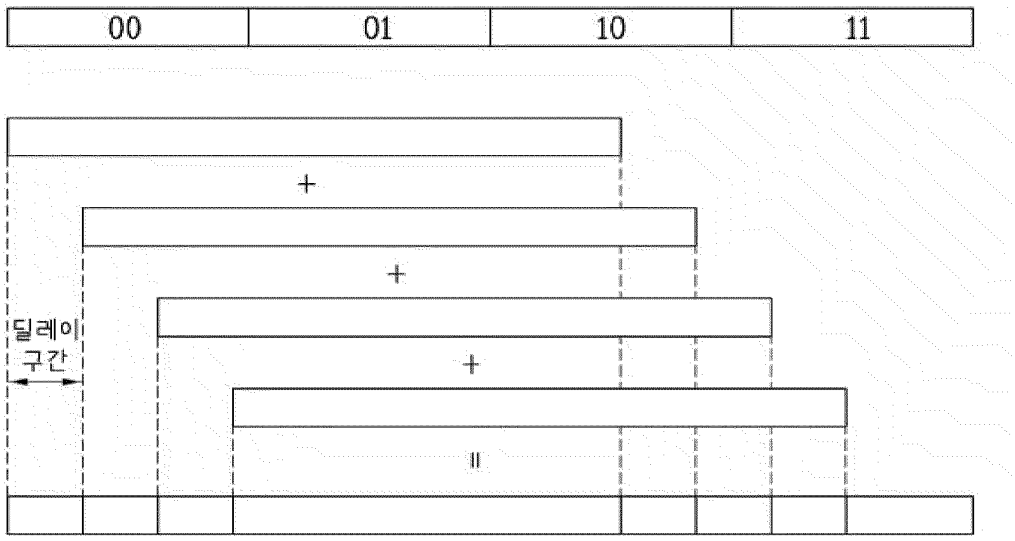
【도 12】


0
1
0
1
단일 시퀀스 길이를 가지는 믹스된 CAZAC 시퀀스
0 0에 대한 CAZAC1 시퀀스
1 1에 대한 CAZAC2 시퀀스

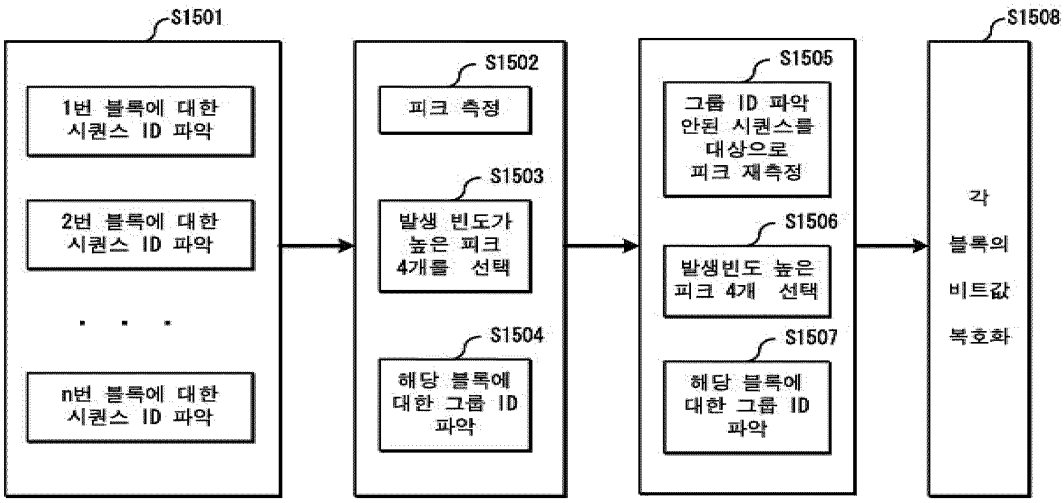
【도 13】


S1301
1번 블록에 대한 시퀀스 ID 파악
2번 블록에 대한 시퀀스 ID 파악
n번 블록에 대한 시퀀스 ID 파악
S1302
피크 측정
S1303
발생 빈도가 높은 피크 2개를 선택
S1304
해당 블록에 대한 그룹 ID 파악
S1305
그룹 ID 파악 안된 시퀀스를 대상으로 피크 재측정
S1306
발생빈도 높은 피크 2개 선택
S1307
해당 블록에 대한 그룹 ID 파악
S1308
각 블록의 비트값 복호화

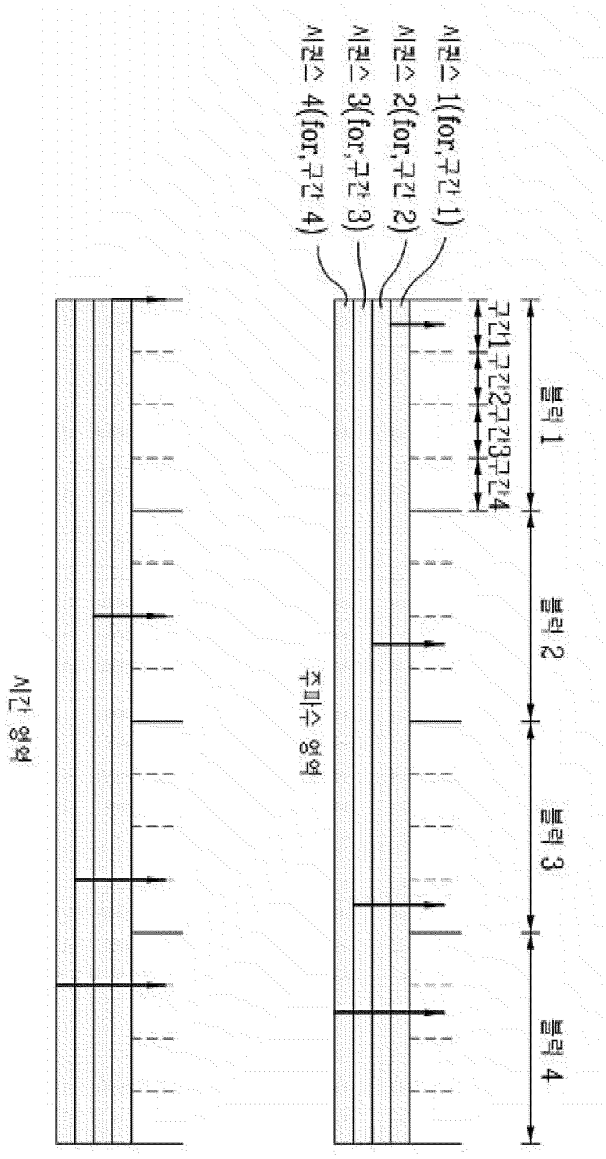
【도 14】


00
01
10
11
딜레이
구간

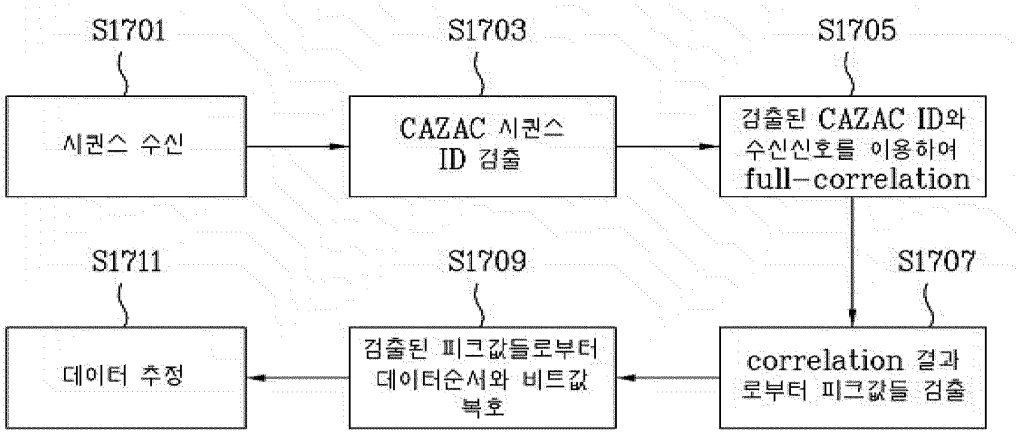
【도 15】


S1501
1번 블록에 대한 시퀀스 ID 파악
2번 블록에 대한 시퀀스 ID 파악
n번 블록에 대한 시퀀스 ID 파악
S1502
피크 측정
S1503
발생 빈도가 높은 피크 4개를 선택
S1504
해당 블록에 대한 그룹 ID 파악
S1505
그룹 ID 파악 안된 시퀀스를 대상으로 피크 재측정
S1506
발생빈도 높은 피크 4개 선택
S1507
해당 블록에 대한 그룹 ID 파악
S1508
각 블록의 비트값 복호화

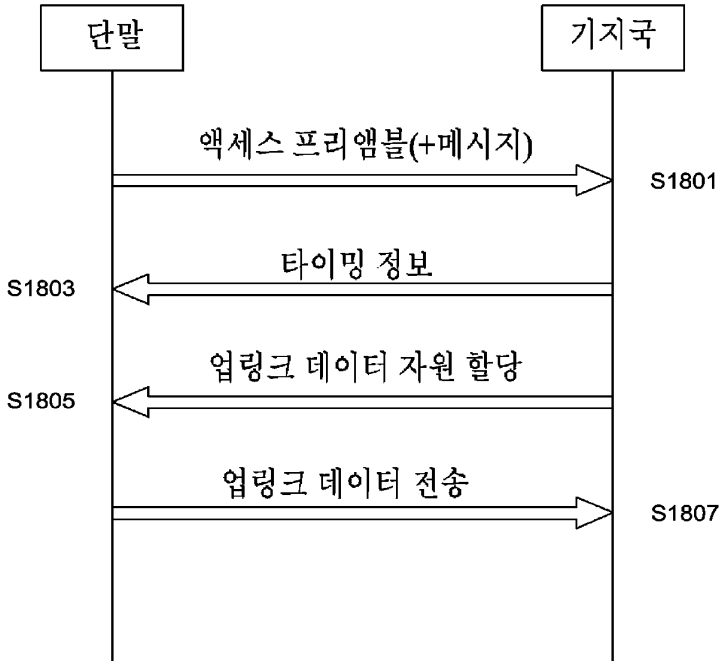
【도 16】


시퀀스 1(for,구간 1)
시퀀스 2(for,구간 2)
시퀀스 3(for,구간 3)
시퀀스 4(for,구간 4)
구간1,구간2,구간3,구간4
블럭 1
블럭 2
블럭 3
블럭 4
주파수 영역
시간 영역

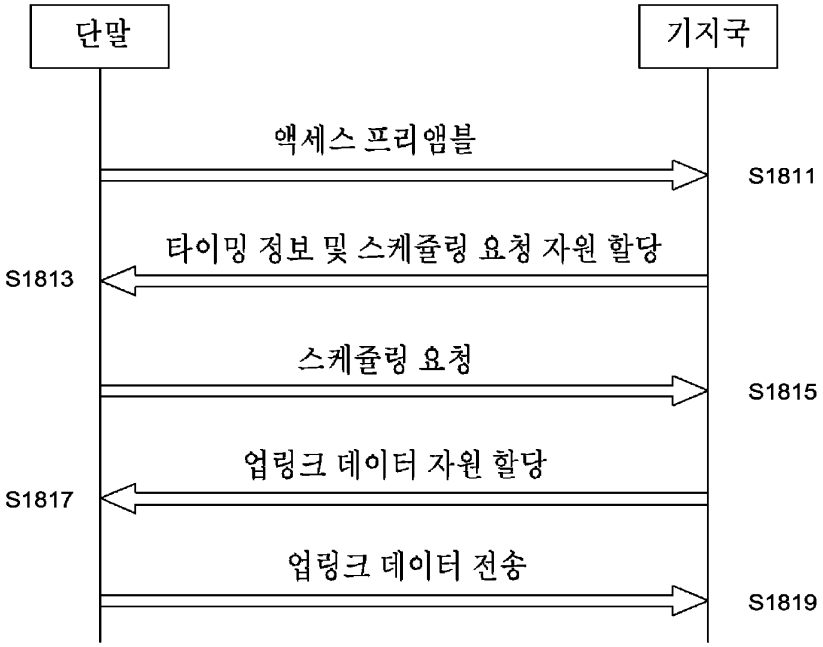
【도 17】


S1701
시퀀스 수신
S1703
CAZAC 시퀀스 ID 검출
S1705
검출된 CAZAC ID와 수신신호를 이용하여 full-correlation
S1707
correlation 결과로부터 피크값들 검출
S1709
검출된 피크값들로부터 데이터순서와 비트값 복호
S1711
데이터 추정

【도 18a】


단말
기지국
액세스 프리앰블(+메시지)
S1801
타이밍 정보
S1803
업링크 데이터 자원 할당
S1805
업링크 데이터 전송
S1807

【도 18b】


단말
기지국
액세스 프리앰블
S1811
타이밍 정보 및 스케쥴링 요청 자원 할당
S1813
스케쥴링 요청
S1815
업링크 데이터 자원 할당
S1817
업링크 데이터 전송
S1819