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
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

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

I hereby appoint:

■ Practitioners associated with Customer Number: 24374

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: 24374

OR

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

Assignee Name and Address: InterDigital Technology Corporation
200 Bellevue Parkway
Suite 300
Wilmington, DE 19809

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	[signature]	Date	17-JAN-2013
Name	Bradley N. Ditty	Telephone	
Title	Senior Patent Executive		

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

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/96 (08-12)
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 of1995, no persons arerequired 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: InterDigital Technology Corporation

Application No./Patent No.: _____ Filed/Issue Date: _____

Titled: SUPPORTING ENHANCED UPLINK TRANSMISSION DURING SOFT HANDOVER

InterDigital Technology Corporation, 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 018603, Frame 0910, or for which a copy thereof is attached.

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

   1. From: _____ To: _____

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

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

   2. From: _____ To: _____

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

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

This collection of information is required by37 CFR3.73(b). The information is required toobtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentialityis governed by35 U.S.C. 122and 37 CFR1.11 and1.14. Thiscollection is estimated to take 12 minutes to complete, including gathering, preparing, and submittingthe 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 tothe Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS.**SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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

STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

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

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

4. From: _____ To: _____

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

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

5. From: _____ To: _____

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

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

6. From: _____ To: _____

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

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

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

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

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

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

/Thomas A. Mattioli/	June 3, 2013
Signature	Date
Thomas A. Mattioli	56773
Printed or Typed Name	Title or Registration Number

Privacy Act Statement

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

The informationprovided 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 informationin 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 InternationalApplication 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, arecord 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 thissystem of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	SUPPORTING ENHANCED UPLINK TRANSMISSION DURING SOFT HANDOVER
First Named Inventor/Applicant Name:	Guodong Zhang
Filer:	Thomas A Mattioli/Angel Wolf
Attorney Docket Number:	I-2-0674US05

Filed as Large Entity

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Utility application filing	1011	1	280	280
Utility Search Fee	1111	1	600	600
Utility Examination Fee	1311	1	720	720
Pages:				
Claims:				
Miscellaneous-Filing:				
Late Filing Fee for Oath or Declaration	1051	1	140	140
Petition:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1740**

Electronic Acknowledgement Receipt

EFS ID:	15928329
Application Number:	13908242
International Application Number:	
Confirmation Number:	5287
Title of Invention:	SUPPORTING ENHANCED UPLINK TRANSMISSION DURING SOFT HANDOVER
First Named Inventor/Applicant Name:	Guodong Zhang
Customer Number:	24374
Filer:	Thomas A Mattioli/Angel Wolf
Filer Authorized By:	Thomas A Mattioli
Attorney Docket Number:	I-2-0674US05
Receipt Date:	03-JUN-2013
Filing Date:	
Time Stamp:	14:19:32
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$1740
RAM confirmation Number	633
Deposit Account	090435
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 1.16 (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)

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		20130603_I_2_0674US05_Application.PDF	81371 eec72c659eed5adfba35aa0c1079a8b6dbf4089b	yes	15
	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Specification		1	12	
	Claims		13	14	
	Abstract		15	15	
Warnings:					
Information:					
2	Application Data Sheet	20130603_I_2_0674US05_ADS.PDF	1504246 b1b5609d48afc12a5923c4ac486c3e63aca95e9e	no	8
Warnings:					
Information:					
3	Drawings-only black and white line drawings	20130603_I_2_0674US05_Drawings.PDF	572580 cbb32b362090f118e5b1919883323088a31b97c4	no	4
Warnings:					
The page size in the PDF is too large. The pages should be 8.5 x 11 or A4. If this PDF is submitted, the pages will be resized upon entry into the Image File Wrapper and may affect subsequent processing					
Information:					
4	Power of Attorney	20130603_I_2_0674US05_POA.PDF	86478 5ed1518773f91b63dae06ef035808c0119cce7ad	no	1
Warnings:					
Information:					
5	Assignee showing of ownership per 37 CFR 3.73.	20130603_I_2_0674US05_373cStatement.PDF	117767 015e2ed2a3a660ed0c7ba41e52e5d9f23c6378a0	no	3
Warnings:					
Information:					
6	Fee Worksheet (SB06)	fee-info.pdf	36605 e1b347e98fcbda7d07e32f41b0e5a3211ca2f062	no	2
Warnings:					

Information:	
Total Files Size (in bytes):	2399047

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.

SUPPORTING ENHANCED UPLINK TRANSMISSION DURING SOFT HANDOVER

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. Patent Application No. 13/308,950 filed on December 1, 2011, which is a continuation of U.S. Patent Application No. 11/434,330 filed on May 15, 2006, now U.S. Patent 8,130,720 issued on March 6, 2012, which is a continuation of U.S. Patent Application No. 10/962,720 filed October 12, 2004, now U.S. Patent 7,046,648 issued on May 16, 2006, which claims the benefit of U.S. Provisional Application Serial Nos. 60/578,674 filed June 10, 2004; 60/520,692 filed November 17, 2003; 60/519,990 filed November 14, 2003; and 60/517,656 filed November 5, 2003, which are incorporated by reference as if fully set forth.

FIELD OF INVENTION

[0002] The present invention is related to a wireless communication system. More particularly, the present invention is related to a method and apparatus for coordinating Node-Bs and supporting enhanced uplink (EU) transmissions during handover.

BACKGROUND

[0003] Many schemes have been proposed to improve coverage, throughput, and transmission latency for EU transmissions in third generation partnership project (3GPP). One of the developments is to move the functions for scheduling and assigning uplink (UL) physical channel resources from a radio network controller (RNC) to a Node-B. A Node-B can make more efficient decisions and manage UL radio resources on a short-term basis better than the RNC, even if the RNC retains overall control over Node-Bs. A similar approach has already been adopted in downlink for high speed data packet access (HSDPA) in both universal mobile telecommunication system (UMTS) frequency division duplex (FDD) and time division duplex (TDD) modes.

[0004] It has also been recognized that performance is greatly enhanced with the

use of medium access control (MAC) level automatic repeat request (ARQ) and hybrid ARQ (H-ARQ). Application of these techniques during soft handover provides additional significant benefits.

[0005] Figure 1 shows a conventional wireless multi-cell communication system 100 including a wireless transmit/receive unit (WTRU) 105, a Node-B 110, an RNC 115, and at least two cells 120A, 120B. Each of the cells 120A, 120B, is served by the Node-B 110. Node-B 110 is controlled by the RNC 115. When a change in the cell offering the best radio conditions is determined between cells 120A and 120B, a handover process is initiated.

[0006] An "intra-Node-B handover" occurs when a WTRU changes from one cell to another cell controlled by the same Node-B, as shown in Figure 1. An "inter-Node-B handover" occurs when a WTRU changes from one cell to another cell controlled by a different Node-B. In the latter case, the Node-B that controls the cell before the handover is called a source Node-B, and the Node-B that controls the cell after the handover is called a target Node-B.

[0007] During soft handover, a WTRU establishes a plurality of connections with a plurality of Node-Bs in an active set. In this situation, a problem may arise for scheduling and H-ARQ operation. A WTRU may receive conflicting EU transmission scheduling from more than one Node-B. It is also difficult for the WTRU to receive, decode and process H-ARQ positive and negative acknowledgements (ACKs/NACKs) generated by a plurality of Node-Bs. The soft buffer of an H-ARQ process in Node-Bs may be corrupted during soft handover.

[0008] One method to support H-ARQ across multiple Node-Bs, when the WTRU is in soft handover, is to place the ACK/NACK generation function in the RNC, which derives a single ACK/NACK based on the results from the multiple Node-Bs. However, this approach presents a significant delay to the ACK/NACK process, which is highly undesirable for performance reasons.

[0009] When a WTRU undergoes an inter-Node-B hard handover, there is a possibility that a source Node-B, which is a Node-B before hard handover is completed, may not successfully receive EU transmissions for data packets that have been

NACKed prior to hard handover activation time. Other WTRUs competing for UL resources may not be provided with enough physical resources in the source cell. If data blocks that have been NACKed prior to the handover are retransmitted to the source Node-B before the handover activation timer expires, those data blocks can be combined with the previous data blocks for H-ARQ decoding. In this way, the decoding takes the advantage of previous, although failed, transmissions of those data blocks in the source cell. If data blocks that have been NACKed prior to the handover are not retransmitted to the source Node-B before the handover activation timer is expired, they have to be transmitted again in the target cell as new data blocks. In this case, the previous transmissions of those data blocks in the source cell are not utilized.

SUMMARY

[0010] An enhanced uplink user equipment is in soft handover. A radio network controller selects a primary Node-B out of a plurality of Node-Bs supporting the soft handover. The radio network controller receiving successfully received enhanced uplink data packets from the plurality of Node-Bs. The radio network controller reordered the successfully received enhanced uplink data packets for in-sequence deliver. The primary Node-B sends specified scheduling information to the user equipment that the other Node-Bs does not transmit. At least the primary Node-B transmits acknowledgements and negative acknowledgements to the user equipment.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] A more detailed understanding of the invention may be had from the following description, given by way of example and to be understood in conjunction with the accompanying drawings wherein:

[0012] Figure 1 shows a conventional wireless communication system;

[0013] Figure 2 shows a system which uses a UL scheduler located in a primary Node-B during soft handover for EU in accordance with the present invention;

[0014] Figure 3 shows a system which uses an ACK/NACK generation function located in a primary Node-B during soft handover for EU in accordance with the

present invention;

[0015] Figure 4 is a flowchart of a process including method steps for coordinating Node-Bs during soft handover in accordance with one embodiment of the present invention; and

[0016] Figure 5 is a flowchart of a process including method steps for prioritizing the transmission of NACKed data in a source Node-B before hard handover is completed in accordance with a separate embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0017] The present invention will be described with reference to the drawing figures wherein like numerals represent like elements throughout.

[0018] Hereafter, the terminology "WTRU" includes but is not limited to a user equipment (UE), a mobile station, a fixed or mobile subscriber unit, a pager, or any other type of device capable of operating in a wireless environment.

[0019] When referred to hereafter, the terminology "Node-B" includes but is not limited to a base station, a site controller, an access point or any other type of interfacing device in a wireless environment.

[0020] The present invention may be implemented in any type of wireless communication systems, such as UMTS - FDD, TDD, time division synchronous code division multiple access (TDSCDMA), code division multiple access 2000 (CDMA2000) (EV-DO and EV-DV) or any other type of wireless communication system.

[0021] The features of the present invention may be incorporated into an IC or be configured in a circuit comprising a multitude of interconnecting components.

[0022] Figure 2 shows a wireless multi-cell communication system 200 which uses a UL scheduler located in a primary Node-B in accordance with the present invention. The wireless multi-cell communication system 200 includes a WTRU 205, a plurality of Node-Bs 210 (i.e., 210A, 210B), an RNC 215 and a plurality of cells 260 (i.e., 260A, 260B, 260C). Cells 260A and 260C are served by the Node-B 210A. Cells 260B are served by the Node-Bs 210B. All of the Node-Bs 210 are controlled by the RNC 215.

[0023] During soft handover, the WTRU 205 establishes multiple connections with the Node-Bs 210 included in an active set. Each transmission from the WTRU 205 is processed independently at each of the Node-Bs 210. One of the Node-Bs 210 in the active set is designated as a primary Node-B 210A, and the other Node-Bs are designated as non-primary Node-Bs 210B.

[0024] As shown in Figure 2, the primary Node-B 210A includes a MAC entity 250A including a UL scheduler 255. Each of the non-primary Node-Bs 210B also includes a MAC entity 250B. Each of the MAC entities 250A, 250B, handles EU transmissions. The UL scheduler 255 in the MAC entity 250A is responsible for scheduling the EU transmissions.

[0025] In accordance with one embodiment of the present invention, the UL scheduler 255 is implemented only at the primary Node-B 210A during soft handover. The WTRU 205 receives a UL transmission schedule only from the primary Node-B 210A in a primary cell 260A. However, the primary Node-B 210A cannot send the scheduling information to the non-primary Node-Bs 210B in every transmission time interval (TTI). In order to allow the primary Node-B 210A to allocate resources for the WTRU 205 to transmit in cells controlled by the non-primary Node-Bs 210B, those resources scheduled by the primary Node-B 250A in a plurality of cells 260B controlled by the non-primary Node-Bs 210B cannot be assigned by the non-primary Node-Bs 210B. Therefore, some physical resources common to all of the cells in the active EU subset should be assigned and reserved by a particular Node-B for the WTRU 205 during the soft handover, so that those resources can be used only by the primary Node-B 210A.

[0026] The UL scheduler 255 located in the primary Node-B 210A considers the interference level caused by the EU transmission at any cell 260A, 260B, 260C, in the EU active subset to be below a predetermined maximum allowed interference level. Thus, the primary Node-B 250A limits the transmit power level of the WTRU 205 such that the interference levels are also within the maximum allowed interference levels at other cells 260B, 260C. To achieve this, the RNC 215 needs to relay necessary information, such as transmission power level and interference level, of the cells 260B

controlled by the non-primary Node-Bs 210B to the primary Node-B 210A, which then uses the information to schedule the UL transmissions.

[0027] The EU scheduling information is transmitted to the WTRU 205 only by the primary Node-B 210A through the primary cell 260A. During soft handover, the WTRU 205 receives EU scheduling information only in the primary cell 260A, although the EU scheduling information is valid in all other cells 260B, 260C.

[0028] In one embodiment, the primary Node-B 250A is selected by either the RNC 215 or the WTRU 205. The RNC 215 may choose a Node-B that has the highest percentage of correctly received data blocks during a predefined time window as a primary Node-B.

[0029] In another embodiment, the RNC 215 generates statistics for each Node-B, such as a bit error rate (BER) or a frame error rate (FER), or the like, over a predetermined time period. Then, the RNC 215 may select a Node-B having the best performance to be the primary Node-B 210A. The RNC 215 then notifies the WTRU 205 and all other Node-Bs about the primary Node-B 210A via radio resource control (RRC) and Iub signaling, respectively.

[0030] In another embodiment, the WTRU 102 may choose a Node-B 210 that has the best downlink pilot power, (i.e., best downlink path loss or highest code power), as a primary Node-B 210A. The WTRU 205 measures the power of pilot signals received from all Node-Bs 210 and selects the Node-B 210 having the highest pilot power to be the primary Node-B 210A. The WTRU 205 then notifies all other Node-Bs about the primary Node-B 210A via fast physical layer signaling.

[0031] The WTRU 205 may report the downlink pilot power of all cells 260 to the RNC 215. The RNC 215 then chooses one Node-B 210 to be the primary Node-B 210a based on the combined uplink and downlink quality. The uplink quality of a cell 260 based on the percentage of correctly received data blocks, (or BER, FER, or the like), during a predefined time window, and the downlink quality of a cell 260is based on the WTRU received downlink pilot power. Then, the RNC 215 notifies the WTRU 205 and all of the Node-Bs 210 about the primary Node-B 210A via RRC and Iub signaling, respectively.

[0032] The present invention is advantageous over prior art systems. Using the present invention, a WTRU does not receive conflicting scheduling of EU transmissions from Node-Bs during soft handover. In addition, EU transmission is scheduled in consideration of an interference level and radio resources in cells controlled by non-primary Node-Bs. Signaling delay from the primary Node-B 210A to the WTRU 205 is much lower as compared to signaling delay from the RNC 215 to the WTRU 205.

[0033] In a separate embodiment, Figure 3 shows a wireless multi-cell communication system 300, similar to the system 200 shown in Figure 2. As shown in Figure 3, the primary Node-B 210A includes a MAC entity 250A including an ACK/NACK generator 305. Only the primary Node-B 210A has the ACK/NACK generator 305. The primary Node-B 210A may perform H-ARQ with incremental redundancy, or only ARQ without implementing incremental redundancy.

[0034] Still referring to Figure 3, the primary Node-B 210A receives at least one data packet from the WTRU 205 through the primary cell 260A and performs an error check on the data packet. Any error checking method, such as a cyclic redundancy check (CRC), may be utilized. If the primary Node-B 210A correctly decodes the data packet, such as passing the CRC, the primary Node-B 210A transmits an ACK to the WTRU 205 and also transmits the correctly decoded data packet to the RNC 215. If the primary Node-B 210A fails to correctly decode the data packet, the primary Node-B 210A transmits a NACK to the WTRU 205.

[0035] The non-primary Node-Bs 210B also perform an error check on the data packet. However, the non-primary Node-Bs 210B do not send ACKs or NACKs to the WTRU 205. Instead, the non-primary Node-Bs send successfully decoded data packets to the RNC 215. During soft handover, only the primary Node-B 210A generates H-ARQ (or ARQ), ACKs and NACKs, and controls retransmissions.

[0036] The MAC layer WTRU identities received by the non-primary Node-Bs 210B may be used for routing of successfully received transmissions in a universal terrestrial radio access network (UTRAN). Since the non-primary Node-Bs 210B are not aware of which WTRUs have been scheduled for EU transmission by the primary Node-B 210A, the non-primary Node-Bs 210B may rely on in-band MAC layer signaling

of the WTRU ID to route correctly received transmissions to the correct RNC radio link. Even though the primary Node-B 210A may be aware of which WTRU is scheduled, the same method may be implemented by the primary Node-B 210A.

[0037] Preferably, the primary Node-B 210A may use soft combining to process transmissions, while the non-primary Node-Bs 210B may process each transmission without soft combining. If the primary Node-B sends a NACK to the WTRU 205, the NACKed data packet is stored in a buffer of the primary Node-B 210A, and the NACKed data packet is combined with a retransmitted data packet. In contrast, the non-primary Node-Bs 210B do not store the NACKed data packets. This eliminates the problem of soft buffer corruption between the Node-Bs 210, and the complexities of multiple independent ACKs and/or NACKs.

[0038] When an incremental combining process is implemented, measures should be taken to avoid soft buffer corruption. Sequence information or a new data indicator is required to enable a Node-B 210 to detect that the WTRU 205 is no longer repeating data for a particular WTRU H-ARQ process, but instead is sending new data. This is specifically required because the Node-B 210 has no other way to learn that a new transmission has started. Alternatively, the non-primary Node-Bs 210B may simply perform an ARQ, without using an incremental combining process. This eliminates the soft buffer corruption problem.

[0039] In the case where non-primary Node-Bs 210B perform simple ARQ without incremental combining, the WTRU 205 must transmit self-decodable data packets to ensure that all of the Node-Bs 210 may decode transmissions, regardless of the result of earlier transmissions. Preferably, the H-ARQ functionality is terminated at the Node-Bs 210. Each of the Node-Bs 210 sends to the RNC 215 successfully decoded data packets with explicit identification of transmission, such as a transmission sequence number (TSN). The RNC 215 may optionally use data packets delivered from the non-primary Node-Bs 210B. A MAC entity 310, located in the RNC 215, is used to implement an in-sequence delivery process for delivering data to higher layers over all of the packets received from the Node-Bs 210. After the RNC MAC entity 310 has completed its re-ordering process, it sends the data to a radio link

control (RLC) (not shown). Missed packets are identified at the RNC 215 and the WTRU 205 is informed through RLC messaging.

[0040] Alternatively, EU transmissions may identify WTRU ID, H-ARQ process, transmission sequence and/or new data indication (NDI) to allow for soft combining in the non-primary Node-B's 210B. If this method is used to allow soft combining in the non-primary Node-Bs 210B, the primary Node-B 210A may not have to rely on scheduling and H-ARQ ACK/NACK decisions to determine when combining should be performed.

[0041] There are two options for the transmission of ACK/NACK messages. The first option is a synchronous transmission. The ACK/NACK messages are transmitted after a unique time delay with respect to the corresponding uplink transmission or the EU channel allocation message. The second option is an asynchronous transmission. There is no unique delay between the transmission of ACK/NACK messages and the corresponding uplink transmission or the EU channel allocation message. Explicit information in the ACK/NACK message identifies the corresponding uplink transmission to enable the WTRU 205 to make the correct association between the ACK/NACK message and the transmission. This association is made by either identifying the H-ARQ process number and/or a unique sequence number, such as a TSN with each ACK/NACK feedback message to the WTRU 205.

[0042] In a separate embodiment, preferably implemented for the asynchronous ACK/NACK feedback case, the non-primary Node-Bs 210B may provide H-ARQ ACK/NACK results to the primary Node-B 210A in order to avoid unnecessary retransmissions for transmissions that are not correctly received by the primary Node-B 210A, but are correctly received by the non-primary Node-Bs 210B. A non-primary Node-B 210B does not directly send an ACK or NACK message to the WTRU 205. The non-primary Node-Bs 210B sends ACK/NACK or CRC results to the RNC 215. Then, the RNC 215 sends ACK or CRC results to the primary Node-B 210A.

[0043] In order to speed up H-ARQ processing, the first ACK message from any non-primary Node-B 210B received by the RNC is preferably immediately forwarded to the primary Node-B 210A. The primary Node-B 210A also immediately generates an

ACK message if the transmission is received correctly in the primary Node-B 210A without waiting for feedback from the non-primary Node-Bs 210B. The primary Node-B 210A also generates an ACK message immediately upon reception of a forwarded ACK message from the RNC, even if other ACK messages may be forwarded. Since an ACK is generated if any of the paths are successful, an ACK can be generated as soon as the first successful transmission is found.

[0044] Alternatively, in order to simplify the design of the ACK/NACK generator 205, only a subset of the generating nodes may be used. For example, ACKs may be generated only at the RNC, or at the RNC and the primary Node-B 210A.

[0045] When the WTRU 205 sends an uplink transmission, for each H-ARQ process the WTRU 205 waits at least the time required for the primary Node-B 210A to send ACK/NACK feedback. For each H-ARQ process, if an ACK is received by the WTRU 205, the WTRU 205 may send new data in the next available or assigned opportunity.

[0046] A NACK message can only originate in the RNC 215 since it is the only node that has all of the information necessary in the soft handover to determine that there have been no successful receptions at any Node-B 210. The RNC 215 generates a NACK command if the RNC 215 receives no ACK from the Node-Bs 210 within a predetermined time interval. The RNC 215 forwards the NACK message to the WTRU 205 via the primary Node-B 210A.

[0047] It is also possible that this procedure can be implemented without an explicit NACK command. In this case, the lack of ACK reception within a particular period of time is considered the same as an explicit NACK command at either the primary Node-B 210A and/or the WTRU 205.

[0048] Figure 4 is a flowchart of a process 400 including method steps for coordinating Node-Bs during soft handover in accordance with one embodiment of the present invention. In step 405, the RNC 215 makes a decision to initiate an inter-Node-B soft handover. In step 410, the WTRU 205 establishes connections with at least two Node-Bs 210 in an active set. In step 415, one of the Node-Bs 210 in the active set is designated as a primary Node-B 210A and the one or more Node-B(s) 210

remaining in the active set are designated as a non-primary Node-Bs 210B. In step 420, the primary Node-B 210A controls UL transmissions during soft handover by performing EU scheduling and H-ARQ operations.

[0049] Figure 5 is a flowchart of a process 500 including method steps for prioritizing the transmission of NACKed data in a source Node-B before hard handover is completed in accordance with a separate embodiment of the present invention. In step 505, the RNC 215 makes a decision to initiate a hard handover for a WTRU 205 connected to a source Node-B 210. In step 510, the RNC 215 informs the source Node-B 210 when the WTRU 205 will stop transmission and reception in the source cell 260. In step 515, the RNC 215 sends an activation timer to the source Node-B 210 to set the time for handover.

[0050] Still referring to Figure 5, if the source Node-B 210 determines that there are data packets that were previously NACKed, as many previously NACKed data packets as possible should be retransmitted before the handover activation timer expires. Otherwise, the system may lose the benefit of incrementally combining the previous transmission with the retransmission. Therefore, the source Node-B scheduler 255 takes the handover activation time into account when it schedules the data packets that have been NACKed. If there is not enough radio resource for the source Node-B 210 to schedule transmission of all the NACKed data packets in time, the source Node-B 210 should manage to schedule transmission of as many NACKed data packets as possible.

[0051] Still referring to Figure 5, in order to transmit as many NACKed data packets as possible before the activation timer expires, the source Node-B 210 adjusts the priority of transmissions (step 525) and, in step 530, the source node-B 210 adjusts the MCS of the transmissions (step 530). Higher priority of scheduling is given to the data packets that have been NACKed. If the radio resources are sufficient, a more robust MCS may be used to increase the probability of successful transmissions from the WTRU 205 to the source Node-B 210. In step 535, the handover is completed at the expiration of the activation timer.

[0052] In order for the WTRU 205 to understand that the scheduled uplink

transmission is intended for data blocks with previous transmission failures, the source Node-B 210 uplink scheduler 255 may specify that the scheduled UL transmission is intended for the data blocks that were previously NACKed. This may be implemented by including H-ARQ process identification in the UL scheduling information that is sent from the source Node-B 210 to the WTRU 205. By receiving the scheduling information from the source Node-B 210, the WTRU 205 knows that the scheduled transmission is for specific data associated with HARQ process identification sent together with the scheduling information.

[0053] While this invention has been particularly shown and described with reference to preferred embodiments, it will be understood by those skilled in the art that various changes in forms and details may be made therein without departing from the scope of the invention as described above.

* * *

CLAIMS

What is claimed is:

1. A Node B comprising:

a circuit configured to receive uplink data from a first wireless transmit/receive unit (WTRU) in a first cell;

wherein the first WTRU is simultaneously transmitting the same uplink data to a plurality of cells including a first cell and at least one second cell;

wherein the circuit is further configured to transmit first scheduling information to the first WTRU using the first cell;

wherein the circuit is further configured to transmit hybrid automatic repeat requests (HARQ) acknowledgments (ACKs) and HARQ negative acknowledgments (NACKs) to the first WTRU using the first cell;

wherein the circuit is further configured to receive the uplink data from a second WTRU in the first cell; wherein the second WTRU is simultaneously transmitting the uplink data to the plurality of cells;

wherein the first cell is not the primary cell and at least a third cell of the plurality of cells is the primary cell;

wherein the circuit is further configured to not transmit first scheduling information to the second WTRU using the first cell;

wherein the second WTRU receives the first scheduling information from the third cell; and

wherein the circuit is further configured to not transmit the HARQ NACKs to the second WTRU using the first cell; wherein the first WTRU receives the HARQ ACKS and NACKs from the third cell.

2. The Node B of claim 1 wherein the circuit is further configured to receive information from a radio network controller designating the first cell as being the primary cell.

3. The Node B of claim 2 wherein the simultaneous uplink data transmissions include a WTRU identification.

4. A wireless transmit/receive unit (WTRU) comprising:

circuitry configured to simultaneously transmit a same uplink data to a plurality of cells including a first cell and a second cell;

circuitry configured to receive first scheduling information from the first cell;

circuitry configured to receive hybrid automatic repeat requests (HARQ) acknowledgments (ACKs) and HARQ negative acknowledgments (NACKs) from the first cell;

wherein the first cell is not the primary cell and the second cell of the plurality of cells is the primary cell; and

wherein the WTRU receives the HARQ ACKS and NACKs from the second cell.

5. The WTRU of claim 4 wherein the circuit is further configured to receive information from a radio network controller designating the first cell as being the primary cell.

6. The WTRU of claim 4 wherein the simultaneous uplink data transmissions include a WTRU identification.

ABSTRACT

An enhanced uplink user equipment is in soft handover. A radio network controller selects a primary Node-B out of a plurality of Node-Bs supporting the soft handover. The radio network controller receiving successfully received enhanced uplink data packets from the plurality of Node-Bs. The radio network controller reordered the successfully received enhanced uplink data packets for in-sequence deliver. The primary Node-B sends specified scheduling information to the user equipment that the other Node-Bs does not transmit. At least the primary Node-B transmits acknowledgements and negative acknowledgements to the user equipment.

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	I-2-0674US05
	Application Number	
Title of Invention	SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER	

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

Secrecy Order 37 CFR 5.2

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

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Guodong		Zhang	

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

City	Syosset	State/Province	NY	Country of Residence i	US

Mailing Address of Inventor:

Address 1	14 Walnut Drive		
Address 2			
City	Syosset	State/Province	NY
Postal Code	11791	Country i	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Sung-Hyuk		Shin	

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

City	Northvale	State/Province	NJ	Country of Residence i	US

Mailing Address of Inventor:

Address 1	104 Eidner Way		
Address 2			
City	Northvale	State/Province	NJ
Postal Code	07647	Country i	US

Inventor 3 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Stephen	E.	Terry	

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

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	I-2-0674US05
	Application Number	
Title of Invention	SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER	

City	Northport	State/Province	NY	Country of Residence i	US

Mailing Address of Inventor:

Address 1	15 Summit Avenue		
Address 2			
City	Northport	State/Province	NY
Postal Code	11768	Country i	US

Inventor 4 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	James	M.	Miller	

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

City	Verona	State/Province	NJ	Country of Residence i	US

Mailing Address of Inventor:

Address 1	18 Louisburg Square		
Address 2			
City	Verona	State/Province	NJ
Postal Code	07044	Country i	US

Inventor 5 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Stephen	G.	Dick	

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

City	Nesconset	State/Province	NY	Country of Residence i	US

Mailing Address of Inventor:

Address 1	61 Bobann Drive		
Address 2			
City	Nesconset	State/Province	NY
Postal Code	11767	Country i	US

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

Correspondence Information:

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

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

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	I-2-0674US05
	Application Number	
Title of Invention	SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER	

Customer Number	24374		
Email Address	eoffice@vklaw.com	Add Email	Remove Email

Application Information:

Title of the Invention	SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER		
Attorney Docket Number	I-2-0674US05	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	4	**Suggested Figure for Publication (if any)**	3

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)
☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

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

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	24374		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

Prior Application Status	Pending	Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Continuation of	13308950	2011-12-01
Prior Application Status	Patented	Remove	

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13308950	Continuation of	11434330	2006-05-15	8130720	2012-03-06

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	I-2-0674US05
	Application Number	
Title of Invention	SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER	

Prior Application Status	Patented			Remove

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
11434330	Continuation of	10962720	2004-10-12	7046648	2006-05-16

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
10962720	non provisional of	60578674	2004-06-10
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
10962720	non provisional of	60520692	2003-11-17
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
10962720	non provisional of	60519990	2003-11-14
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
10962720	non provisional of	60517656	2003-11-05

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

Foreign Priority Information:

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

Remove

Application Number	Country [i]	Filing Date (YYYY-MM-DD)	Access Code [i] (if applicable)

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

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	I-2-0674US05
	Application Number	
Title of Invention	SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER	

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

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

Authorization to Permit Access:

☒ Authorization to Permit Access to the Instant Application by the Participating Offices

If checked, the undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date of filing this Authorization.

Applicant Information:

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

Applicant 1 Remove

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

Clear

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

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	I-2-0674US05
	Application Number	
Title of Invention	SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER	

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

Name of the Deceased or Legally Incapacitated Inventor :

If the Applicant is an Organization check here. ☒

Organization Name	InterDigital Technology Corporation		
Mailing Address Information:			
Address 1	200 Bellevue Parkway		
Address 2	Suite 300		
City	Wilmington	**State/Province**	DE
Country [i]	US	Postal Code	19809
Phone Number		Fax Number	
Email Address			

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

Non-Applicant Assignee Information:

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

Assignee 1

Complete this section only if non-applicant assignee information is desired to be included on the patent application publication in accordance with 37 CFR 1.215(b). Do not include in this section an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest), as the patent application publication will include the name of the applicant(s).

Remove

If the Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	I-2-0674US05
	Application Number	
Title of Invention	SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER	

Mailing Address Information:			
Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

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

Signature:

Remove

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications					
Signature	/Thomas A. Mattioli/			Date (YYYY-MM-DD)	2013-06-03
First Name	Thomas	Last Name	Mattioli	Registration Number	56773

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

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

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

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

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

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

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

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

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

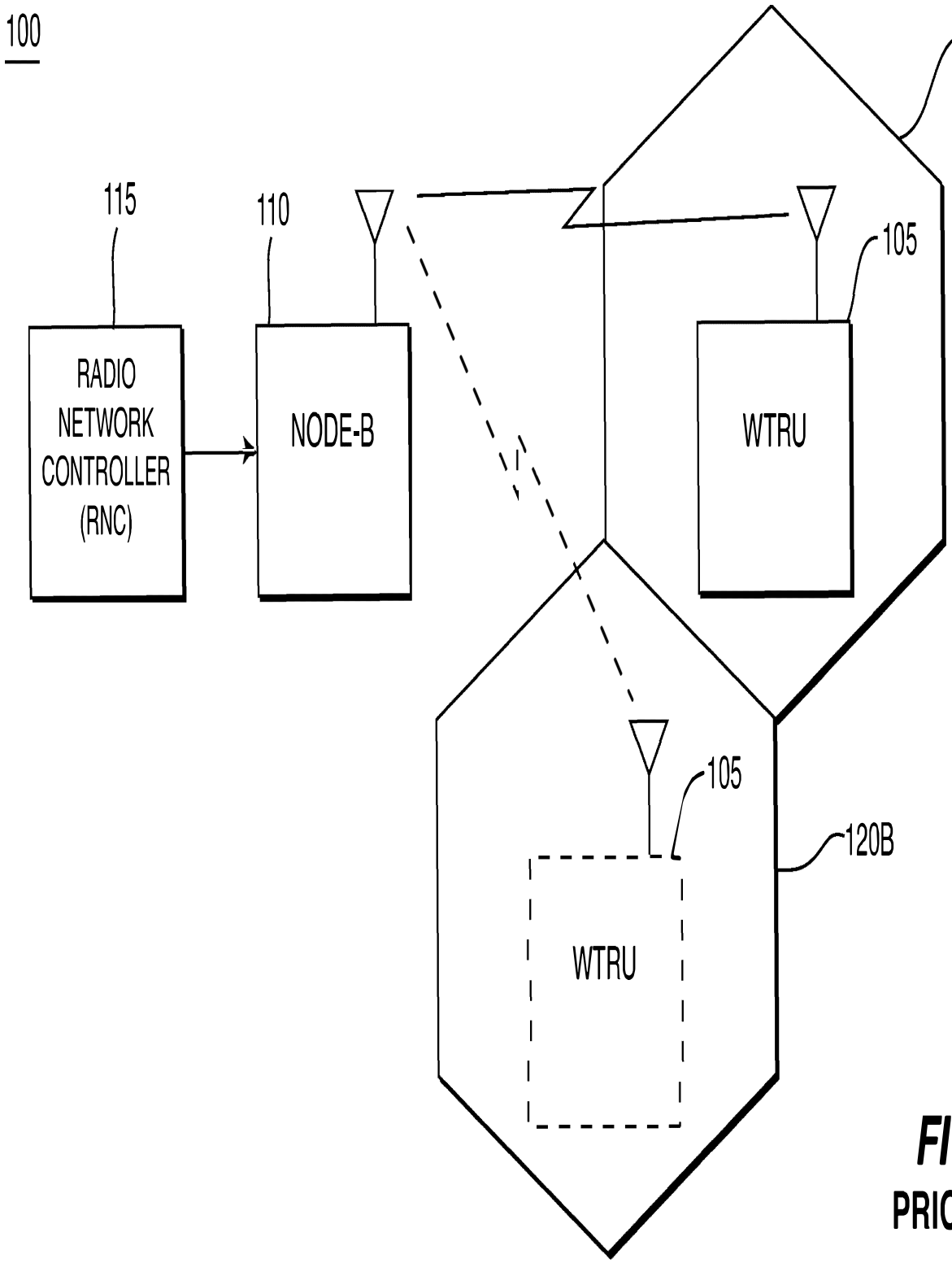


FIG. 1
PRIOR ART

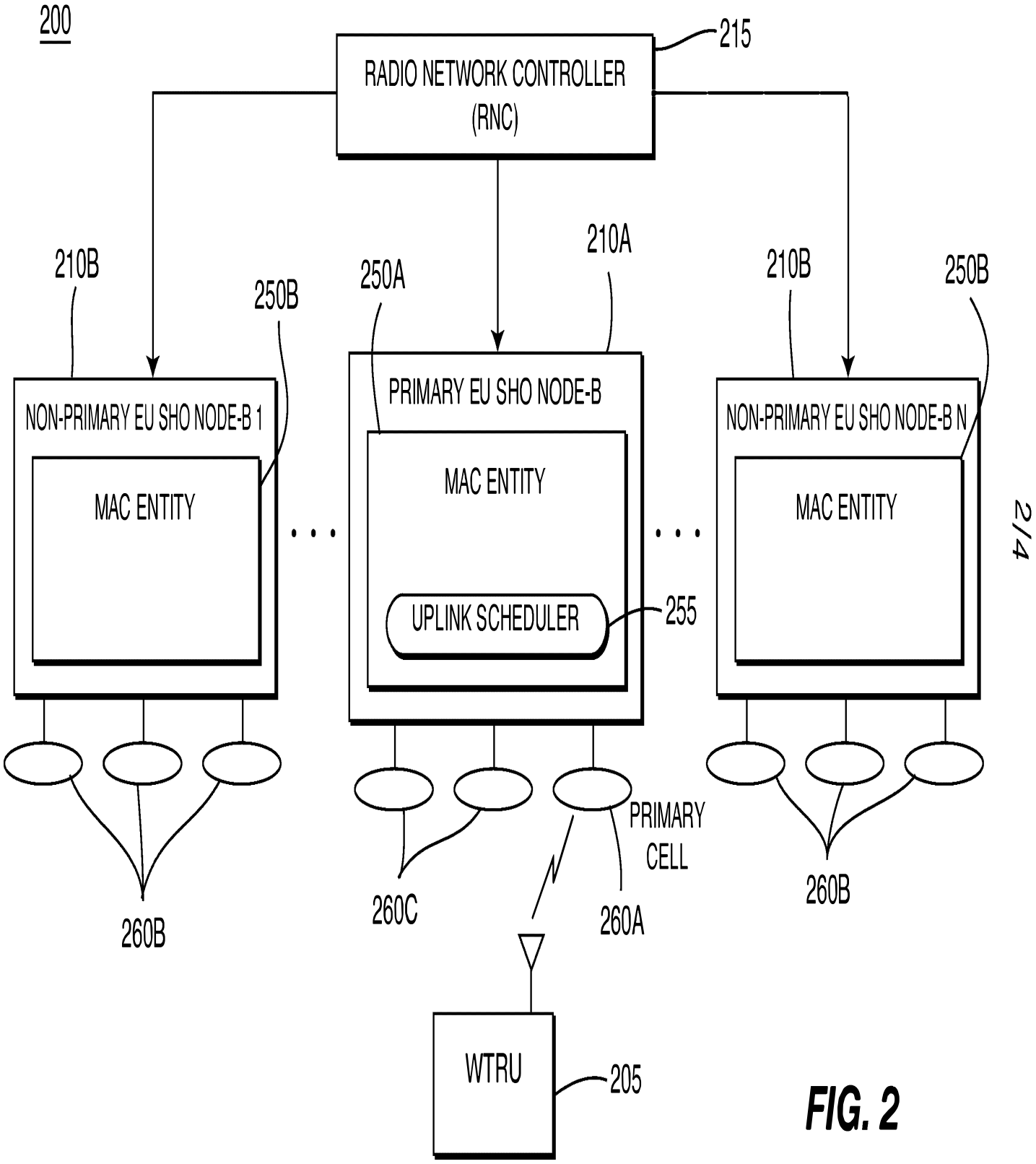

200
RADIO NETWORK CONTROLLER (RNC)
215
210B
250B
250A
210A
210B
250B
NON-PRIMARY EU SHO NODE-B 1
MAC ENTITY
PRIMARY EU SHO NODE-B
MAC ENTITY
UPLINK SCHEDULER
255
NON-PRIMARY EU SHO NODE-B N
MAC ENTITY
260B
260C
PRIMARY CELL
260A
260B
WTRU
205

FIG. 2

2/4

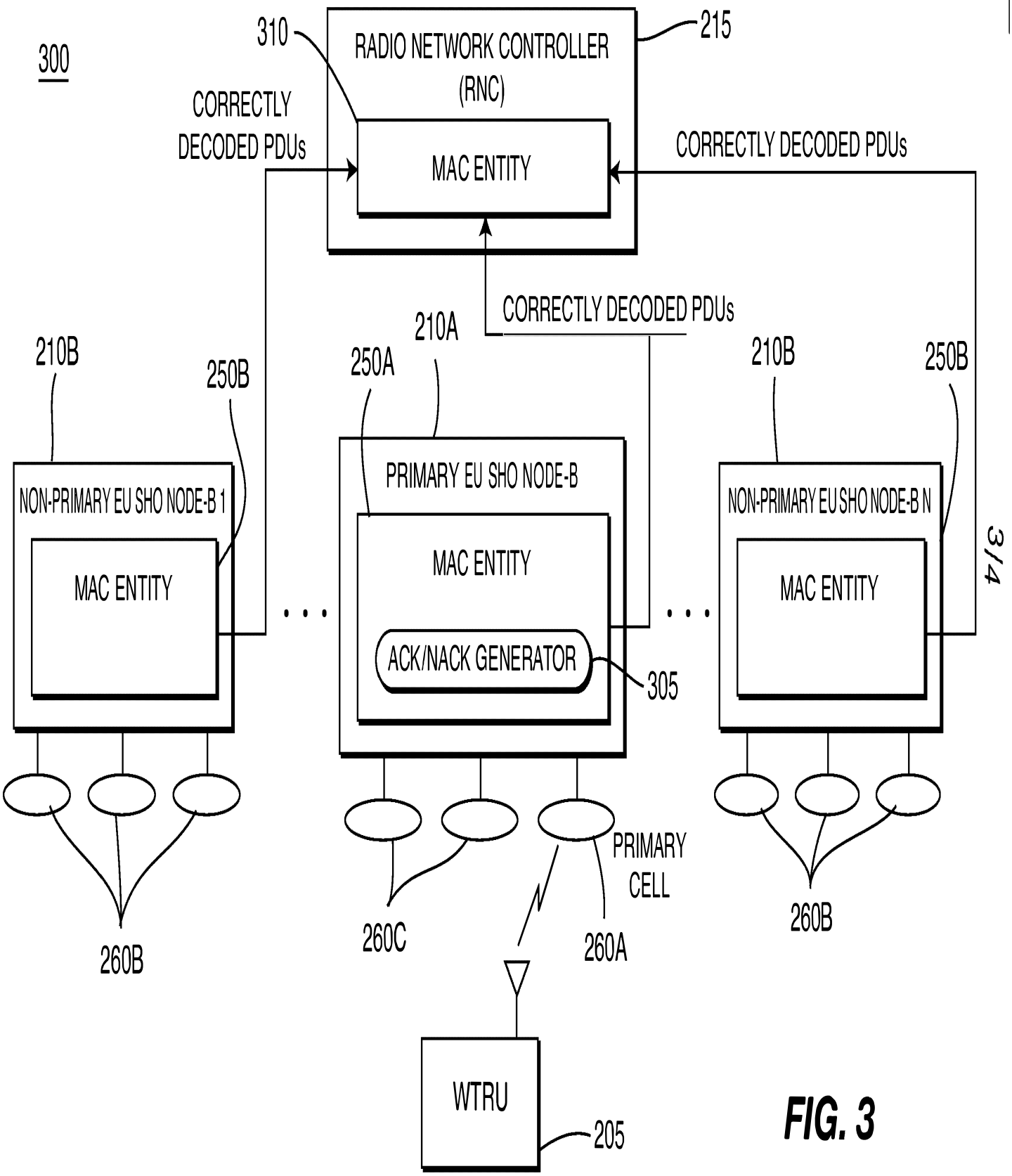

300
310
RADIO NETWORK CONTROLLER (RNC)
215
CORRECTLY DECODED PDUs
MAC ENTITY
CORRECTLY DECODED PDUs
CORRECTLY DECODED PDUs
210A
210B
250B
250A
210B
250B
NON-PRIMARY EU SHO NODE-B 1
MAC ENTITY
PRIMARY EU SHO NODE-B
MAC ENTITY
ACK/NACK GENERATOR
305
NON-PRIMARY EU SHO NODE-B N
MAC ENTITY
PRIMARY CELL
260B
260C
260A
260B
WTRU
205

FIG. 3

3/4

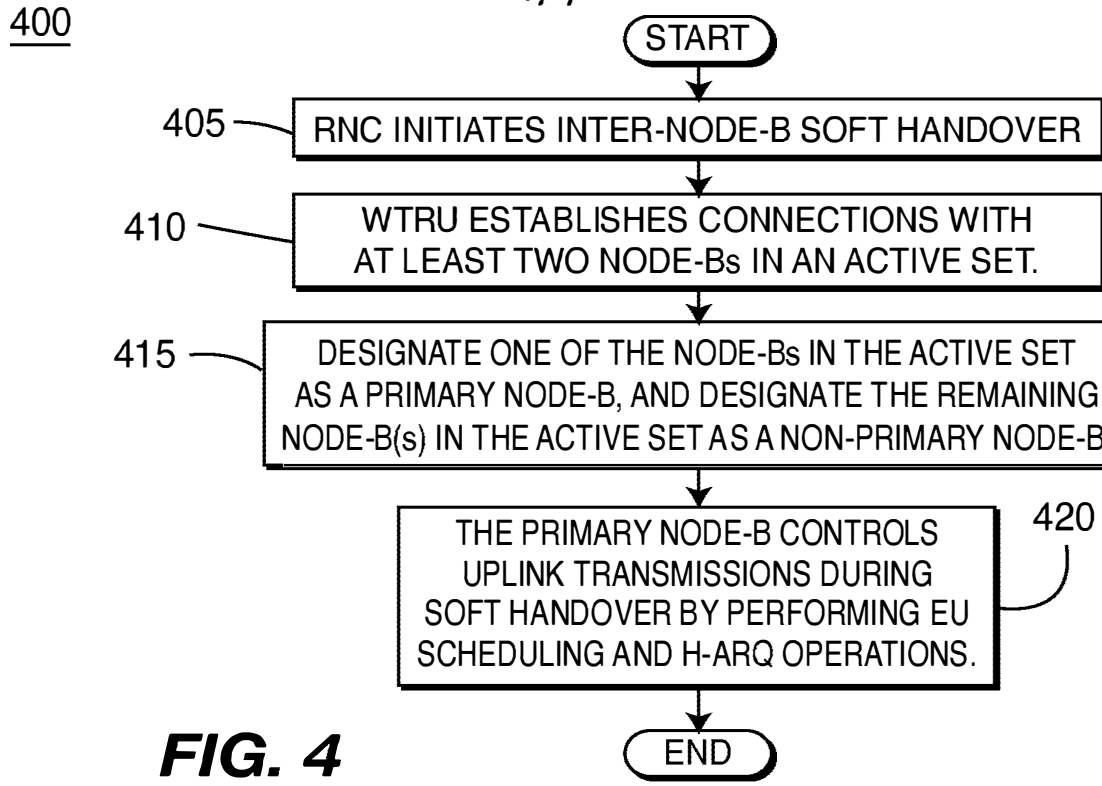

400
START
405
RNC INITIATES INTER-NODE-B SOFT HANDOVER
410
WTRU ESTABLISHES CONNECTIONS WITH AT LEAST TWO NODE-Bs IN AN ACTIVE SET.
415
DESIGNATE ONE OF THE NODE-Bs IN THE ACTIVE SET AS A PRIMARY NODE-B, AND DESIGNATE THE REMAINING NODE-B(s) IN THE ACTIVE SET AS A NON-PRIMARY NODE-B.
420
THE PRIMARY NODE-B CONTROLS UPLINK TRANSMISSIONS DURING SOFT HANDOVER BY PERFORMING EU SCHEDULING AND H-ARQ OPERATIONS.
END

FIG. 4

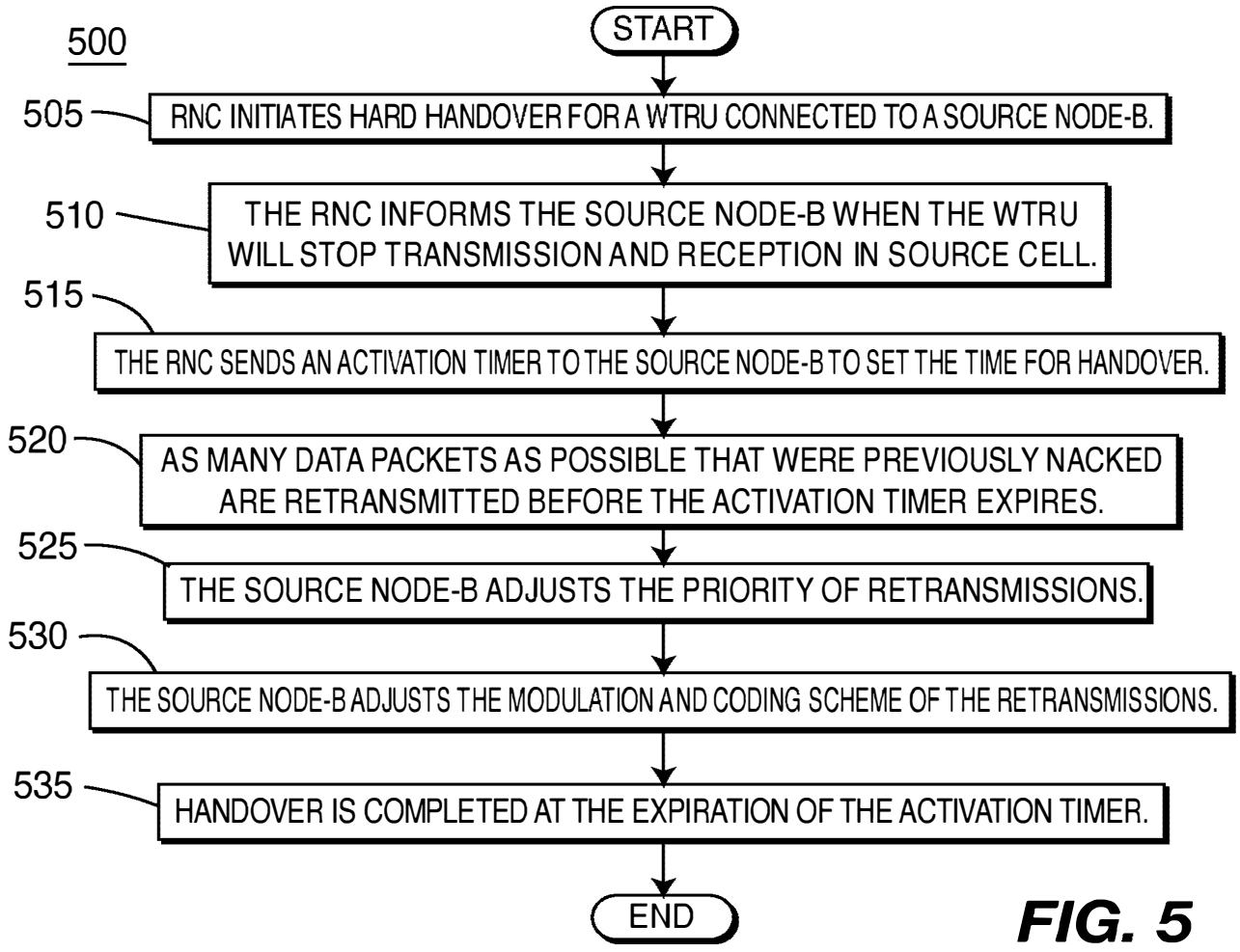

500
START
505
RNC INITIATES HARD HANDOVER FOR A WTRU CONNECTED TO A SOURCE NODE-B.
510
THE RNC INFORMS THE SOURCE NODE-B WHEN THE WTRU WILL STOP TRANSMISSION AND RECEPTION IN SOURCE CELL.
515
THE RNC SENDS AN ACTIVATION TIMER TO THE SOURCE NODE-B TO SET THE TIME FOR HANDOVER.
520
AS MANY DATA PACKETS AS POSSIBLE THAT WERE PREVIOUSLY NACKED ARE RETRANSMITTED BEFORE THE ACTIVATION TIMER EXPIRES.
525
THE SOURCE NODE-B ADJUSTS THE PRIORITY OF RETRANSMISSIONS.
530
THE SOURCE NODE-B ADJUSTS THE MODULATION AND CODING SCHEME OF THE RETRANSMISSIONS.
535
HANDOVER IS COMPLETED AT THE EXPIRATION OF THE ACTIVATION TIMER.
END

FIG. 5

Electronic Acknowledgement Receipt

EFS ID:	15928329
Application Number:	13908242
International Application Number:	
Confirmation Number:	5287
Title of Invention:	SUPPORTING ENHANCED UPLINK TRANSMISSION DURING SOFT HANDOVER
First Named Inventor/Applicant Name:	Guodong Zhang
Customer Number:	24374
Filer:	Thomas A Mattioli/Angel Wolf
Filer Authorized By:	Thomas A Mattioli
Attorney Docket Number:	I-2-0674US05
Receipt Date:	03-JUN-2013
Filing Date:	
Time Stamp:	14:19:32
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$1740
RAM confirmation Number	633
Deposit Account	090435
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 1.16 (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)

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		20130603_I_2_0674US05_Application.PDF	81371 eec72c659eed5adfba35aa0c1079a8b6dbf4089b	yes	15
	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Specification		1	12	
	Claims		13	14	
	Abstract		15	15	
Warnings:					
Information:					
2	Application Data Sheet	20130603_I_2_0674US05_ADS.PDF	1504246 b1b5609d48afc12a5923c4ac486c3e63aca95e9e	no	8
Warnings:					
Information:					
3	Drawings-only black and white line drawings	20130603_I_2_0674US05_Drawings.PDF	572580 cbb32b362090f118e5b1919883323088a31b97c4	no	4
Warnings:					
The page size in the PDF is too large. The pages should be 8.5 x 11 or A4. If this PDF is submitted, the pages will be resized upon entry into the Image File Wrapper and may affect subsequent processing					
Information:					
4	Power of Attorney	20130603_I_2_0674US05_POA.PDF	86478 5ed1518773f91b63dae06ef035808c0119cce7ad	no	1
Warnings:					
Information:					
5	Assignee showing of ownership per 37 CFR 3.73.	20130603_I_2_0674US05_373c Statement.PDF	117767 015e2ed2a3a660ed0c7ba41e52e5d9f23c6378a0	no	3
Warnings:					
Information:					
6	Fee Worksheet (SB06)	fee-info.pdf	36605 e1b347e98fcbda7d07e32f41b0e5a3211ca2f062	no	2
Warnings:					

Information:	
Total Files Size (in bytes):	2399047

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

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

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

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

UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
13/908,242	06/03/2013	Guodong Zhang	I-2-0674US05

CONFIRMATION NO. 5287

24374
VOLPE AND KOENIG, P.C.
DEPT. ICC
UNITED PLAZA
30 SOUTH 17TH STREET
PHILADELPHIA, PA 19103

POA ACCEPTANCE LETTER

OC000000062121011

Date Mailed: 06/28/2013

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 06/03/2013.

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.

/mpaulos/

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

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 13/908,242

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	280
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	600
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	720
TOTAL CLAIMS (37 CFR 1.16(i))	6 minus 20 =	*			OR	x 80 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*				x 420 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1600

APPLICATION AS AMENDED - PART II

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

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

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

UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
13/908,242	06/03/2013	2473	1740	I-2-0674US05	6	2

CONFIRMATION NO. 5287

24374
VOLPE AND KOENIG, P.C.
DEPT. ICC
UNITED PLAZA
30 SOUTH 17TH STREET
PHILADELPHIA, PA 19103

FILING RECEIPT

OC000000062120996

Date Mailed: 06/28/2013

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Guodong Zhang, Syosset, NY;
Sung-Hyuk Shin, Northvale, NJ;
Stephen E. Terry, Northport, NY;
James M. Miller, Verona, NJ;
Stephen G. Dick, Nesconset, NY;

Applicant(s)

InterDigital Technology Corporation, Wilmington, DE

Power of Attorney: The patent practitioners associated with Customer Number 24374

Domestic Priority data as claimed by applicant

This application is a CON of 13/308,950 12/01/2011 PAT 8457072
which is a CON of 11/434,330 05/15/2006 PAT 8130720
which is a CON of 10/962,720 10/12/2004 PAT 7046648
which claims benefit of 60/578,674 06/10/2004
and claims benefit of 60/520,692 11/17/2003
and claims benefit of 60/519,990 11/14/2003
and claims benefit of 60/517,656 11/05/2003

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access - A proper **Authorization to Permit Access to Application by Participating Offices** (PTO/SB/39 or its equivalent) has been received by the USPTO.

If Required, Foreign Filing License Granted: 06/20/2013

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 13/908,242**

Projected Publication Date: 10/03/2013

Non-Publication Request: No

Early Publication Request: No

Title

SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER

Preliminary Class

370

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

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

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

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

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

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

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific

countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

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

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

NOT GRANTED

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

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop

technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

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
13/908,242	06/03/2013	Guodong Zhang	I-2-0674US05

CONFIRMATION NO. 5287

24374
VOLPE AND KOENIG, P.C.
DEPT. ICC
UNITED PLAZA
30 SOUTH 17TH STREET
PHILADELPHIA, PA 19103

NOTICE

OC000000062120997

Date Mailed: 06/28/2013

INFORMATIONAL NOTICE TO APPLICANT

Applicant is notified that the above-identified application contains the deficiencies noted below. No period for reply is set forth in this notice for correction of these deficiencies. However, if a deficiency relates to the inventor's oath or declaration, the applicant must file an oath or declaration in compliance with 37 CFR 1.63, or a substitute statement in compliance with 37 CFR 1.64, executed by or with respect to each actual inventor no later than the expiration of the time period set in the "Notice of Allowability" to avoid abandonment. See 37 CFR 1.53(f).

The item(s) indicated below are also required and should be submitted with any reply to this notice to avoid further processing delays.

- A properly executed inventor's oath or declaration has not been received for the following inventor(s):
  Guodong Zhang
  Sung-Hyuk Shin
  Stephen E. Terry
  James M. Miller
  Stephen G. Dick

  Applicant may submit the inventor's oath or declaration at any time before the Notice of Allowance and Fee(s) Due, PTOL-85, is mailed.

FORM PTO-1449 U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use several sheets if necessary)	ATTY. DOCKET NO. I-2-0674US05	SERIAL NO. 13/908,242
	APPLICANT Zhang et al.	
	FILING DATE June 3, 2013	GROUP 2473

U.S. PATENT DOCUMENTS							
EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
		6,678,249	01/2004	Toskala et al.[4]			
		6,778,830	08/2004	Oizumi et al.			
		6,892,071	05/2005	Park et al.[6]			
		7,013,143	03/2006	Love et al.			
		7,346,035	03/2008	Lee et al.			
		7,414,989	08/2002	Kuchibhotla et al.			
		2002/0095635	07/2002	Wager et al.			
		2002/0191544	12/2002	Cheng et al.			
		2003/0007480	01/2003	Kim et al.			
		2003/0043786	03/2003	Kall et al.			
		2003/0054824	03/2003	Choi et al.			
		2003/0081692	05/2003	Kwan et al.			
		2003/0161284	08/2003	Chen			
		2003/0210668	11/2003	Malladi et al.			
		2004/0004954	01/2004	Terry et al.			
		2004/0072567	04/2004	Cao et al.			
		2004/0085934	05/2004	Balachandran et la.			
		2004/0120306	06/2004	Wigard et al.			
		2004/0160925	08/2004	Heo et al.[1]			
		2004/0202129	10/2004	Kolding et al.			
		2004/0203991	10/2004	Chen et al.			
		2004/0219917	11/2004	Love et al.			
		2004/0219919	11/2004	Whinnett et al.			
		2004/0219920	11/2004	Love et al.			
		2004/0228313	11/2004	Cheng et al.			

EXAMINER	DATE CONSIDERED

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

2150192-1

FORM PTO-1449 U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use several sheets if necessary)	ATTY. DOCKET NO. I-2-0674US05	SERIAL NO. 13/908,242
	APPLICANT Zhang et al.	
	FILING DATE June 3, 2013	GROUP 2473

EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
		2005/0041694	02/2005	Liu			
		2005/0047354	03/2005	Zeira et al.			
		2005/0048920	03/2005	Liu			
		2005/0083888	04/2005	Smee et al.			
		2007/0047501	03/2007	Usuda et al.[2]			

FOREIGN PATENT DOCUMENTS

EXAMINER INITIAL		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION YES	TRANSLATION NO
		0 977 393	02/2000	EP[5]				
		2 353 439	02/2001	GB				
		2001-128209	05/2001	JP			X**	
		2003-163960	06/2003	JP			X**	
		2002-0095231	12/2002	KR			X**	
		2003112283	12/2005	RU			X**	
		2005110767	10/2006	RU			X**	
		00/074263	12/2000	WO[3]				
		00/35226	06/2000	WO				
		02/01893	01/2002	WO				
		03/003643	01/2003	WO				
		03/026231	03/2003	WO				
		03/053087	06/2003	WO				
		03/067953	08/2003	WO				
		03/088545	10/2003	WO				

EXAMINER	DATE CONSIDERED

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

2150192-1

FORM PTO-1449 U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use several sheets if necessary)	ATTY. DOCKET NO. I-2-0674US05	SERIAL NO. 13/908,242
	APPLICANT Zhang et al.	
	FILING DATE June 3, 2013	GROUP 2473

OTHER DOCUMENTS

EXAMINER INITIAL		DESCRIPTION (Including Author, Title, Date, Pertinent Pages, Etc.)
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Feasibility Study for Enhanced Uplink for UTRA FDD; (Release 6)," 3GPP TR 25.896 V1.0.2 (October 2003).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Feasibility Study for Enhanced Uplink for UTRA FDD (Release 6)," 3GPP TR 25.896 V6.0.0 (March 2004).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Multiplexing and channel coding (FDD) (Release 1999)," 3GPP TS 25.212 V3.11.0 (September 2002).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Medium Access Control (MAC) protocol specification (Release 1999)." 3GPP TS 25.321 V3.16.0 (September 2003).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Multiplexing and channel coding (FDD) (Release 4)," 3GPP TS 25.212 V4.6.0 (September 2002).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Multiplexing and channel coding (FDD) (Release 5)," 3GPP TS 25.212 V5.6.0 (September 2003).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Multiplexing and channel coding (FDD) (Release 5)," 3GPP TS 25.212 V5.9.0 (June 2004).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Multiplexing and channel coding (FDD) (Release 6)," 3GPP TS 25.212 V6.2.0 (June 2004).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Medium Access Control (MAC) protocol specification (Release 1999)," 3GPP TS 25.321 V3.17.0 (June 2004).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Medium Access Control (MAC) protocol specification (Release 6)," 3GPP TS 25.321 V6.2.0 (June 2004).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Medium Access Control (MAC) protocol specification (Release 4)," 3GPP TS 25.321 V4.9.0 (September 2003).

EXAMINER	DATE CONSIDERED

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

2150192-1

FORM PTO-1449 U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use several sheets if necessary)	ATTY. DOCKET NO. I-2-0674US05	SERIAL NO. 13/908,242
	APPLICANT Zhang et al.	
	FILING DATE June 3, 2013	GROUP 2473

EXAMINER INITIAL		DESCRIPTION (Including Author, Title, Date, Pertinent Pages, Etc.)
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Medium Access Control (MAC) protocol specification (Release 5)," 3GPP TS 25.321 V5.9.0 (June 2004).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Medium Access Control (MAC) protocol specification (Release 4)," 3GPP TS 25.321 V4.10.0 (June 2004).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Medium Access Control (MAC) protocol specification (Release 5)," 3GPP TS 25.321 V5.6.0 (September 2003).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Feasibility Study for Enhanced Uplink for UTRA FDD; (Release 6)," 3GPP TR 25.896 V1.0.1 (October 2003).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Radio Resource Control (RRC) protocol specification (Release 1999)," 3GPP TS 25.331 V3.16.0 (September 2003).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Radio Resource Control (RRC) protocol specification (Release 1999)," 3GPP TS 25.331 V3.20.0 (September 2004).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network;Radio Resource Control (RRC); Protocol Specification (Release 4)," 3GPP TS 25.331 V4.11.0 (September 2003).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Radio Resource Control (RRC); Protocol Specification (Release 4)," 3GPP TS 25.331 V4.15.0 (June 2004).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Radio Resource Control (RRC); Protocol Specification (Release 5)," 3GPP TS 25.331 V5.6.0 (September 2003).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Radio Resource Control (RRC); Protocol Specification (Release 5)," 3GPP TS 25.331 V5.10.0 (September 2004).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Radio Resource Control (RRC); Protocol Specification (Release 6)," 3GPP TS 25.331 V6.3.0 (September 2004).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; UTRAN lub interface NBAP signaling (Release 1999)," 3GPP TS 25.433 V3.14.2 (September 2004).

EXAMINER	DATE CONSIDERED

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

2150192-1

FORM PTO-1449 U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Use several sheets if necessary)	ATTY. DOCKET NO. I-2-0674US05	SERIAL NO. 13/908,242
	APPLICANT Zhang et al.	
	FILING DATE June 3, 2013	GROUP 2473

EXAMINER INITIAL		DESCRIPTION (Including Author, Title, Date, Pertinent Pages, Etc.)
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; UTRAN lub interface NBAP signaling (Release 1999)," 3GPP TS 25.433 V3.14.0 (September 2003).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; UTRAN lub interface NBAP signaling (Release 4)," 3GPP TS 25.433 V4.10.0 (September 2003).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; UTRAN lub interface NBAP signaling (Release 4)," 3GPP TS 25.433 V4.13.0 (September 2004).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; UTRAN lub interface NBAP signaling (Release 5)," 3GPP TS 25.433 V5.6.0 (September 2003).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; UTRAN lub interface NBAP signaling (Release 5)," 3GPP TS 25.433 V5.10.0 (September 2004).
		3GPP, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; UTRAN lub interface NBAP signaling (Release 6)," 3GPP TS 25.433 V6.3.0 (September 2004).
		3GPP, "Third Generation Partnership Project; Technical Specification Group Radio Access Network; FDD Enhanced Uplink; Overall Description; Stage 2 (Release 6)," 3GPP TS 25.309 V6.0.0 (September 2004).
		3GPP2 C.20003-C, "Medium Access Control (MAC) Standard for cdma2000 Spread Spectrum Systems", 3rd Generation Partnership Project 2 "3GPP2", Version 2.0, Release C, August 2004.
		3GPP2 C.S0004-C, "Signaling Link Access Control (LAC) Standard for cdma2000 Spread Spectrum Systems", 3rd Generation Partnership Project 2 "3GPP2", Version 2.0, Revision C, July 23, 2004.
		3GPP2 C.S0005-C, "Upper Layer (Layer 3) Signaling Standard for cdma2000 Spread Spectrum Systems", 3rd Generation Partnership Project 2 "3GPP2", Version 2.0, Revision c, July 23, 2004.
		GPP2 C.S0002-C, "Physical Layer Standard for cdma2000 Spread Spectrum Systems", 3rd Generation Partnership Project 2 "3GPP2", Version 2.0, Revision C, July 23, 2004.

X** Abstract only

[1] Corresponds to RU2004104196; [2] Corresponds to RU 2006130462; [3] Corresponds to RU 2001135846; [4] Corresponds to WO 03/067953; [5] Corresponds to WO 98/47253; [6] Corresponds to US 2002/0045448.

EXAMINER	DATE CONSIDERED

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

2150192-1

Electronic Acknowledgement Receipt

EFS ID:	16830585
Application Number:	13908242
International Application Number:	
Confirmation Number:	5287
Title of Invention:	SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER
First Named Inventor/Applicant Name:	Guodong Zhang
Customer Number:	24374
Filer:	Robert D. Leonard/Carey Kulp
Filer Authorized By:	Robert D. Leonard
Attorney Docket Number:	I-2-0674US05
Receipt Date:	11-SEP-2013
Filing Date:	03-JUN-2013
Time Stamp:	23:56:23
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	IDS.pdf	45526 9669991c789aa9aba053aa05af59fec658e a07	no	2
Warnings:					
Information:					

2	Information Disclosure Statement (IDS) Form (SB08)	pto1449.pdf	55634 37f32630ee0c09772898a4e548ff5e836bf06936	no	5

Warnings:	
Information:	
This is not an USPTO supplied IDS fillable form	
Total Files Size (in bytes):	101160

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

New Applications Under 35 U.S.C. 111

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

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

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

New International Application Filed with the USPTO as a Receiving Office

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

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the PATENT APPLICATION of:	
	Zhang et al.
Application No.:	13/908,242
Confirmation No.:	5287
Filed:	June 3, 2013
For:	SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER
Group:	2473
Examiner:	Kwang Bin Yao

Our File:	I-2-0674US05
Date:	September 11, 2013

INFORMATION DISCLOSURE STATEMENT

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

Madam:

Further to Applicants' Duty of Disclosure pursuant to 37 C.F.R. §1.56, Applicants wish to bring to the Examiner's attention the material cited on the enclosed Form PTO-1449.

This Application is a continuation of Non-Provisional Application No. 13/308,950, filed on December 1, 2011, which issued on June 4, 2013 as U.S. Patent No. 8,457,072, which is a continuation of Non-Provisional Application No. 11/434,330, which was filed on May 15, 2006, which issued on March 6, 2012 as US Patent 8,130,720, which is a continuation of Non-Provisional Application No. 10/962,720, filed

on October 12, 2004, which issued on May 16, 2006 as U.S. Patent No. 7,046,648, which claims priority from Provisional Application No. 60/578,674, which was filed on June 10, 2004, Provisional Application No. 60/520,692, which was filed on November 17, 2003, Provisional Application No. 60/519,990, which was filed on November 14, 2003, and Provisional Application No. 60/517,656, which was filed on November 5, 2003.

Pursuant to 37 C.F.R. §1.98(d) copies of documents cited in the parent application are not enclosed, but copies will be provided upon request.

It is respectfully requested that the Examiner consider these documents and return an initialed copy of the Form PTO-1449 indicating his consideration of the cited materials.

Respectfully submitted,

Zhang et al.

By /Thomas A. Mattioli/
Thomas A. Mattioli
Registration No. 56,773
(215) 568-6400

Volpe and Koenig, P.C.
United Plaza, Suite 1600
30 South 17th Street
Philadelphia, PA 19103

TAM/PCK
Enclosure

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
13/908,242	06/03/2013	Guodong Zhang	I-2-0674US05

CONFIRMATION NO. 5287

24374
VOLPE AND KOENIG, P.C.
DEPT. ICC
UNITED PLAZA
30 SOUTH 17TH STREET
PHILADELPHIA, PA 19103

PUBLICATION NOTICE

OC00000064179074

Title:SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER

Publication No.US-2013-0259002-A1
Publication Date:10/03/2013

NOTICE OF PUBLICATION OF APPLICATION

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

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Office of Public Records. The Office of Public Records can be reached by telephone at (703) 308-9726 or (800) 972-6382, by facsimile at (703) 305-8759, by mail addressed to the United States Patent and Trademark Office, Office of Public Records, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently http://pair.uspto.gov/. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

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

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

Title of Invention	SUPPORTING ENHANCED UPLINK TRANSMISSION DURING SOFT HANDOVER

As the below named inventor, I hereby declare that:

This declaration is directed to: ☐ The attached application, or

☑ United States application or PCT international application number 13/908,242

filed on June 3, 2013.

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

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

I have reviewed and understand the contents of the above-identified application, including the claims.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in 37 CFR 1.56.

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

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Guodong Zhang Date: 8/29/13

Signature:

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

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. This information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14.

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

Title of invention	SUPPORTING ENHANCED UPLINK TRANSMISSION DURING SOFT HANDOVER

As the below named inventor, I hereby declare that:

This declaration is directed to: ☐ The attached application, or

☑ United States application or PCT international application number 13/908,242

filed on June 3, 2013.

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

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

I have reviewed and understand the contents of the above-identified application, including the claims.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in 37 CFR 1.56.

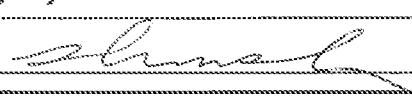
I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Sung-Hyuk Shin Date: Sep 1, 2013

Signature: 

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

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14.

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

Title of Invention	SUPPORTING ENHANCED UPLINK TRANSMISSION DURING SOFT HANDOVER

As the below named inventor, I hereby declare that:

This declaration is directed to: ☐ The attached application, or

☑ United States application or PCT international application number 13/908,242

filed on June 3, 2013.

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

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

I have reviewed and understand the contents of the above-identified application, including the claims.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in 37 CFR 1.56

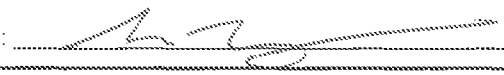
I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Stephen E. Terry Date: 10/3/13

Signature: 

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

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14.

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

Title of Invention	SUPPORTING ENHANCED UPLINK TRANSMISSION DURING SOFT HANDOVER

As the below named inventor, I hereby declare that:

This declaration is directed to:

☐ The attached application, or

☑ United States application or PCT international application number 13/908,242

filed on June 3, 2013.

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

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

I have reviewed and understand the contents of the above-identified application, including the claims.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in 37 CFR 1.56.

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

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: James M. Miller Date: 8/29/13

Signature: James M. Miller

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

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14.

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

Title of Invention	SUPPORTING ENHANCED UPLINK TRANSMISSION DURING SOFT HANDOVER

As the below named inventor, I hereby declare that:

This declaration is directed to:

☐ The attached application, or

☑ United States application or PCT international application number 13/908,242

filed on June 3, 2013.

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

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

I have reviewed and understand the contents of the above-identified application, including the claims.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in 37 CFR 1.56.

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

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Stephen G. Dick Date: 6/3/13

Signature: Stephen G. Dick

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

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14.

Electronic Acknowledgement Receipt

EFS ID:	17221981
Application Number:	13908242
International Application Number:	
Confirmation Number:	5287
Title of Invention:	SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER
First Named Inventor/Applicant Name:	Guodong Zhang
Customer Number:	24374
Filer:	Thomas A Mattioli/Angel Wolf
Filer Authorized By:	Thomas A Mattioli
Attorney Docket Number:	I-2-0674US05
Receipt Date:	25-OCT-2013
Filing Date:	03-JUN-2013
Time Stamp:	11:47:12
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Oath or Declaration filed	20131025_I_2_0674US05_Declarations.PDF	679235 84db8be8b6f9ac1104348de719aedcb7e117b57d	no	5
Warnings:					
Information:					

Total Files Size (in bytes):	679235

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.

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the PATENT APPLICATION of:	
	Zhang et al.
Application No.:	13/908,242
Confirmation No.:	5287
Filed:	June 3, 2013
For:	SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER
Group:	2473
Examiner:	Kwang Bin Yao

Our File:	SIG-2-0674US05
Date:	June 18, 2014

PRELIMINARY AMENDMENT

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

Prior to examination, please amend the application as follows:

AMENDMENTS TO THE CLAIMS

This listing of the claims will replace all prior versions of the claims in the application:

1. (Original) A Node B comprising:

a circuit configured to receive uplink data from a first wireless transmit/receive unit (WTRU) in a first cell;

wherein the first WTRU is simultaneously transmitting the same uplink data to a plurality of cells including a first cell and at least one second cell;

wherein the circuit is further configured to transmit first scheduling information to the first WTRU using the first cell;

wherein the circuit is further configured to transmit hybrid automatic repeat requests (HARQ) acknowledgments (ACKs) and HARQ negative acknowledgments (NACKs) to the first WTRU using the first cell;

wherein the circuit is further configured to receive the uplink data from a second WTRU in the first cell; wherein the second WTRU is simultaneously transmitting the uplink data to the plurality of cells;

wherein the first cell is not the primary cell and at least a third cell of the plurality of cells is the primary cell;

wherein the circuit is further configured to not transmit first scheduling information to the second WTRU using the first cell;

wherein the second WTRU receives the first scheduling information from the third cell; and

wherein the circuit is further configured to not transmit the HARQ NACKs to the second WTRU using the first cell; wherein the first WTRU receives the HARQ

ACKS and NACKs from the third cell.

2. (Original) The Node B of claim 1 wherein the circuit is further configured to receive information from a radio network controller designating the first cell as being the primary cell.

3. (Original) The Node B of claim 2 wherein the simultaneous uplink data transmissions include a WTRU identification.

4. (Original) A wireless transmit/receive unit (WTRU) comprising:

circuitry configured to simultaneously transmit a same uplink data to a plurality of cells including a first cell and a second cell;

circuitry configured to receive first scheduling information from the first cell;

circuitry configured to receive hybrid automatic repeat requests (HARQ) acknowledgments (ACKs) and HARQ negative acknowledgments (NACKs) from the first cell;

wherein the first cell is not the primary cell and the second cell of the plurality of cells is the primary cell; and

wherein the WTRU receives the HARQ ACKS and NACKs from the second cell.

5. (Original) The WTRU of claim 4 wherein the circuit is further configured to receive information from a radio network controller designating the first cell as being the primary cell.

6. (Original) The WTRU of claim 4 wherein the simultaneous uplink data transmissions include a WTRU identification.

7. (New) A method, comprising:

transmitting, to a wireless transmit/receive unit (WTRU), specified uplink scheduling information, wherein the specified uplink scheduling information is not transmitted to the WTRU by any non-primary Node-B (210B);

receiving at least one data packet from the WTRU in response to transmitting the specified uplink scheduling information;

performing a cyclic redundancy check (CRC) on a received data packet;

transmitting an acknowledgement (ACK) or a negative acknowledgement (NACK) to the WTRU in response to a received data packet, wherein the transmission of either the ACK or NACK is based on the result of the CRC, and wherein the NACK is not transmitted to the WTRU by any non-primary Node-B; and

transmitting a successfully decoded data packet to a radio network controller (RNC).

8. (New) The method of claim 7, further comprising:

soft combining, at a primary Node-B, the data packet, stored in a buffer, with a retransmission of the data packet.

9. (New) The method of claim 8, further comprising:

storing a NACKed data packet in the buffer, wherein the NACKed data packet is not stored by any non-primary Node-B.

10. (New) A wireless multi-cell communication system, comprising:

a Node-B operating as a primary Node-B and at least one Node-B operating as a non-primary Node-B;

a receiver in the primary Node-B configured to receive at least one data packet from a wireless transmit/receive unit (WTRU) in response to transmitting specified uplink scheduling information, wherein the primary Node-B configured to perform a cyclic redundancy check (CRC) on a received data packet; and

a transmitter in the primary Node-B configured to transmit to the WTRU the specified uplink scheduling information, wherein the specified uplink scheduling information is not transmitted to the WTRU by any non-primary Node-B (210B);

the transmitter further configured to transmit an acknowledgement (ACK) or a negative acknowledgement (NACK) to the WTRU in response to a received data packet, wherein the transmission of either the ACK or the NACK is based on the result of the CRC;

the transmitter further configured to transmit successfully decoded data packets to a radio network controller (RNC); and

the at least one non-primary Node-B configured not to transmit a NACK to the WTRU in response to the received data packet.

11. (New) The system of claim 10, the primary Node-B further comprising:

a processor configured to soft combine the data packet, stored in a buffer, with a retransmission of the data packet.

12. (New) The system of claim 10, the primary Node-B further comprising:

a processor configured to store a NACKed data packet in a buffer, wherein the NACKed data packet is not stored by any non-primary Node-B.

REMARKS

Early consideration and allowance of the pending claims is respectfully requested.

Respectfully submitted,

SIGNAL TRUST FOR
WIRELESS INNOVATION

By /Abhik A. Huq/
Abhik A. Huq
Registration No. 40,656
(215) 568-6400

Volpe and Koenig, P.C.
United Plaza
30 South 17th Street
Philadelphia, PA 19103-4009

AAH/say

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
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

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

I hereby appoint:

■ Practitioners associated with Customer Number: 03624

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: 03624

OR

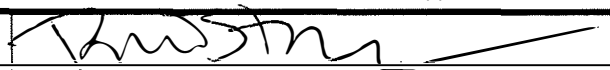
☐	Firm or Individual Name	Volpe and Koenig, P.C.	
	Address		
	City	State	Zip
	Country		
	Telephone	Email	

Assignee Name and Address: Signal Trust For Wireless Innovation
1011 Centre Road, Suite 327
Wilmington, Delaware 19805

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be Filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of The practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature		Date	November 25, 2013
Name	HCJ Advisors LLC, as Trustee, by Bruce Bernstein	Telephone	302-573-3819
Title	President		

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

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

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

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

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

PTO/AIA/96 (08-12)
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: Signal Trust for Wireless Innovation

Application No./Patent No.: 13/908,242 Filed/Issue Date: June 3, 2013

Titled: SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER

Signal Trust for Wireless Innovation, 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: Guodong Zhang, Sung-HyukShin, Stephen E. Terry, James M. Miller and Stephen G. Dick To: INTERDIGITAL TECHNOLOGY CORPORATION

   The document was recorded in the United States Patent and Trademark Office at Reel 019109, Frame 0717, or for which a copy thereof is attached.

2. From: INTERDIGITAL TECHNOLOGY CORPORATION To: INTERDIGITAL HOLDINGS, INC.

   The document was recorded in the United States Patent and Trademark Office at Reel 031434, Frame 0015, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

3. From: INTERDIGITAL HOLDINGS, INC. To: INTERDIGITAL, INC.

The document was recorded in the United States Patent and Trademark Office at
Reel 031434, Frame 0249, or for which a copy thereof is attached.

4. From: INTERDIGITAL, INC. To: DST HOLDINGS, INC.

The document was recorded in the United States Patent and Trademark Office at
Reel 031434, Frame 0302, or for which a copy thereof is attached.

5. From: DST HOLDINGS, INC. To: SIGNAL TRUST FOR WIRELESS INNOVATION

The document was recorded in the United States Patent and Trademark Office at
Reel 031597, Frame 0485, 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.

/Abhik A. Huq/	June 18, 2014
Signature	Date
Abhik A. Huq	40,656
Printed or Typed Name	Title or Registration Number

Privacy Act Statement

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

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

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

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~1-2-0674US05~~ SIG-2-0674US05
	Application Number	13/908,242
Title of Invention	SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER	

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

Secrecy Order 37 CFR 5.2

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

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Guodong		Zhang	

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

City	Syosset	State/Province	NY	Country of Residence	US

Mailing Address of Inventor:

Address 1	14 Walnut Drive		
Address 2			
City	Syosset	State/Province	NY
Postal Code	11791	Country	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Sung-Hyuk		Shin	

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

City	Northvale	State/Province	NJ	Country of Residence	US

Mailing Address of Inventor:

Address 1	104 Eidner Way		
Address 2			
City	Northvale	State/Province	NJ
Postal Code	07647	Country	US

Inventor 3 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Stephen	E.	Terry	

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

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~1-2-0674US05~~ SIG-2-0674US05
	Application Number	13/908,242
Title of Invention	SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER	

City	Northport	State/Province	NY	Country of Residence	US

Mailing Address of Inventor:

Address 1	15 Summit Avenue		
Address 2			
City	Northport	State/Province	NY
Postal Code	11768	Country	US

Inventor 4 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	James	M.	Miller	

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

City	Verona	State/Province	NJ	Country of Residence	US

Mailing Address of Inventor:

Address 1	18 Louisburg Square		
Address 2			
City	Verona	State/Province	NJ
Postal Code	07044	Country	US

Inventor 5 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Stephen	G.	Dick	

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

City	Nesconset	State/Province	NY	Country of Residence	US

Mailing Address of Inventor:

Address 1	61 Bobann Drive		
Address 2			
City	Nesconset	State/Province	NY
Postal Code	11767	Country	US

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

Correspondence Information:

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

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

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~I-2-0674US05~~ SIG-2-0674US05
	Application Number	13/908,242
Title of Invention	SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER	

Customer Number	~~24574~~ 03624		
Email Address	eoffice@vklaw.com	Add Email	Remove Email

Application Information:

Title of the Invention	SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER		
Attorney Docket Number	~~I-2-0674US05~~ SIG-2-0674US05	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	4	**Suggested Figure for Publication (if any)**	3

Publication Information:

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

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

Representative Information:

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

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	~~24374~~ 03624		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
13908242	Continuation of	13308950	2011-12-01

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13308950	Continuation of	11434330	2006-05-15	8130720	2012-03-06

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~1-2-0674US05~~ SIG-2-0674US05
	Application Number	13/908,242
Title of Invention	SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER	

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
11434330	Continuation of	10962720	2004-10-12	7046648	2006-05-16

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
10962720	non provisional of	60578674	2004-06-10

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
10962720	non provisional of	60520692	2003-11-17

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
10962720	non provisional of	60519990	2003-11-14

Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
10962720	non provisional of	60517656	2003-11-05

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

Foreign Priority Information:

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

			Remove
Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

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

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~I-2-0674US05~~ SIG-2-0674US05
	Application Number	13/908,242
Title of Invention	SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER	

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

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

Authorization to Permit Access:

☒ Authorization to Permit Access to the Instant Application by the Participating Offices

If checked, the undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date of filing this Authorization.

Applicant Information:

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

Applicant 1

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

Clear

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

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. OMB 0651-0032
U.S Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~1-2-0674US05~~ SIG-2-0674US05
	Application Number	13/908,242
Title of Invention	SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER	

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

Name of the Deceased or Legally Incapacitated Inventor :

If the Applicant is an Organization check here. ☒

Organization Name: ~~InterDigital Technology Corporation~~ Signal Trust for Wireless Innovation

Mailing Address Information For Applicant:

Address 1	~~200 Bellevue Parkway~~ 1011 Centre Road		
Address 2	~~Suite 300~~ Suite 327		
City	Wilmington	**State/Province**	DE
Country	US	Postal Code	~~19809~~ 19805
Phone Number		Fax Number	
Email Address			

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

Non-Applicant Assignee Information:

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

Assignee 1

Complete this section only if non-applicant assignee information is desired to be included on the patent application publication in accordance with 37 CFR 1.215(b). Do not include in this section an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest), as the patent application publication will include the name of the applicant(s).

If the Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

PTO/AIA/14 (03-13)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~1-2-0674US05~~ SIG-2-0674US05
	Application Number	13/908,242
Title of Invention	SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER	

Mailing Address Information For Non-Applicant Assignee:			
Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

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

Signature:

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

Signature	~~/Thomas A. Mattioli/~~ /Abhik A. Huq/			Date (YYYY-MM-DD)	~~2013-06-03~~ 2014-06-18
First Name	~~Thomas~~ Abhik A.	Last Name	~~Mattioli~~ Huq	Registration Number	~~56773~~ 40656

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

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

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

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

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

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

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

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

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Co o p eration 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:	13908242
Filing Date:	03-Jun-2013
Title of Invention:	SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER
First Named Inventor/Applicant Name:	Guodong Zhang
Filer:	Abhik A. Huq/Sandy Yi
Attorney Docket Number:	SIG-2-0674US05

Filed as Large Entity

Utility under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Independent claims in excess of 3	1201	1	420	420
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
			Total in USD ($)	**420**

Electronic Acknowledgement Receipt

EFS ID:	19337019
Application Number:	13908242
International Application Number:	
Confirmation Number:	5287
Title of Invention:	SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER
First Named Inventor/Applicant Name:	Guodong Zhang
Customer Number:	24374
Filer:	Abhik A. Huq/Sandy Yi
Filer Authorized By:	Abhik A. Huq
Attorney Docket Number:	SIG-2-0674US05
Receipt Date:	18-JUN-2014
Filing Date:	03-JUN-2013
Time Stamp:	14:42:17
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$420
RAM confirmation Number	993
Deposit Account	220493
Authorized User	HUQ, ABHIK A.

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		20140618_SIG_2_0674US05_Prel_Amend.pdf	73701 72c3148c379966af313d4239939b0b93d2003556	yes	6

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Preliminary Amendment	1	1
	Claims	2	5
	Applicant Arguments/Remarks Made in an Amendment	6	6

Warnings:

Information:

2	Power of Attorney	SIG_Trust_POA.PDF	165839 2a002e9c7289f27f2d31af413491301f13334d9b	no	2

Warnings:

Information:

3	Assignee showing of ownership per 37 CFR 3.73.	20140618_SIG_2_0674US05_373c.pdf	4235393 e239a94ced4c96229bd26f4749d77addecd789b5	no	3

Warnings:

Information:

4	Application Data Sheet	20140618_SIG_2_0674US05_Suppl_ADS.pdf	5579746 afb7685835f2c7275f5134eadde40b7b233db256	no	8

Warnings:

Information:

This is not an USPTO supplied ADS fillable form

5	Fee Worksheet (SB06)	fee-info.pdf	30733 68598705adbf00f995f7823588053ca3b63d20fe	no	2

Warnings:

Information:

Total Files Size (in bytes):	10085412

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

New Applications Under 35 U.S.C. 111

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

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

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

New International Application Filed with the USPTO as a Receiving Office

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

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 13/908,242	Filing Date 06/03/2013	☐ To be Mailed

ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)		
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)
☒ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	**280**
☒ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	**600**
☒ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	**720**
TOTAL CLAIMS (37 CFR 1.16(i))	6 minus 20 =	* 0	x $80 =	**0**
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	* 0	x $420 =	**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 $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	**1600**

APPLICATION AS AMENDED – PART II

AMENDMENT	06/18/2014	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 12	Minus	** 20	= 0	x $80 =	0
	Independent (37 CFR 1.16(h))	* 4	Minus	***3	= 1	x $420 =	420
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	**420**

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

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

LDRC
/SUSAN HAY/

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.

Doc Code: N572

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 DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
13/908,242	06/03/2013	Guodong Zhang	SIG-2-0674US05

CONFIRMATION NO. 5287

OC000000069168919

24374
VOLPE AND KOENIG, P.C.
DEPT. ICC
UNITED PLAZA
30 SOUTH 17TH STREET
PHILADELPHIA, PA 19103

DATE: 06/18/14

03624
VOLPE AND KOENIG, P.C.
UNITED PLAZA
30 SOUTH 17TH STREET
PHILADELPHIA, PA 19103

DENIAL OF REQUEST FOR POWER OF ATTORNEY

The request for Power of Attorney filed 06/18/14 is acknowledged. However, the request cannot be granted at this time for the reason stated below.

- ☐ The Power of Attorney you provided did not comply with the new Power of Attorney rules that became effective on June 25, 2004. See 37 CFR 1.32.
- ☐ The revocation is not signed by the applicant, the assignee of the entire interest, or one particular principal attorney having the authority to revoke.
- ☐ The Power of Attorney is from an assignee and the Certificate required by 37 CFR 3.73(c) has not been received.
- ☐ The person signing for the assignee has omitted their empowerment to sign on behalf of the assignee.
- ☐ The inventor(s) is without authority to appoint attorneys since the assignee has intervened as provided by 37 CFR 3.71.
- ☐ The signature(s) of _____, a co-inventor in this application, has been omitted. The Power of Attorney will be entered upon receipt of confirmation signed by said co-inventor(s).
- ☐ The person(s) appointed in the Power of Attorney is not registered to practice before the U.S. Patent and Trademark Office.
- ☐ Only one Customer Number can be designated for the Power of Attorney in an application. The Customer Number that was captured is the first Customer Number provided on the Power of Attorney document.

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

- ☐ A request under 37 CFR 1.48 to add an inventor was granted in this application, however, no power of attorney consistent with the power of attorney granted by the originally named inventive entity has been received. Thus, the addition of the inventor has resulted in the loss of power of attorney in the application. See 37 CFR 1.32(e).

- ☑ The power of attorney has not been accepted because the party who is giving power of attorney has not been identified. Power of attorney may only be signed by the applicant for patent (37 CFR 1.42) or the patent owner. A patent owner who was not the applicant must appoint any power of attorney in compliance with 37 CFR 3.71 and 3.73. See 37 CFR 1.32(b)(4).

- ☐ The power of attorney from the inventors has not been accepted because it is a copy from a prior national application for which benefit is claimed and the continuing application names an inventor who was not named as an inventor in the prior application.

- ☐ The power of attorney from the inventors has not been accepted because the power of attorney must be signed by the applicant for patent. See 37 CFR 1.32(b)(4).

- ☑ Any request to correct or update the name of the applicant must include an application data sheet (ADS) in compliance with 37 CFR 1.76 specifying the correct or updated name of the applicant in the applicant information section. Any request to change the applicant after an original applicant has been specified under 37 CFR 1.46(b) must include a new ADS in compliance with 37 CFR 1.76 specifying the applicant in the applicant information section and comply with 37 CFR 3.71 and 3.73. See 37 CFR 1.46(c).

Any inquiries regarding this notice should be directed to the Application Assistance Unit at 571-272-4200.

AP

Application Assistance Unit
571-272-4200

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
13/908,242	06/03/2013	Guodong Zhang	SIG-2-0674US05

CONFIRMATION NO. 5287

24374
VOLPE AND KOENIG, P.C.
DEPT. ICC
UNITED PLAZA
30 SOUTH 17TH STREET
PHILADELPHIA, PA 19103

MISCELLANEOUS NOTICE

OC000000069168919

Date Mailed: 06/23/2014

A communication which cannot be delivered in electronic form has been mailed to the applicant.

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
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13908242
Filing Date	2013-06-03
First Named Inventor	Zhang et al.
Art Unit	2473
Examiner Name	Kwang Bin Yao
Attorney Docket Number	SIG-2-0674US05

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	5794149	B1	1998-08-11	Hoo	
	2	5946320	B1	1999-08-31	Decker et al.	
	3	6434396	B1	2002-08-13	Rune	
	4	6643813	B1	2003-11-04	Johansson et al.	
	5	6678523	B1	2004-01-13	Ghosh et al.	* Corresponds to WO 02/37872, JP 2004-519122, and KR 2003-0048115
	6	6907245	B2	2005-06-14	Ohlsson et al.	* Corresponds to TW 515212
	7	6915465	B2	2005-07-05	Fujiwara et al.	
	8	6977888	B1	2005-12-20	Frenger et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	13908242
	Filing Date	2013-06-03
	First Named Inventor	Zhang et al.
	Art Unit	2473
	Examiner Name	Kwang Bin Yao
	Attorney Docket Number	SIG-2-0674US05

	9	7046648	B2	2006-05-16	Zhang et al.	
	10	7054633	B2	2006-05-30	Seo et al.	
	11	7103729	B2	2006-09-05	Altahan et al.	
	12	7124350	B2	2006-10-17	Chao et al.	
	13	7158504	B2	2007-01-02	Kadaba et al.	* Corresponds to JP 2002-369261
	14	7185256	B2	2007-02-27	Miki et al.	* Corresponds to JP 2002-009741
	15	7269420	B2	2007-09-11	Heo et al.	
	16	7283508	B2	2007-10-16	Choi et al.	
	17	7315741	B2	2008-01-01	Chun	
	18	7317700	B2	2008-01-08	Hwang	
	19	7403513	B2	2008-07-22	Lee et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	13908242
	Filing Date	2013-06-03
	First Named Inventor	Zhang et al.
	Art Unit	2473
	Examiner Name	Kwang Bin Yao
	Attorney Docket Number	SIG-2-0674US05

	20	8023463	B2	2011-09-20	Dick et al.	

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	20020093937	A1	2002-07-18	Kim et al.	* Corresponds to RU 2002116683
	2	20030081692	A1	2003-05-01	Kwan et al.	
	3	20030202500	A1	2003-10-30	Ha et al.	* Corresponds to RU 2003137005
	4	20060045010	A1	2006-03-02	Baker et al.	* Corresponds to RU 2005106865
	5	20060105796	A1	2006-05-18	Malladi et al.	* Corresponds to RU 2005128547
	6	20070079207	A1	2007-04-05	Seidel et al.	* Corresponds to RU 2006107917

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]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	13908242
	Filing Date	2013-06-03
	First Named Inventor	Zhang et al.
	Art Unit	2473
	Examiner Name	Kwang Bin Yao
	Attorney Docket Number	SIG-2-0674US05

	1	1217777	EP	A1	2002-06-26	Dold et al.		☐
	2	20030003943	KR	A	2003-01-14	Hong et al.	* An English abstract has been provided.	☐
	3	02037872	WO	A2	2002-05-10	Ghosh et al.		☐
	4	02047317	WO	A	2002-06-13	Wigell et al.		☐
	5	02082108	WO	A1	2002-10-17	Cheng et al.		☐
	6	02101966	WO	A2	2002-12-19	Cheng et al.		☐
	7	03047155	WO	A1	2003-06-05	Torsner et al.		☐

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

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	HECK ET AL., "Diversity Effects on the Soft Handover Gain in UMTS Networks," Proceedings of the IEEE Vehicular Technology Conference, volume 2, pp. 1269-1273 (September 2002).	☐
	2	INTERDIGITAL, "Performance Analysis of HARQ in Soft Handover," 3GPP TSG-RAN WG1 #34 meeting, R1-030979 (October 6-10, 2003).	☐

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	13908242
	Filing Date	2013-06-03
	First Named Inventor	Zhang et al.
	Art Unit	2473
	Examiner Name	Kwang Bin Yao
	Attorney Docket Number	SIG-2-0674US05

	3	NOKIA, "HARQ overhead issues", TSG-RAN1 #33, R1-030733 (August 25-29, 2003).	☐
	4	R1-030803, "HARQ operation during Soft Handover", Panasonic, TSG RAN1 #33	☐
	5	SAMSUNG, "HARQ performance in soft handover", TSG RAN1 #33, R1-030765 (August 25-29, 2003).	☐
	6	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Feasibility Study for Enhanced Uplink for UTRA FDD; (Release 6," 3GPP TR 25.896 V0.4.2 (R1-030952) (September 2003).	☐
	7	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Requirements for support of radio resource management (FDD) (Release 1999)," 3GPP TS 25.133 V3.19.0 (September 2004).	☐
	8	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Requirements for support of radio resource management (FDD) (Release 4)," 3GPP TS 25.133 V4.10.0 (September 2003).	☐
	9	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Requirements for support of radio resource management (FDD) (Release 4)," 3GPP TS 25.133 V4.13.0 (September 2004).	☐
	10	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Requirements for support of radio resource management (FDD) (Release 5)," 3GPP TS 25.133 V5.12.0 (September 2004).	☐
	11	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Requirements for support of radio resource management (FDD) (Release 6)," 3GPP TS 25.133 V6.7.0 (September 2004).	☐
	12	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Requirements for support of radio resource management (FDD) (Release 1999)," 3GPP TS 25.133 V3.15.0 (September 2003).	☐
	13	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Requirements for support of radio resource management (FDD) (Release 5)," 3GPP TS 25.133 V5.8.0 (September 2003).	☐

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	13908242
	Filing Date	2013-06-03
	First Named Inventor	Zhang et al.
	Art Unit	2473
	Examiner Name	Kwang Bin Yao
	Attorney Docket Number	SIG-2-0674US05

	14	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Requirements for support of radio resource management (FDD) (Release 6)," 3GPP TS 25.133 V6.3.0 (September 2003).	☐
	15	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Physical layer procedures (FDD) (Release 1999)," 3GPP TS 25.214 V3.12.0 (March 2003).	☐
	16	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Physical layer procedures (FDD) (Release 4)," 3GPP TS 25.214 V4.6.0 (March 2003).	☐
	17	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Physical layer procedures (FDD) (Release 5)," 3GPP TS 25.214 V5.6.0 (September 2003).	☐
	18	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Physical layer procedures (FDD) (Release 5)," 3GPP TS 25.214 V5.9.0 (June 2004).	☐
	19	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Physical channels and mapping of transport channels onto physical channels (FDD) (Release 1999)," 3GPP TS 25.211 V3.12.0 (September 2002).	☐
	20	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Physical channels and mapping of transport channels onto physical channels (FDD) (Release 4)," 3GPP TS 25.211 V4.6.0 (September 2002).	☐
	21	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Physical channels and mapping of transport channels onto physical channels (FDD) (Release 5)," 3GPP TS 25.211 V5.5.0 (September 2003).	☐
	22	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Physical channels and mapping of transport channels onto physical channels (FDD) (Release 5)," 3GPP TS 25.211 V5.6.0 (September 2004).	☐
	23	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Physical channels and mapping of transport channels onto physical channels (FDD) (Release 6)," 3GPP TS 25.211 V6.2.0 (September 2004).	☐
	24	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Physical layer procedures (FDD) (Release 6)," 3GPP TS 25.214 V6.3.0 (September 2004).	☐

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	13908242
	Filing Date	2013-06-03
	First Named Inventor	Zhang et al.
	Art Unit	2473
	Examiner Name	Kwang Bin Yao
	Attorney Docket Number	SIG-2-0674US05

	25	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; High Speed Downlink Packet Access (HSDPA); Overall description; Stage 2 (Release 6)," 3GPP TS 25.308 V6.2.0 (September 2004).	☐
	26	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; High Speed Downlink Packet Access (HSDPA); Overall description; Stage 2 (Release 5)," 3GPP TS 25.308 V5.6.0 (September 2004).	☐
	27	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; High Speed Downlink Packet Access (HSDPA); Overall description; Stage 2 (Release 5)," 3GPP TS 25.308 V5.4.0 (March 2003).	☐
	28		☐

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	13908242
	Filing Date	2013-06-03
	First Named Inventor	Zhang et al.
	Art Unit	2473
	Examiner Name	Kwang Bin Yao
	Attorney Docket Number	SIG-2-0674US05

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	/Abhik A. Huq/	Date (YYYY-MM-DD)	2014-08-13
Name/Print	Abhik A. Huq	Registration Number	40,656

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.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
10 May 2002 (10.05.2002)

PCT

(10) International Publication Number
WO 02/37872 A2

(51) International Patent Classification[7]: H04Q 7/00

(21) International Application Number: PCT/US01/31508

(22) International Filing Date: 9 October 2001 (09.10.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
09/705,850 3 November 2000 (03.11.2000) US

(71) Applicant: **MOTOROLA, INC. A corporation of the State of Delaware** [US/US]; 1303 East Algonquin Road, Schaumubrg, IL 60196 (US).

(72) Inventors: **GHOSH, Amitava**; 289 Hunter Court, Vernon Hills, IL 60061 (US). **JALLOUL, Louay**; 1501 Churchill Drive, Apt. 104, Palatine, IL 60067 (US).

(74) Agents: **WILLIAMS, Lalita, P.** et al.; Motorola, Inc., Intellectual Property Dept., 1303 East Algonquin Road, Schaumburg, IL 60196 (US).

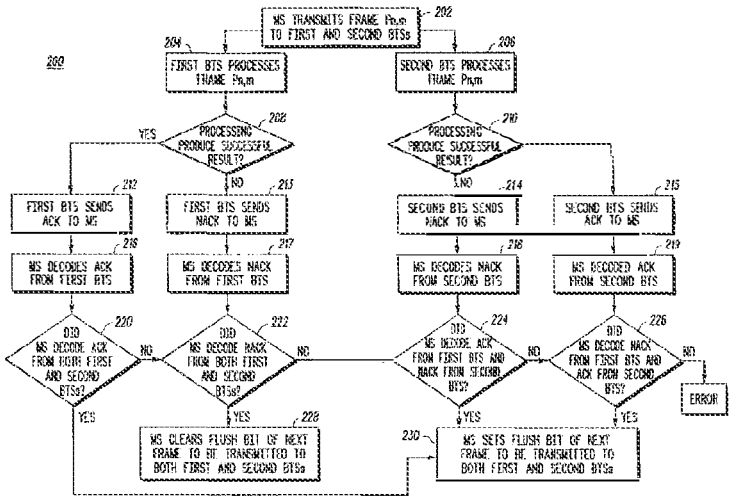
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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: CLOSED LOOP METHOD FOR REVERSE LINK SOFT HANDOFF HYBRID AUTOMATIC REPEAT REQUEST



(57) Abstract: A method of combining soft-handoff with a hybrid ARQ scheme to maximize throughput and gain in a communications system. After receiving a frame from the MS (110), the BTSs (104 and 106) will process the frame and communicate to the MS over a forward control channel whether the frame contained any errors. If all BTSs communicate that the frame contains errors, the MS will retransmit the same frame to all BTSs with a flush bit set to instruct the BTSs 104 and 106 to combine the retransmitted frame with the original frame. If only some BTSs communicate that the frame contains errors, the MS will transmit the next frame to all BTSs that successfully decoded the frame with the flush bit set to instruct the BTSs to erase the previous frame from memory and not to combine the previous frame with the current frame. The MS will retransmit the frame to the BTSs that did not successfully decode the frame with the flush bit set to instruct the BTSs to combine the previous frame with the retransmitted frame.

WO 02/37872 A2

CLOSED LOOP METHOD FOR REVERSE LINK SOFT HANDOFF HYBRID AUTOMATIC REPEAT REQUEST

Field of the Invention

The present invention relates generally to communication systems and in particular to soft handoff combining hybrid automatic repeat request (ARQ).

Background of the Invention

Interim Standard IS-95-A (IS-95) has been adopted by the Telecommunications Industry Association for implementing CDMA in a cellular system. In a CDMA system, a mobile station communicates with any one or more of a plurality of base stations dispersed in a geographic region. Each base station continuously transmits a pilot channel signal having the same spreading code but with a different code phase offset. Phase offset allows the pilot signals to be distinguished from one another, which in turn allows the base stations to be distinguished. Hereinafter, a pilot signal of a base station will be simply referred to as a pilot. The mobile station monitors the pilots and measures the received energy of the pilots.

IS-95 defines a number of states and channels for communication between the mobile station and the base station. For example, in the Mobile Station Control on the Traffic State, the base station communicates with the mobile station over a Forward Traffic Channel, and the mobile station communicates with the base station over a Reverse Traffic Channel. During a call, the mobile station must constantly monitor and maintain four sets of pilots collectively referred to as the Pilot Set--the Active Set, the Candidate Set, the Neighbor Set, and the Remaining Set. The Active Set are pilots associated with the Forward Traffic Channel assigned to the mobile station. The

Candidate Set are pilots that are not currently in the Active Set but have been received by a particular mobile station with sufficient strength to indicate that the associated Forward Traffic Channel could be successfully demodulated. The Neighbor Set are pilots that are not currently in the Active Set or Candidate Set but are likely candidates for handoff. The Remaining Set are all possible pilots in the current system on the current CDMA frequency assignment, excluding the pilots in the Neighbor Set, the Candidate Set, and the Active Set.

The mobile station constantly searches a Pilot Channel of neighboring base stations for a pilot that is sufficiently stronger than a threshold value. The mobile station signals this event to the base station using the Pilot Strength Measurement Message. As the mobile station moves from the region covered by one base station to another, the base station promotes certain pilots from the Candidate Set to the Active Set, Neighbor Set to the Candidate Set, and notifies the mobile station of the promotions via a Handoff Direction Message. When the mobile station commences communication with a new base station in the new Active Set before terminating communications with the old base station, a "soft handoff" has occurred. For the reverse link, typically each base station demodulates and decodes each frame or packet independently. It is up to the switching center to arbitrate between the two base station's decoded frames. Such soft-handoff operation has multiple advantages. Qualitatively, this feature improves and renders more reliable handoff between base stations as a user moves from one cell to the adjacent one. Quantitatively soft-handoff improves the capacity/coverage in a CDMA system.

The CDG Phase-II (consortium of service providers that have set requirements for the next phase of wireless communications) requires a high peak rate (>1 Mbps) as well as higher average throughput (approximately 600 kbps) on the reverse link. To achieve

these requirements on the reverse link techniques such as hybrid ARQ and Adaptive Modulation and Coding are needed.

Adaptive Modulation and Coding (AMC) provides the flexibility to match the modulation and forward error correction (FEC) coding scheme to the average channel conditions for each user. AMC promises a large increase in average data rate for users that have a favorable channel quality due to their proximity to the base site or other geographical advantage. Enhanced GSM systems using AMC offer data rates as high as 384 kbps compared to 100 kbps without AMC. Likewise, 1.25 MHz CDMA systems can offer downlink peak data rates as high as 5 Mbps through AMC, where 460 kbps was typical without AMC. AMC, however, does have a few drawbacks. AMC is sensitive to measurement error and delay. In order to select the appropriate modulation, the scheduler must be aware of the channel quality. Errors in the channel estimate will cause the scheduler to select the wrong data rate and either transmit at too high a power, wasting system capacity, or too low a power, raising the block error rate. Delay in reporting channel measurements also reduces the reliability of the channel quality estimate due to constantly varying mobile channel. To overcome measurement delay, the frequency of the channel measurement reports may be increased, however, the measurement reports consume system capacity that otherwise night be used to carry data.

Hybrid ARQ (H-ARQ) is an implicit link adaptation technique. Whereas, in AMC explicit C/I measurements or similar measurements are used to set the modulation and coding format, in H-ARQ, link layer acknowledgements are used for re-transmission decisions. There are many schemes for implementing H-ARQ, such as, Chase combining, Rate compatible Punctured Turbo codes and Incremental Redundancy. Incremental redundancy or H-ARQ-type-II is another implementation of the H-ARQ technique wherein instead of sending simple repeats of the

entire coded packet, additional redundant information is incrementally transmitted if the decoding fails on the first attempt.

H-ARQ-type-III also belongs to the class of incremental redundancy ARQ schemes. However, with H-ARQ-type-III, each retransmission is self-decodable which is not the case with H-ARQ-type II. Chase combining (also called H-ARQ-type-III with one redundancy version) involves the retransmission by the transmitter of the same coded data packet. The decoder at the receiver combines these multiple copies of the transmitted packet weighted by the received SNR. Diversity (time) gain is thus obtained. In the H-ARQ-type-III with multiple redundancy version different puncture bits are used in each retransmission. The details for how to implement the various H-ARQ schemes are commonly known in the art and therefore are not discussed herein.

H-ARQ combined with AMC can greatly increase user throughputs, potentially doubling system capacity. In effect, Hybrid ARQ adapts to the channel by sending additional increments of redundancy, which increases the coding rate and effectively lowers the data rate to match the channel. Hybrid ARQ does not rely only on channel estimates but also relies on the errors signaled by the ARQ protocol. Currently, the H-ARQ function resides at the BTS while the reverse link soft-handoff is performed at the RNC. Furthermore, base stations can communicate only through the RNC.

Thus there is a need for a method of combining AMC and H-ARQ scheme(s) with soft handoff in the reverse link to maximize system throughput and gain.

Brief Description of the Drawings

FIG. 1 is a block diagram of a communication system that can implement the reverse link soft handoff using H-ARQ method of the present invention.

FIG. 2 is a flow chart of the soft handoff method of the present invention.

FIG. 3 is a flow chart of the processing block in the flow chart of FIG. 2

Summary of the Preferred Embodiment

The present invention provides a method of implementing soft handoff using hybrid ARQ scheme(s) to maximize system throughput and gain. In the presently preferred embodiment, the method includes the steps of: providing a plurality of base stations in communication with at least one RNC and in communication with a mobile station; transmitting a frame $P_{n,m}$ from the mobile station to a first of the plurality of base stations and to a second of the plurality of base stations;

at the first and second of the plurality of base stations, processing the frame $P_{n,m}$; and at the mobile station, determining whether to retransmit the frame $P_{n,m}$ or whether to transmit a next frame $P_{n+1,m}$ to the first and second of the plurality of base stations, wherein if the decision is to retransmit frame $P_{n,m}$, transmitting frame $P_{n,m+1}$, and at the first and second of the plurality of base stations, combining frame $P_{n,m}$ with frame $P_{n,m+1}$ using H-ARQ and if the decision is to transmit the next frame $P_{n+1,m}$, transmitting the next frame to the first and second of the plurality of base stations.

Description of the Preferred Embodiment

Soft-handoff on the reverse link (from the mobile station (MS) to the base station (BTS)) is an essential component of any Code Division

Multiple Access (CDMA) system. In a typical IS-95, IS-2000 or wideband CDMA (W-CDMA) system, the BTSs in soft handoff will decode packets or frames (hereinafter referred to as frames) transmitted by the MS. There can be a maximum of six (6) base stations in soft handoff. The quality information on the decoded frames is transmitted from the BTS up to the Radio Network Controller (RNC) or Selection Distribution Unit (SDU). The RNC selects the frame received from the BTS with the highest quality. Quantitatively, soft-handoff improves the capacity/coverage in a CDMA system.

Referring to FIG. 1, a block diagram of a communication system in accordance with the preferred embodiment of the present invention is shown. In the preferred embodiment, the communication system 100 includes an RNC 102 coupled to a first BTS 104 and a second BTS 106 through a 3GPP TSG UTRAN Iub Interface 108 (Iub Interface). The Iub interface 108 is described in Specification #3GTS25.430, v3.2.0, General Aspects and Principles. The first BTS 104 and the second BTS 106 are coupled to a MS 110. A BTS and MS that can be used with the present invention are available from Motorola, Inc. of Arlington Heights, Illinois. An RNC that can be used with the present invention can be purchased from several sources, such as, Alcatel of France and Nortel of Dallas, Texas. As will be described herein, during reverse link communications, the MS 110 transmits frames $P_{n,m}$ to the BTSs 104 and 106. In the chosen nomenclature, n refers to the frame number and m refers to the number of times the same frame has been transmitted from the MS 110 to a BTS 104 or 106. For example, $P_{1,2}$ refers to the first frame which is transmitted from the MS 110 to a BTS 104 or 106 for a second time (retransmitted).

The structure of the frames, as shown in FIG. 1, includes: (1) a flush (F) bit which indicates to the BTS when to combine a current frame with a previously stored frame or to flush the current buffer; (2)

data; (3) a cyclic redundancy check (CRC) bit which indicates whether a frame decoded successfully or not (i.e., whether the frame contained any errors); and (4) a tail bit (T) for flushing the channel decoder memory. The information contained in the frame is referred to herein as soft information. In accordance with the invention, the BTSs 104 and 106 will combine frames from multiple re-transmissions using an H-ARQ scheme.

In the presently preferred embodiment, after receiving a frame $P_{1,1}$ from the MS 110, the BTSs 104 and106 will process the frame and communicate to the MS 110 over a forward control channel whether the frame contained any errors. If both BTSs 104 and 106 communicate that the frame contains errors, the MS 110 will retransmit the same frame $P_{1,2}$ to both BTSs 104 and 106 with the F bit set to instruct the BTSs 104 and 106 to combine the retransmitted frame $P_{1,2}$ with the original stored frame $P_{1,1}$. If only one or none of the BTSs 104 or 106 communicates that the frame $P_{1,1}$ contains errors, the MS 110 will transmit the next frame $P_{2,1}$ to the BTSs 104 and106 with the F bit set to instruct both BTSs 104 and 106 to erase the previous frame $P_{1,1}$ from memory and not to combine the previous frame with the current frame $P_{2,1}$. The preferred embodiment of the method of the present invention will be described in more detail with reference to the flow chart of FIG. 2.

FIG. 2 is a flow chart of the preferred embodiment of the reverse link soft-handoff method of the present invention. The flow chart consists of four cases: (1) both BTSs successfully decode the frame transmitted by the MS (no errors are detected); (2) both BTSs decode the frame in error; (3) the first BTS decodes the frame successfully and the second BTS decodes the frame in error; and (4) the first BTS decodes the frame in error and the second BTS successfully decodes the frame.

Starting with case 1, at block 202 the MS 110 transmits frame $P_{n,m}$, in the present example $P_{1,1}$, to the first BTS 104 and the second BTS 106. At block 204, the first BTS 104 processes the frame $P_{1,1}$. In the preferred embodiment as shown in FIG. 3, the BTS 104 decodes frame $P_{1,1}$ (block 301), checks the CRC which is a quality indicator for the frame $P_{1,1}$ (block 303) and stores the frame $P_{1,1}$ (block 305). The CRC quality indicator indicates whether there are any errors in the frame. Referring back to FIG. 2, at block 206, the second BTS 106 also processes the frame $P_{1,1}$. In the preferred embodiment as shown in FIG. 3, BTS 106 decodes frame $P_{1,1}$ (block 302), checks the CRC for the frame $P_{1,1}$ (block 304) and stores the frame $P_{1,1}$ (block 306). Next, in decision blocks 208 and 210, both the first BTS 104 and the second BTS 106 determine whether the processing produced a successful result (e.g., whether the CRC indicates that the frame $P_{1,1}$ was successfully decoded or not). If both BTSs 104 and 106 successfully decoded the frame $P_{1,1}$, both BTSs 104 and 106 send a success message, in the preferred embodiment an ACK, to the MS 110 (blocks 212 and 215). The MS 110 then decodes the ACKS sent from the BTSs 104 and 106 (blocks 216 and 219) and then determines at decision block 220 whether ACKs were decoded from both BTSs 104 and 106. Since, in case 1, ACKS were decoded from both BTSs 104 and 106, the MS sets the flush bit (F=1) of the next frame $P_{2,1}$ to be transmitted to both BTSs 104 and 106 (block 230). Setting the F bit to "1" instructs the BTSs 104 and 106 not to combine the stored frame $P_{1,1}$ with the next frame $P_{2,1}$ it receives. Thus, the BTSs 104 and 106 will clear frame $P_{1,1}$ from memory.

In case 2, steps 202, 204 and 206 are performed as stated above. At decision blocks 208 and 210, both BTSs 104 and 106, determine that the frame $P_{1,1}$ decoded in error. At blocks 213 and 214, the BTSs 104 and 106 send an error message, in the preferred embodiment a NACK, to the MS 110. The MS 110 then decodes the

NACKs at blocks 217 and 218. Flow then continues through the "no" path of decision block 220 to decision block 222. At decision block 222, the MS determines that it decoded NACKS from both BTSs 104 and 106 and clears the flush bit (F=0) for the next frame $P_{1,2}$ (retransmission of first frame) to be transmitted to both BTSs 104 and 106 (block 228). Clearing F instructs the BTSs 104 and 106 to combine the stored frame $P_{1,1}$ with the next frame $P_{1,2}$ it receives. Thus, the BTSs 104 and106 will not clear frame $P_{1,1}$ from memory. In case 2, the described process of decoding frames unsuccessfully, storing the unsuccessful frames, retransmitting the unsuccessful frames and combining the unsuccessful frames will continue until at least one of the BTSs 104 or 106 decodes a frame successfully or until a preset timeout period is reached. In accordance with the invention, the BTSs 104 and 106 will use one of the H-ARQ schemes, such as that previously disclosed, to combine the frames.

In case 3, steps 202, 204 and 206 are performed as stated for case 1 above. At decision block 208, the first BTS 104 determines that frame $P_{1,1}$ decoded successfully. At decision block 210, the second BTS 106 determines that frame $P_{1,1}$ decoded in error. At block 212, the first BTS 104 sends an ACK to the MS 110. At block 214, the second BTS 106 sends a NACK to the MS 110. At block 216, MS 110 decodes the ACK sent from the first BTS 104 and at block 218 decodes the NACK sent from the second BTS 106. Flow continues through the "no" paths of decision blocks 220 and 222 to decision block 224. At decision block 224, the MS 110 determines that it decoded an ACK from the first BTS 104 and a NACK from the second BTS 106. In block 230, the MS sets the F bit of the next frame $P_{2,1}$ to one (F=1). Since one of the BTSs 104 decoded frame $P_{1,1}$ successfully, both BTSs 104 and 106 will erase frame $P_{1,1}$ from memory and will not combine the next frame $P_{2,1}$ with frame $P_{1,1}$.

In case 4, steps 202, 204 and 206 are performed as stated for case 1 above. At decision block 208, the first BTS 104 determines that frame $P_{1,1}$ decoded in error. At decision block 210, the second BTS 106 determines that frame $P_{1,1}$ decoded successfully. At block 213, the first BTS 104 sends a NACK to the MS 110. At block 215, the second BTS 106 sends an ACK to the MS 110. At block 217, MS 110 decodes the NACK sent from the first BTS 104 and at block 219 decodes the ACK sent from the second BTS 106. Flow continues through the "no" paths of decision blocks 220, 222 and 224 to decision block 226. At decision block 226, the MS 110 determines that it decoded a NACK from the first BTS 104 and an ACK from the second BTS 106. In block 230, the MS sets the F bit of the next frame $P_{2,1}$ to one (F=1). Since one of the BTSs 106 decoded frame $P_{1,1}$ successfully, both BTSs 104 and 106 will erase frame $P_{1,1}$ from memory and will not combine the next frame $P_{2,1}$ with frame $P_{1,1}$.

In all four cases described above, after the BTSs 104,106 process the frames received from the MS 110, the BTSs will transmit the frames to the RNC 102 along with a quality indicator for the frame. The RNC will choose the frame with the highest quality. Combining H ARQ with soft handoff provides several advantages which include increase in capacity or throughput, increase in coverage and longer mobile station battery life.

Those skilled in the art will recognize that various modifications and variations can be made in the apparatus of the present invention and in construction of this apparatus without departing from the scope or spirit of this invention. For example, the method of the present invention can be implemented in a communications system that includes more than two base stations.

What is claimed is:

CLAIMS

1. A method of implementing soft handoff using hybrid ARQ comprising the steps of:

a. providing a plurality of base stations in communication with at least one RNC and in communication with a mobile station;

b. transmitting a frame $P_{n,m}$ from the mobile station to a first of the plurality of base stations and to a second of the plurality of base stations;

c. at the first and second of the plurality of base stations, processing the frame $P_{n,m}$; and

d. at the mobile station, determining whether to retransmit the frame $P_{n,m}$ or whether to transmit a next frame $P_{n+1,m}$ to the first and second of the plurality of base stations, wherein if the decision is to retransmit frame $P_{n,m}$, transmitting frame $P_{n,m+1}$, and at the first and second of the plurality of base stations, combining frame $P_{n,m}$ with frame $P_{n,m+1}$ using H-ARQ and if the decision is to transmit the next frame $P_{n+1,m}$, transmitting the next frame to the first and second of the plurality of base stations.

2. The method of claim 1 wherein the step of processing the frame $P_{n,m}$ comprises the step of decoding the frame $P_{n,m}$ at the first and second of the plurality of base stations.

3. The method of claim 1 wherein the step of processing the frame $P_{n,m}$ comprises the steps of at the first of the plurality of base stations, determining a first quality measure indicating whether there are any errors in the frame $P_{n,m}$ and at the second of the plurality of base stations, determining a second quality measure indicating whether there are any errors in the frame $P_{n,m}$.

4. The method of claim 3 wherein the step of determining a first quality measure comprises checking a first CRC.

5. The method of claim 3 wherein the step of determining a second quality measure comprises checking a second CRC.

6. The method of claim 1 wherein the step of processing the frame $P_{n,m}$ comprises the steps of storing soft information of the frame $P_{n,m}$.

7. The method of claim 6 wherein the step of determining whether to retransmit the frame $P_{n,m}$ or whether to transmit a next frame $P_{n+1,m}$ to the first and second of the plurality of base stations comprises deciding to transmit the next frame $P_{n+1,m}$ if at least one of the first or second of the plurality of base stations decoded frame $P_{n,m}$ correctly.

8. The method of claim 7 further comprising the step of the mobile station setting a flush bit to "1", wherein the flush bit set to "1" instructs the first and second of the plurality of base stations to clear the soft information of frame $P_{n,m}$ from memory.

9. The method of claim 8 further comprising the step of erasing the soft information of frame $P_{n,m}$ at the first and second of the plurality of base stations.

10. The method of claim 1 wherein the step of determining whether to retransmit the frame $P_{n,m}$ or whether to transmit a next frame $P_{n+1,m}$ to the first and second of the plurality of base stations comprises the steps of deciding to retransmit the frame $P_{n,m}$ if neither of the base stations decoded the frame $P_{n,m}$ correctly and setting a flush bit to "0" to instruct the first and second of the plurality of base stations to combine frame $P_{n,m}$ with a retransmitted frame $P_{n,m+1}$.

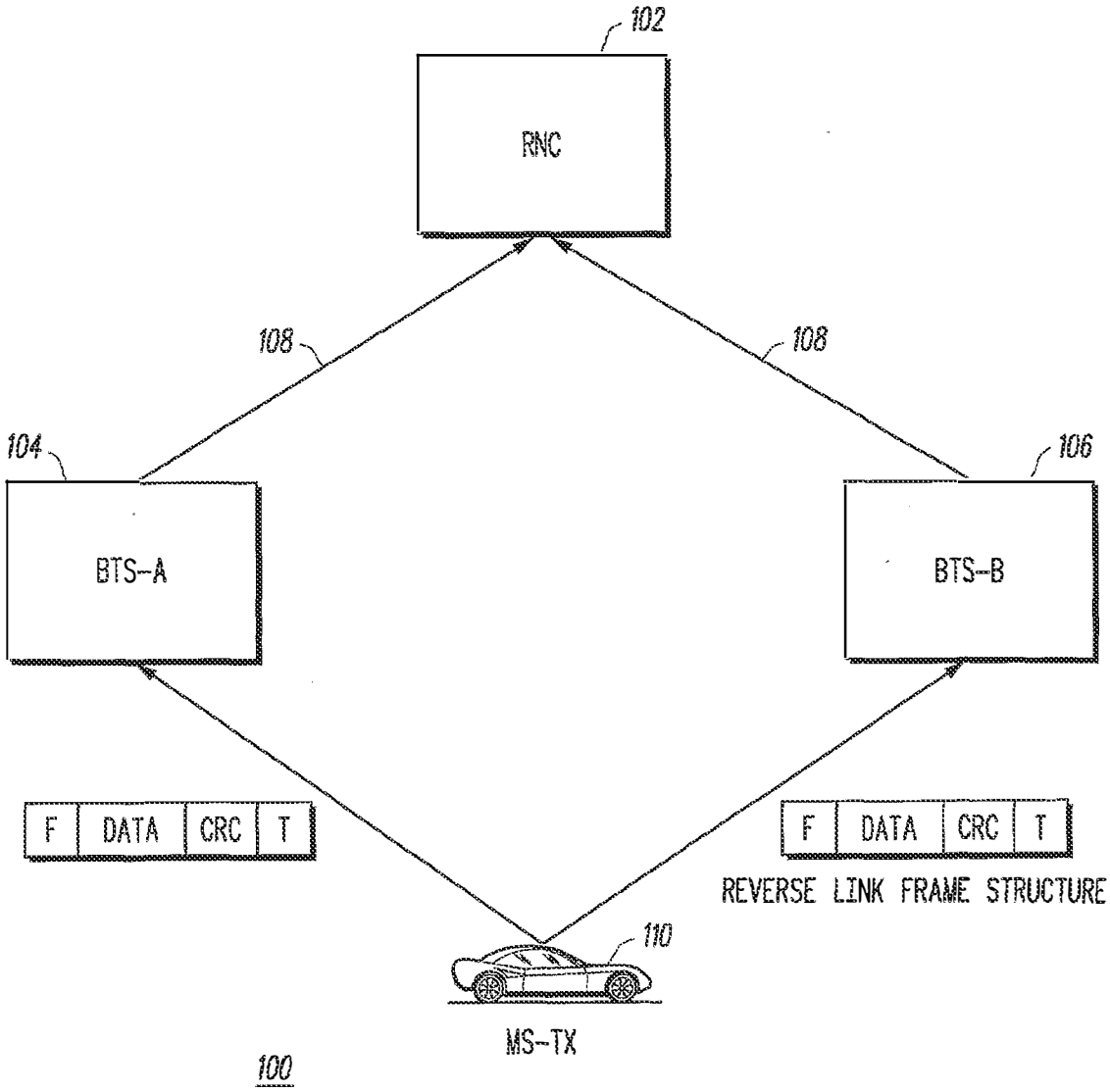
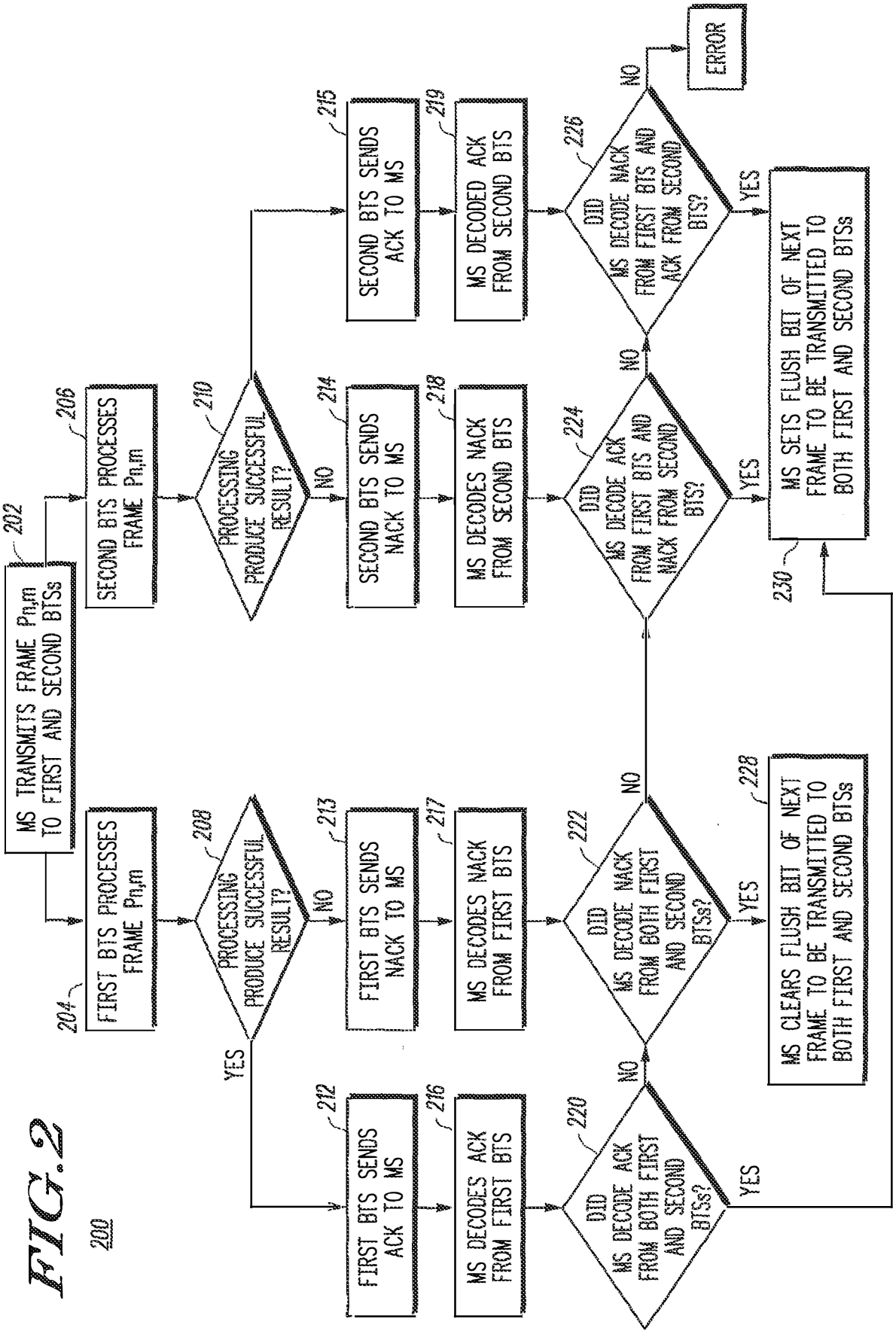

102
RNC
108
108
104
106
BTS-A
BTS-B
F
DATA
CRC
T
F
DATA
CRC
T
REVERSE LINK FRAME STRUCTURE
110
MS-TX
100

FIG.1

FIG. 2


200
MS TRANSMITS FRAME Pn,m TO FIRST AND SECOND BTSs
202
FIRST BTS PROCESSES FRAME Pn,m
204
SECOND BTS PROCESSES FRAME Pn,m
206
PROCESSING PRODUCE SUCCESSFUL RESULT?
208
YES
NO
210
FIRST BTS SENDS ACK TO MS
212
FIRST BTS SENDS NACK TO MS
213
SECOND BTS SENDS ACK TO MS
215
SECOND BTS SENDS NACK TO MS
214
MS DECODES ACK FROM FIRST BTS
216
MS DECODES NACK FROM FIRST BTS
217
MS DECODED ACK FROM SECOND BTS
219
MS DECODES NACK FROM SECOND BTS
218
DID MS DECODE ACK FROM BOTH FIRST AND SECOND BTSs?
220
DID MS DECODE NACK FROM BOTH FIRST AND SECOND BTSs?
222
DID MS DECODE ACK FROM FIRST BTS AND NACK FROM SECOND BTS?
224
DID MS DECODE NACK FROM FIRST BTS AND ACK FROM SECOND BTS?
226
ERROR
MS CLEARS FLUSH BIT OF NEXT FRAME TO BE TRANSMITTED TO BOTH FIRST AND SECOND BTSs
228
MS SETS FLUSH BIT OF NEXT FRAME TO BE TRANSMITTED TO BOTH FIRST AND SECOND BTSs
230

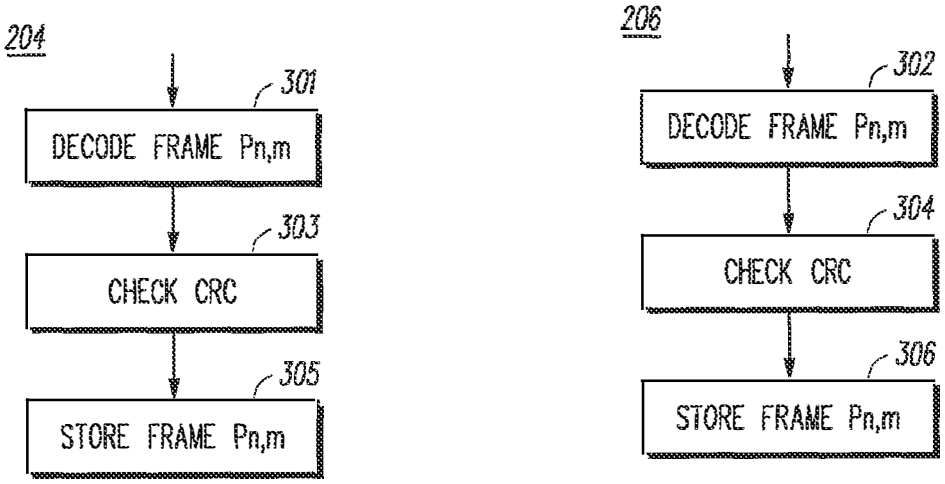

204
301
DECODE FRAME Pn,m
303
CHECK CRC
305
STORE FRAME Pn,m
206
302
DECODE FRAME Pn,m
304
CHECK CRC
306
STORE FRAME Pn,m

FIG.3

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
5 June 2003 (05.06.2003)

PCT

(10) International Publication Number
WO 03/047155 A1

(51) International Patent Classification[7]: H04L 1/18

(21) International Application Number: PCT/SE02/02186

(22) International Filing Date:
27 November 2002 (27.11.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0104022-9 28 November 2001 (28.11.2001) SE

(71) Applicant *(for all designated States except US)*: **TELEFONAKTIEBOLAGET L M ERICSSON (publ)** [SE/SE]; S-126 25 Stockholm (SE).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **TORSNER, Johan** [SE/FI]; Grindbergsgatan 6 A 3, FIN-02600 Espoo (FI). **WIGELL, Toomas** [FI/FI]; Venepuuntie 6, FIN-02360 Espoo (FI).

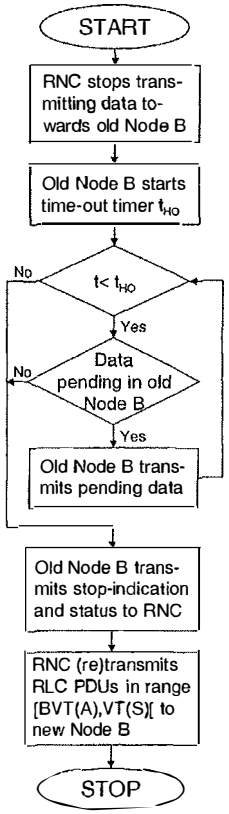
(74) Agent: **MAGNUSSON, Monica**; Ericsson AB, Patent Unit Radio Networks, S-164 80 Stockholm (SE).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),

[Continued on next page]

(54) Title: METHOD AND SYSTEM OF RETRANSMISSION



(57) Abstract: The present invention relates to a method and system of transmissions and retransmissions of packet data in a communications system, introducing concatenated ARQ loops between a radio network controller and a user equipment. Particularly, the invention relates to a Universal Mobile Telecommunications System, UMTS, or WCDMA system.

WO 03/047155 A1

European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, SK, TR), ●API patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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.

Published:
— *with international search report*

Method and system of retransmission

TECHNICAL FIELD OF THE INVENTION

The present invention relates to transmissions and retransmissions of packet data in a communications system. Especially, it relates to transmissions of packet data in a cellular mobile radio system, particularly a Universal Mobile Telecommunications System, UMTS, or WCDMA system.

BACKGROUND AND DESCRIPTION OF RELATED ART

Retransmission of data to or from a mobile station, MS, or user equipment, UE, is previously known. It is also known to use medium access control and radio link control layers of a UMTS protocol structure in acknowledged mode for dedicated channels.

In acknowledged mode of UMTS, retransmissions are undertaken in case of detected transmission errors not recovered by forward error control. This is also called automatic repeat request, ARQ. With ARQ, retransmissions can be undertaken unless a transmitted message is (positively) acknowledged within a predetermined time frame, or if it is negatively acknowledged.

Within this patent application, a radio network controller, RNC, is understood as a network element including a radio resource controller. The RNC is connected to a fixed network. Node B is a logical node responsible for radio transmission/reception in one or more cells to/from a User Equipment. A base station, BS, is a physical entity representing Node B.

With reference to figure 1, base stations «BS 1» and «BS 2» are physical entities representing Nodes B «Node B 1» and

«Node B 2» respectively. «Node B 1» and «Node B 2» terminate the air interface, called Uu interface within UMTS, between UE and respective Node B towards the radio network controller «RNC». A radio network controller «RNC» controlling the respective Nodes B «Node B 1», «Node B 2» is connected to each of them over an Iub interface.

Medium access control, MAC, and radio link control, RLC, are used within radio communications systems like General Packet Radio Services, GPRS, and UMTS.

U.S. Patent US5570367 discloses a wireless communications system arranged to transmit acknowledgement and request for retransmission messages. Data received in a microcell from an end user device is forwarded to a cell site. Data received by the cell site is transmitted to a cellular switch. A base station sends a poll message to the end user device, inquiring for the status of unacknowledged messages previously transmitted from the base station.

Also, a base station transmitter window is defined. A lower end pointer identifies a lowest numbered packet transmitted to and acknowledged by the base station. The upper end pointer identifies the highest numbered packet transmitted by the base station. Consequently, the window represents packets transmitted by the base station and unacknowledged by the end user device.

U.S. Patent US6118765 also recognizes an acknowledge scheme of a discriminator using a sliding window. The discriminator passes valid packets for forwarding.

International Patent Application WO0021231 relates to a system for communicating data packets over a packet switched network where a buffering network entity acts as

end-receiver of data packets transmitted from a sending host.

3rd Generation Partnership Project (3GPP): *Technical Specification Group Radio Access Network, Physical Layer Procedures, 3G TS 25.301 v3.6.0, France, September 2000,* specifies in chapter 5 Radio Interface Protocol Architecture of a UMTS system. There are three protocol layers:

- physical layer, layer 1 or L1,
- data link layer, layer 2 or L2, and
- network layer, layer 3 or L3.

Layer 2, L2, and layer 3, L3 are divided into Control and User Planes. Layer 2 consists of two sub-layers, RLC and MAC, for the Control Plane and four sub-layers, BMC, PDCP, RLC and MAC, for the User Plane. The acronyms BMC, PDCP, RLC and MAC denote Broadcast/Multicast Control, Packet Data Convergence Protocol, Radio Link Control and Medium Access Control respectively.

Figure 2 illustrates a simplified UMTS layers 1 and 2 protocol structure for a Uu Stratum, UuS, or Radio Stratum, between a user equipment UE and a Universal Terrestrial Radio Access Network, UTRAN.

Radio Access Bearers, RABs, are associated with the application for transportation of services between core network, CN, and user equipment, UE, through a radio access network. Each RAB is associated with quality attributes such as service class, guaranteed bit rate, transfer delay, residual BER, and traffic handling priority. An RAB may be assigned one or more Radio Bearers, RBs, being responsible for the transportation between UTRAN and UE. For each mobile station there may be one or several RBs representing a radio link comprising one or more channels between UE and

UTRAN. Data flows (in the form of segments) of the RBs are passed to respective Radio Link Control, RLC, entities which amongst other tasks buffer the received data segments. There is one RLC entity for each RB. In the RLC layer, RBs are mapped onto respective logical channels. A Medium Access Control, MAC, entity receives data transmitted in the logical channels and further maps logical channels onto a set of transport channels. In accordance with subsection 5.3.1.2 of the 3GPP technical specification MAC should support service multiplexing e.g. for RLC services to be mapped on the same transport channel. In this case identification of multiplexing is contained in the MAC protocol control information.

Transport channels are finally mapped to a single physical channel which has a total bandwidth allocated to it by the network. In frequency division duplex mode, a physical channel is defined by code, frequency and, in the uplink, relative phase (I/Q). In time division duplex mode a physical channel is defined by code, frequency, and time-slot. As further described in subsection 5.2.2 of the 3GPP technical specification the L1 layer is responsible for error detection on transport channels and indication to higher layer, FEC encoding/decoding and interleaving/deinterleaving of transport channels.

PDCP provides mapping between Network PDUs (Protocol Data Units) of a network protocol, e.g. the Internet protocol, to an RLC entity. PDCP compresses and decompresses redundant Network PDU control information (header compression and decompression).

For transmissions on point-to-multipoint logical channels, BMC stores at UTRAN-side Broadcast Messages received from an RNC, calculates the required transmission rate and re-

quests for the appropriate channel resources. It receives scheduling information from the RNC, and generates schedule messages. For transmission the messages are mapped on a point-to-multipoint logical channel. At the UE side, BMC evaluates the schedule messages and deliver Broadcast Messages to upper layer in the UE.

3G TS 25.301 also describes protocol termination, i.e. in which node of the UTRAN the radio interface protocols are terminated, or equivalently, where within UTRAN the respective protocol services are accessible.

In UMTS, the RLC protocol is terminated in a serving RNC, SRNC, responsible for interconnecting the radio access network of UMTS to a core network. In relation to a Node B, an RNC controlling it is a Controlling RNC. The Serving RNC and Controlling RNC can be separate or co-incident. In case of separate RNCs they communicate over an Iur interface, otherwise they communicate locally. An RNC comprises an RLC entity including an L2/RLC protocol layer «L2/RLC» at UTRAN side in figure 2. There are two MAC-entities, MAC-d and MAC-c/-sh, routing dedicated channels over common or shared channels. MAC-d resides in the Serving RNC and MAC-c/-sh in the Controlling RNC. The routing comprises buffering of data in the MAC-entities MAC-d and MAC-c/-sh, to accommodate for the unsynchronized data flows into and out of MAC-d and MAC-c/-sh. The two MAC-entities MAC-d and MAC-c/-sh are responsible for the L2/MAC protocol layer functionality at UTRAN side according to figure 2.

3rd Generation Partnership Project (3GPP): *Technical Specification Group Radio Access Network, RLC Protocol Specification, 3GPP TS 25.322 v3.5.0, France, December 2000,* specifies the RLC protocol. The RLC layer provides three services to higher layers:

- transparent data transfer service,

- unacknowledged data transfer service, and

- acknowledged data transfer service.

In subsection 4.2.1.3 an acknowledged mode entity, AM-entity, is described (see figure 4.4 of the 3GPP Technical Specification). In acknowledged mode automatic repeat request, ARQ, is used. The RLC sub-layer provides ARQ functionality closely coupled with the radio transmission technique used. The 3GPP technical specification also reveals various triggers for a status report to be transmitted. The receiver shall always send a status report, if it receives a polling request. There are also three status report triggers, which can be configured

1. Missing PU(s) Detected,
2. Timer Initiated Status Report, and
3. Estimated PDU Counter.

For trigger 1, the receiver shall trigger transmission of a status report to the sender if a payload unit, PU, is detected to be missing. (One PU is included in one RLC PDU.) With trigger 2, a receiver triggers transmission of a status report periodically according to a timer. Finally, trigger 3 relates in short to a timer corresponding to an estimated number of received PUs before the requested PUs are received. The 3GPP Technical Specification specifies a status PDU used to report the status between two RLC AM ('Acknowledged Mode') entities.

3GPP TS 25.322 specifies RLC state variables at the transmitter and at the receiver. At the transmitter side some of these are

VT(S) Send state variable,

VT(A) Acknowledge state variable,

VT(MS) Maximum Send state variable, and

VT(WS) Transmitter window size state variable.

VT(S) is the sequence number of the next PU to be transmitted for the first time (i.e. excluding retransmission). VT(A) is the sequence number of the next in-sequence PU expected to be acknowledged, which forms the lower edge of the window of acceptable acknowledgements. VT(MS) is the sequence number of the first PU not allowed by the receiver [i.e. the receiver will allow up to VT(MS) - 1]. This value represents the upper edge of the transmit window. VT(WS) is the size that shall be used for the transmitter window. Consequently, VT(WS) relates to VT(A) and VT(MS) according to

$$VT(WS) = VT(MS) - VT(A).$$

One of the state variables at the receiver side is

VR(R) Receive state variable.

VR(R) is the sequence number of the next in-sequence PU expected to be received. It is set equal to SNmax+1 upon receipt of the next in-sequence PU, where SNmax is the sequence number of the highest received in-sequence PU.

None of the cited documents above discloses a method and system of transmissions and retransmissions of packet data, splitting a connection involving multiple ARQ loops and transferring transmitter state variables between the loops.

SUMMARY OF THE INVENTION

In a radio communications system operating in acknowledged mode, according to prior art, data is buffered in a Radio Network Controller. ARQ loops introduces delay and round-

trip time latency. I.e., the time for an application to perceive a response to transmitted data or undertaken action from the opposite end is not immediate. ARQ loops will also require buffering.

Higher layer applications can be, e.g., applications on the Internet. Most applications on the Internet use protocols, such as TCP (Transport Control Protocol), that control the transmission rate, based on link quality in terms of packet loss and delay characteristics. Consequently, besides the negative effect of retransmission delays as such on perceived quality, substantial queuing delay can also lead to secondary effects further reducing quality of service.

A proper introduction of a hybrid ARQ protocol in Node B, according to the invention, would render at least some of the required acknowledgements of prior art superfluous and improve system performance. Elimination of an existing ARQ loop raises requirements on proper handling of acknowledgements and status reports, between nodes involved, particularly in connection with handover involving more than one Node B.

Consequently, it is an object of this invention to eliminate or reduce delay and latency as perceived by a user.

A related object is to reduce delay and latency as perceived by a flow control algorithm in a WCDMA (Wideband Code Division Multiple Access) system.

A further object is to provide a method and system for providing an ARQ loop with handover status information from another ARQ loop.

Finally, it is an object to fast and efficiently provide a Node B with queuing data for in-sequence delivery of RLC PDUs to a user equipment at handover.

These objects are met by the invention, which is particularly well suited for a Universal Mobile Telecommunications System, UMTS, splitting an ARQ loop into two or more single loops and taking appropriate measures, explained in detail below, for queue updating at handover.

Preferred embodiments of the invention, by way of examples, are described with reference to the accompanying drawings below.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows communication, according to the invention, between a UE and a base station involved in a connection between an RNC and the UE.

Figure 2 displays a layered protocol structure, according to prior art, in a radio communications system.

Figure 3 shows a preferred layered protocol structure, a protocol stack, according to the invention.

Figure 4 shows data units and transport blocks of a preferred protocol stack, according to the invention.

Figure 5 schematically illustrate status report generation and transmissions, according to the invention.

Figure 6 illustrates a communications system with ARQ functionality located to RNC, according to the invention.

Figure 7 illustrates an alternative exemplary communications system with ARQ functionality located to RNC, according to the invention.

Figure 8 schematically illustrates a flowchart of a first embodiment according to the invention.

Figure 9 schematically depicts a flowchart of a second embodiment according to the invention.

Figure 10 shows a block diagram including elements of the first and second embodiments.

DESCRIPTION OF PREFERRED EMBODIMENTS

Figure 3 shows a preferred layered protocol structure, a protocol stack, according to the invention. The L2 MAC layer of figure 1 has been extended and divided into two sub-layers, an L2 MAC sub-layer and a MAC-HSDPA sub-layer. Essentially the L2 MAC sub-layer corresponds to the prior art L2 MAC sub-layer of figure 1. The MAC-HSDPA plus the MAC layer could be regarded as one single MAC layer extended to also include hybrid ARQ functionality. However, for reasons of explanation they are preferably regarded as separate sub-layers. Further, on the network side, considering them as separate protocol sub-layers physically better corresponds to the physical entities where they reside. As illustrated in figure 3 on the UTRAN-side (or network side) L2 MAC sub-layer is preferably located in RNC, whereas L2 MAC-HSDPA sub-layer is located in Node B. As the hybrid ARQ protocol combines successively received retransmissions it is a great advantage to have this protocol close to the physical layer and, particularly, in Node B. Among the advantages achieved thereby, e.g., the round-trip delay is reduced as compared to a location in RNC. Within this patent application the protocol layers, except for L2 MAC and L2 MAC-HSDPA as just explained, correspond to those of figure 1.

Figure 4 shows data units and transport blocks of a preferred protocol stack, according to the invention. Packet switched data is transmitted in protocol data units, PDUs, in both directions. Each PDU is transported on a transport

channel in at least one transport block, TB. Preferably there is one TB for each PDU. As described above, transmission errors on the transport channel are corrected and detected by layer L1. Each transport block, TB, can be provided an individual CRC error-detecting checksum prior to transmission on the physical channel. However, preferably a transmission unit, carrying one or more TBs, is provided only one CRC error-detecting checksum. If a transmission unit is detected to be in error on the receiving side, this is reported to the L2 MAC layer.

L2 MAC layer can request retransmission of transmission units received in error. Transmission units, detected to be in error, still carry information that should not be wasted. Preferably hybrid ARQ, utilizing information available from earlier transmission(s) of a transmission unit by proper combining with the latest retransmission, is used prior to an L2 MAC layer request for retransmission.

At the receiving end, error detection is also performed by layer L2 RLC. If an RLC protocol data unit, PDU, is received in error or the PDU is missing, it will be requested for retransmission at a point in time when a status report is established by the RLC layer. RLC PDUs are transferred to/from the MAC layer SDUs. The MAC SDU possibly includes a header not included in the RLC PDU. As explained in relation to figure 3, according to the invention there are preferably two MAC sub-layers, an L2 MAC sub-layer and an L2 MAC-HSDPA sub-layer. In a preferred embodiment of the invention, the L2 MAC sub-layer is located in RNC and the L2 MAC-HSDPA sub-layer is located in Node B. As previously described, the RLC PDUs are transferred in transport blocks, TBs, on the physical channel. The L2 MAC-HSDPA layer transfers TBs to the L1 physical layer. In the reverse direction the L2 MAC-HSDPA layer transfers TBs, pos-

sibly after combining of multiple transmissions of the respective TBs, indicated to be error-free to the L2 MAC layer. TBs not indicated to be error-free are requested for retransmission.

A network layer PDU or L3 PDU can comprise several RLC PDUs. RLC PDUs are reassembled into RLC service data units, RLC SDUs, prior to delivery to higher layer PDU. The L3 protocol can be, e.g., the Internet Protocol, IP. Upon reception from L3, RLC SDUs are segmented into RLC PDUs.

In an evolved WCDMA system, a high-speed downlink packet access channel, HSDPA channel, is a channel with similarities to a DSCH. However, it is based on a novel transport channel type. In the sequel, this is referred to as a High-Speed Downlink Shared CHannel, HS-DSCH. An HS-DSCH supports many features not supported by DSCH, but also inherits some of the characteristics of a DSCH. There are several important features of an HS-DSCH. A sample of features is:

- High data rates with peak data rates up to tens of Mbit/s.
- Data is transmitted to multiple users on a shared channel by means of time-division multiplex, TDM, or code-division multiplex, CDM.
- Higher-order modulation.
- Modulation adaptive to radio channel conditions.
- Fast retransmission with soft combining of retransmitted data at UE, also referred to as Fast Hybrid ARQ or Fast HARQ.

- Low air-interface delay, with maximum round-trip delay down to some ten milliseconds.

As an alternative to introducing the MAC-HSDPA sub-layer in Node B, the RLC protocol could reside in Node B. However, for reasons of compatibility RLC is in charge of ciphering and in-order delivery, preferably located in RNC. With RLC sub-layer residing in RNC, reliable packet delivery will be insured between Node B and RNC.

According to preferred embodiments of the invention, an L2 MAC-HSDPA sub-layer is responsible for Fast Hybrid ARQ.

One reason for terminating the Fast Hybrid ARQ in Node B is the reduction of round-trip delay as compared to terminating it in RNC. Another reason is that Node B is capable of using soft combining of multiply transmitted data packets, whereas RNC generally only receives hard-quantized bits.

L2 RLC sub-layer requires status reports acknowledging packet data units previously transferred from the L2 RLC layer, e.g. to advance the sliding transmitter window of the L2 RLC protocol. When, e.g., a poll timer times out it consequently transfers an inquiry for a status report. This inquiry is destined for the UE, in accordance with prior art. However, such an inquiry would load the scarce resource of the radio interface between Node B and UE. Further, terminating the Fast Hybrid ARQ in Node B, during stable operating conditions this node will be currently informed of the receive status of the UE in accordance with the Fast Hybrid ARQ scheme, possibly with a short delay for the most recent update of UE.

According to a preferred embodiment of the invention the Hybrid ARQ protocol entity at UTRAN-side generates status reports to the RNC-RLC. Status reports can be generated

either upon request of the RNC-RLC (polling) or as conditionally triggered locally. In case of the latter, the triggers described in prior art and referred to on page 6 apply. Another trigger to be included is the number of PDUs received by Node B from RNC. When a predefined number of PDUs have been received by Node B, a status report is established in the Hybrid ARQ protocol entity, and transmitted to RNC.

Correspondingly, when Node B deals with status report establishment, the status report triggering in the UE can be relieved, in order not to load the scarce communication link resource between Node B and UE. With reference to trigger 1 on page 6, the triggering of UE can be avoided if Node B detects the missing PU in due time for delivery to UE prior to a point in time when it would otherwise have been detected or otherwise initiated establishment and transmission of a status report from UE. Triggers 2 and 3 depend on a preset time interval or number of PDUs. By extending the parameters appropriately, the number of status reports per unit time initiated in UE by these triggers can be reduced to a sufficiently small number, not loading the scarce communication link resource between UE and Node B more than necessary.

Figures 5a and 5b schematically illustrate the status report generation and transmissions, according to the invention. In figure 5a, L2 RLC located in RNC transfers data to UE via Node B, as already described in relation to figure 2. Downlink data 3 and requests for status reports 2 are transferred 2, 3 to UE via Node B. UE can also generate status reports when properly triggered locally. Status reports 1 are transmitted from UE to RNC, as described in relation to cited prior art.

In figure 5a, the Hybrid ARQ protocol resides in Node B. Downlink data is transmitted 3 over the radio interface between Node B and UE. Depending on whether the data transmission was successful or not, acknowledgements are transmitted 4 to Node B from UE. Status reports are generated in UE if data packets are missing, or detected to be out of sequence and transmitted 1, 4 to Node B. Status reports can also be transmitted 4 from UE upon request from Node B. In the sequel acknowledgements and status reports, and possibly other signaling related to Fast Hybrid ARQ, from UE to Node B are collectively referred to as HARQ signaling 4. Consequently, Node B has a good picture of the UE status as regards data packets transmitted to UE from RNC via Node B. This status includes

BVT(S) Node B Send state variable, and

BVT(A) Node B Acknowledge state variable.

BVT(S) is the sequence number of the next PU to be transmitted for the first time (i.e. excluding retransmission) from Node B. BVT(A) is the sequence number of the next in-sequence PU expected to be acknowledged by UE. BVT(A) forms the lower edge of the window of acceptable acknowledgements.

Figure 5b shows a preferred solution according to the invention, where UE status in accordance with transmitted downlink data 3 and HARQ signaling 4 is stored in the HARQ protocol entity, preferably a MAC-HSDPA protocol.

When UE might locally generate status reports according to one or more predefined triggers, the one or more status reports are transferred 4 to Node B. Upon reception in Node B, this Node decides whether or not a received status report concerns also L2 RLC protocol layer. If so, the status report, possibly edited by Node B, is transferred 5

to L2 RLC residing in RNC. If not, Node B will undertake all actions necessary, in accordance with the status report.

An example of a UE-generated status report concerning the L2 RLC protocol of RNC is when UE-HARQ protocol, preferably in the MAC-HSDPA protocol link layer, detects a failure in UE, possibly due to a previously transmitted acknowledgment received in error by Node B. Upon detection of this failure, an RLC PDU will not be transferred from L2 MAC sub-layer to L2 RLC sub-layer of UE, as only presumably correct PDUs are transferred. When L2 RLC sub-layer of UE detects a missing RLC PDU, the sequence number of the missing RLC PDU will be included in a status report, generated by UE, and requested for retransmission from L2 RLC residing in RNC. Swedish patent application No. 0100739-2 assigned to the Applicant, and incorporated herein by reference, describes a method and system of retransmission, reducing or eliminating unnecessary retransmissions. This method and system can also be applied with the present invention, further reducing the load on the radio interface.

When L2 RLC, residing in RNC, sends a request for status report to UE, the request is first received in Node B, in both figures 5a and 5b. In figure 5a, the request for status report is forwarded 2 to UE by default. Consequently, the requests and their responses load the radio interface between Node B and UE. Between Node B and UE, signaling and packet transfer are indicated by double arrows, 1 and 4 for uplink, and 2 and 3 for downlink, due to their logical differences. However, there is only one physical radio spectrum available with a limited channel capacity in each direction. Therefore, when the HARQ protocol entity or Node B is made responsible for status report generation and replies to L2 RLC requests for status

reports, as in figure 5b, the load on the radio interface can be relieved. Hence, the elimination of arrows 1 and 2 between Node B and UE in figure 5b is not absolute. Depending on triggers selected, potential protocol failure etc. some signaling or packet transfer illustrated by the arrows in figure 5a may remain. However, the lack of these arrows in figure 5b illustrates that a substantial amount of the load can be eliminated according to the invention. In the foregoing, it was explained for various status report triggers, not limiting the invention only to this or other particular examples, how the invention can reduce the load of a scarce communication link resource in downlink, in uplink, or both.

There is a sender-receiver relationship between «RNC» and «UE», in accordance with prior art. Packets transmitted from RLC protocol entity residing in RNC are acknowledged by User Equipment «UE». The sender-receiver relationship is subject to latency due to a round-trip delay between «RNC» and «UE», not illustrated to simplify reading.

A first problem of prior art solution relates to bandwidth delay product. HS-DSCH provide high data rate, also referred to as great user bandwidth. A transmitted packet cannot be acknowledged (positively or negatively) until it has propagated to a receiver. Further, it takes a propagation time for an acknowledgement to reach from the receiver to a sender of the packet. Consequently, data that may be requested for retransmission require buffering corresponding to the bandwidth delay product, representing the amount of data that can be transmitted during a time span equivalent to the round-trip time latency. Particularly, for HS-DSCH this bandwidth delay product can be extensive for an ARQ protocol entity in RNC. This can cause RLC PDU loss, or RLC ARQ or HARQ transmissions to stall.

Of course, these shortcomings could be circumvented by increasing buffer size as only measure. However, increasing a buffer size allowing for an extended round-trip time, would necessitate time-out timers of outer ARQ loops to be increased. Further, an extended variability of buffer lengths of the inner loop could be expected, depending on the various rates and delays of a connection during its lifetime. If relying on increased buffer size only, the time-out timers of outer ARQ loops must not time out until the largest round-trip time allowed for has elapsed.

In UMTS, existing RLC protocol operates with limited buffer sizes. One reason for this is delay constraints.

The problem of prior art, as explained above, cannot be solved by increasing RLC buffer size, as long as the RLC buffer is part of an end-to-end-delay of a connection between a data provider and an end user, where the data provider awaits acknowledgements from the user, since increasing RLC buffer size would introduce additional delay and require extensive time-out limits.

As a user moves with his user equipment away from a base station «BS 1» towards another base station «BS 2» in figure 1, the connection between UE and RNC is likely to be rerouted from being over a first Node B «Node B 1» to being over a second Node B «Node B 2» or over both «Node B 1» and «Node B 2» using soft handover. In figure 1, the base stations are connected to the same radio network controller RNC. However, the invention also covers the exemplary situation where the base stations are connected to different RNCs.

Figure 6 illustrates an exemplary communications system with ARQ functionality located to RNC. The UE protocol «MAC» preferably also includes a MAC-HSDPA protocol, not

indicated to simplify reading. In UTRAN, location of MAC-HSDPA protocol «MAC-hs» to Node B is preferred, as explained in relation to figure 3. Serving RNC «SRNC» interconnects UE to a Core Network, not illustrated. «UE» is connected to «SRNC» over «Node B 2» and «CRNC 2/DRNC». According to figure 6, «SRNC» is not controlling the Node B «Node B 2». (For illustration, «SRNC» controls «Node B 1».) «Node B 2» is controlled by Controlling RNC «CRNC 2», acting as a Drift RNC «DRNC» in this exemplary illustration. The Drift RNC supports the Serving RNC when a UE needs to use cells/Nodes B controlled by an RNC different from the SRNC. The RNCs are interconnected over an Iur interface. Routing of dedicated channels over common or shared channels comprises buffering of data in Serving RNC and Node B. In figure 6, the buffering occurs in buffers «Buffer Sb» and «Buffer sB» for the sender-receiver relationship between SRNC and Node B. The latency of the loop involving the buffers «Buffer Sb» and «Buffer sB» will be substantial if the distance between Serving RNC and Node B is large. In figure 6, there is further buffering «ARQ Su» in «SRNC» associated with the ARQ-protocol in the sender-receiver relationship between «SRNC» and «UE». «UE» includes corresponding ARQ buffering «ARQ Su».

Figure 7 illustrates an alternative exemplary communications system with ARQ functionality located to RNC. The figure represents alternatives for the MAC-protocol in RNC, including MAC-HSDPA protocol. However, location of MAC-HSDPA protocol «MAC-hs» to Node B is preferred. The UE protocol «MAC» preferably also includes a MAC-HSDPA protocol, not explicitly indicated in the figure to simplify reading. Serving RNC «SRNC» interconnects UE to a Core Network, not illustrated. «UE» is connected to «SRNC» over «Node B 2» and «CRNC 2/DRNC». According to figure 7 «SRNC» is not controlling the Node B «Node B 2». (For illustra-

tion, «SRNC» controls «Node B 1».) «Node B 2» is controlled by Controlling RNC «CRNC 2», acting as a Drift RNC «DRNC» in this exemplary illustration. The Drift RNC supports the Serving RNC when a UE needs to use cells/Nodes B controlled by an RNC different from the SRNC. The RNCs are interconnected over an Iur interface. Routing of dedicated channels over common or shared channels comprises buffering of data between Serving RNC and Controlling RNC. In figure 7, the buffering occurs in buffers «Buffer Sd» and «Buffer sD» for the sender-receiver relationship between SRNC and DRNC. The latency of the loop involving the buffers «Buffer Sd» and «Buffer sD» will be substantial if the distance between Serving RNC and Controlling RNC is large. In figure 7, there is further buffering «ARQ Su» in «SRNC» associated with the ARQ-protocol in the sender-receiver relationship between «SRNC» and «UE». «UE» includes corresponding ARQ buffering «ARQ Su».

Terminating RLC AM ARQ in Node B benefits from a round-trip time being constant for a particular Node B. This will simplify setting of time-out timers, reducing the round-trip time variability of RLC AM ARQ and outer ARQ loops. The inner HARQ loop RTT is kept at a low level using soft combining of successive retransmissions and due to shorter delay times between Node B and UE than between RNC and UE. The RLC entity in Node B should send an appropriate RLC status message to the Serving RNC when it discovers a missing RLC PDU or when a Poll flag, indicating that a status report is requested, is set by RNC RLC. This poll flag should be cleared prior to passing RLC PDUs further to HARQ transmitter unit to avoid triggering of status report transmissions from UE RLC.

Channels can be switched for several reasons. One example of channel switching is handover from one base station to

another as a user moves. Another reason can be some channels being subject to heavy interference whereas others are not. By use of different channelization codes in WCDMA, users are allocated channels of different data rates. Other wireless systems, such as W-LANs (Wireless Local Area Networks) generally do not provide for handover from one base station to another including channel switching even if they allow for quasi-stationary connections to different base stations of the systems.

According to a first embodiment of the invention, schematically illustrated in figure 8, RLC Acknowledged Mode ARQ, RLC AM ARQ, is at least partly terminated in Node B and RLC state variables transferred and updated at handover and channel switching. RLC AM ARQ also retransmits data packets to Node B at data packet losses in Iub or Iur interface. At an HSDPA handover from an old Node B to a new Node B, the serving RNC stops data transmissions to the old Node B. The old Node B finishes its pending data transmissions during a predefined maximum time-period. When pending data has been transmitted or if the maximum time-period has elapsed, it transmits a stop-indication to the serving RNC. The stop-indication is accompanied by a latest Node B status of old Node B, including the next in-sequence PU expected to be acknowledged by UE, referred to as BVT(A).

When the serving RNC receives this indication it marks all its RLC PDUs within a frame of PU sequence numbers ranging from BVT(A) to VT(S) as negatively acknowledged, and scheduling these RLC PDUs for retransmission to the new Node B, via the RNC controlling new Node B.

Substituting controlling RNC for Node B, figure 8 is also valid for an implementation with MAC-HSDPA in controlling RNC, as in figure 7. The serving RNC then schedules data

packets, interpreted as negatively acknowledged RLC PDUs, for retransmission to new controlling RNC at an inter-RNC handover.

According to a second embodiment schematically depicted in figure 9, at HSDPA handover data queues of new Node B are updated from UE, i.e. over Uu interface. Preferably, the entire transmitter window of PU sequence numbers ranging from BVT(A) to BVT(S) of old Node B is transferred to new Node B, where BVT(S) denotes the sequence number of the next PU scheduled for transmission for the first time from old Node B. This transmitter window is transmitted as soon as possible, without RNC awaiting a stop-indication from old Node B. As Node B regularly transfers status reports to RNC RLC, the transmitter window from the latest update may already be available to RNC and can be transferred to new Node B without further status transfer between Node B and RNC.

As soon as UE receives a handover command, it includes additional control information to its uplink HS-DSCH control messages. This control information includes the receive state variable VR(R). If UE has multiple logical channels on the HS-DSCH, there is one receive state variable for each logical channel.

New Node B will receive this control information from UE, while still being in stand-by mode. The one or more receive state variables are used for updating the transmitter window of new Node B, the transmitter initially set in accordance with old Node B transmitter window. This updating has to be completed prior to new Node B starting its transmissions of PDUs and transport blocks to UE, to maintain in-sequence delivery of RLC PDUs to UE.

Also figure 9 is valid for an implementation with MAC-HSDPA in controlling RNC, substituting controlling RNC for Node B. The serving RNC then schedules RLC PDUs interpreted as negatively acknowledged for retransmission to new controlling RNC for an inter-RNC handover and UE updates status of controlling RNC via Node B.

Figure 10 shows a block diagram including elements of the first and second embodiments. A serving RNC «SRNC» including receive means «R_R», processing means «μ» and transmit means «T_R». Transmit means «T_R» transmits data 7 from a transmitter window comprising data packets with sequence numbers in the range of VT(A) to VT(S) to a node «Node 1» comprising a MAC-HSDPA protocol, preferably «Node 1» is a Node B, but it can also be a controlling RNC. Data packets received by receive means «R_{N1}» in «Node 1», also comprising transmit means «T_{N1}», are buffered in buffer «$Buff_{N1}$» for transmission 9 to user equipment «UE» including receive means «R_U». At handover from a channel associated with «Node 1» to a channel associated with «Node 2», «Node 1» transmits as much of its buffer content in «$Buff_{N1}$» as allowed to user equipment «UE». «Node 1» with receive means «R_{N1}» receives acknowledgements 9 of successfully transmitted packets to «UE». The sequence number of the next data packet expected to be acknowledged, BVT(A), is transmitted 6 to «SRNC» together with a stop-indication, according to the first embodiment of the invention. The status variable BVT(A) and the stop-indication are received by receive means «R_R» of «SRNC». Processing means «μ» interprets data packets with sequence numbers in the range [BVT(A),VT(S)[as negatively acknowledged and (re)transmits 10 these data packets to the new node «Node 2», where they are received by receive means «R_{N2}» and buffered in «$Buff_{N2}$».

According to the second embodiment there is no need for transmission of a stop-indication and time for emptying the buffer «Buff$_{N1}$». Old node «Node 1» transmits 6 its status variables BVT(A) and BVT(S) at the time of handover to «SRNC». Processing means «μ» interprets the data packets in the range as negatively acknowledged and retransmits the data packets to new node «Node 2». Prior to new node «Node 2», with transmit means «T$_{N2}$», starts data transmissions 12 to user equipment «UE», having transmit means «T$_U$» and receive means «R$_U$», it updates its transmit buffer «Buff$_{N2}$» according to current receive status VR(R) of «UE» as received 12.

Preferably, all retransmission entities, interconnecting networks or channels of different characteristics, e.g. RNCs and Nodes B in UMTS, operate according to the invention for outstanding performance. However, the invention can also be used in systems also including retransmission entities, such as Nodes B, not operating according to the invention.

A person skilled in the art readily understands that the receiver and transmitter properties of a BS or a UE are general in nature. The use of concepts such as BS, UE or RNC within this patent application is not intended to limit the invention only to devices associated with these acronyms. It concerns all devices operating correspondingly, or being obvious to adapt thereto by a person skilled in the art, in relation to the invention. As an explicit non-exclusive example the invention relates to mobile stations without a subscriber identity module, SIM, as well as user equipment including one or more SIMs. Further, protocols and layers are referred to in close relation with UMTS and Internet terminology. However, this does not exclude applicability of the invention in other systems with other

protocols and layers of similar functionality. As a non-exclusive example, the invention applies for radio resource management interfacing of a connection protocol application layer as well as interfacing of a connection protocol transport layer, such as TCP.

The invention is not intended to be limited only to the embodiments described in detail above. Changes and modifications may be made without departing from the invention. It covers all modifications within the scope of the following claims.

CLAIMS

1. A method of retransmission in a communications system, wherein a retransmission loop between a sender and a receiver includes two or more concatenated retransmission subloops, the method characterized in that the retransmission loop comprises a first transmitter, a second transmitter and a receiver, and that the second transmitter transfers signaling carrying a status variable indicating next in-sequence number of packet unit expected to be acknowledged by the receiver to the first transmitter.

2. The method according to claim 1 characterized in that the signaling carrying the status variable is transferred at handover of a channel between the second transmitter and the receiver.

3. The method according to claim 1 or 2 characterized in that the second transmitter sends a stop-indication accompanying the status variable to the first transmitter.

4. The method according to any of claims 1-3 characterized in that the second transmitter sends a stop-indication when there are no more data packets for the receiver pending at the second transmitter or a time-out timer has elapsed.

5. The method according to any of claims 1-4 characterized in that one or more data packets to the receiver pending at the second transmitter are transmitted to the receiver prior to the signaling carrying the status variable is transferred.

6. The method according to any of claims 1-5 characterized in that the signaling carrying the status variable is not transferred until there are no more data packets for the receiver pending at the second transmitter or a time-out timer has elapsed.

7. The method according to any of claims 1-6 characterized in that the first transmitter interprets the status variable as a negative acknowledgement of packet units ranging from the next in-sequence number of packet unit expected to be acknowledged by the receiver to the second transmitter up to the sequence number of the next packet unit to be transmitted for the first time from the first transmitter to the second transmitter.

8. The method according to claim 7 characterized in that packet units considered negatively acknowledged are transmitted to a third transmitter.

9. The method according to claim 1 characterized in that the second transmitter transfers signaling carrying a status variable indicating sequence number of next packet unit to be transmitted for the first time from the second transmitter.

10. The method according to claim 9 characterized in that the signaling carrying the status variables is transferred at handover of a channel between the second transmitter and the receiver.

11. The method according to claim 9 or 10 characterized in that the first transmitter interprets the status variables as a negative acknowledgement of packet units ranging from the next in-sequence number of packet unit expected to be acknowledged by the receiver to the second transmitter up to the sequence number of the

next packet unit to be transmitted for the first time from the second transmitter to the receiver.

12. The method according to any of claims 9–11 characterized in that packet units considered negatively acknowledged are transmitted to a third transmitter.

13. The method according to any of claims 9–12 characterized in that the receiver transmits one or more signals carrying its receive status to a third transmitter.

14. The method according to any of claims 9–13 characterized in that a third transmitter updates its transmit status according to the receive status of the receiver.

15. The method according to any of claims 9–13 characterized in that the receive status includes the sequence number of the next in-sequence PU expected to be received.

16. The method according to any of claims 1–15 characterized in that a connection is handed over from a channel between the second transmitter and the receiver to a channel between a third transmitter and the receiver

17. The method according to any of claims 2, 10 and 16 characterized in that the channel is an HSDPA channel or an HS-DSCH.

18. The method according to any of claims 12–15 characterized in that the third transmitter is a radio network controller, a Node B or a base station.

19. The method according to any of claims 1–18 characterized in that the second transmitter is a radio network controller, a Node B or a base station.

20. The method according to any of claims 1–19 characterized in that the first transmitter is a radio network controller.

21. The method according to any of claims 1–20 characterized in that the receiver is a user equipment.

22. The method according to any of claims 1–17 characterized in that the communications system is a universal mobile telecommunications system or a WCDMA system.

23. A network element for retransmission in a communications system, wherein a retransmission loop between a sender and a receiver includes two or more concatenated retransmission subloops, the network element comprising a first transmitter and being characterized by receive means for receiving signaling carrying a status variable from a second transmitter, the status variable indicating next in-sequence number of packet unit expected to be acknowledged by the receiver.

24. The network element according to claim 23 characterized by receive means for receiving a stop-indication accompanying the status variable.

25. The network element according to claim 23 or 24 characterized in that the network element comprises processing means for interpreting reception of the status variable as a negative acknowledgement of packet units ranging from the sequence number indicated by the

status variable up to the sequence number of the next packet unit to be transmitted for the first time from network element to the second transmitter.

26. The network element according to claim 23 characterized by receive means for receiving signaling carrying a status variable from a second transmitter, the status variable indicating sequence number of next packet unit to be transmitted for the first time from the second transmitter.

27. The network element according to claim 26 characterized by processing means for interpreting reception of the status variables as a negative acknowledgement of packet units within a range as indicated by the status variables.

28. The network element according to any of claims 25–27 characterized in that the signaling carrying the status variable is transferred at handover of a channel between the second transmitter and the receiver.

29. The network element according to any of claims 23–28 characterized by transmit means for transmitting packet units considered negatively acknowledged to a third transmitter.

30. The network element according to claim 29 characterized in that the third transmitter is, or is included in, a radio network controller, a Node B or a base station.

31. The network element according to any of claims 23–30 characterized in that the communications system is a universal mobile telecommunications system or a WCDMA system.

32. A network element for retransmission in a communications system, wherein a retransmission loop between a sender and a receiver includes two or more concatenated retransmission subloops, the network element comprising a second transmitter and being characterized by transmit means for transferring signaling carrying a status variable, indicating next in-sequence number of packet unit expected to be acknowledged by the receiver to a first transmitter.

33. The network element according to claim 32 characterized in that the signaling carrying the status variable is transferred at handover of a channel between the second transmitter and the receiver.

34. The network element according to claim 32 or 33 characterized by transmit means for sending a stop-indication accompanying the status variable to the first transmitter.

35. The network element according to any of claims 32–34 characterized in that the second transmitter sends a stop-indication when there are no more data packets for the receiver pending at the second transmitter or a time-out timer has elapsed.

36. The network element according to any of claims 32–35 characterized by a packet data transmit buffer.

37. The network element according to any of claims 32–36 characterized in that one or more data packets to the receiver pending at the second transmitter are transmitted to the receiver prior to the signaling carrying the status variable is transferred.

38. The network element according to any of claims 32–37 characterized in that the signaling carrying the status variable is not transferred until there are no more data packets for the receiver pending at the second transmitter or a time-out timer has elapsed.

39. The network element according to claim 32 characterized by transmit means for transferring signaling carrying a status variable indicating sequence number of next packet unit to be transmitted for the first time from the second transmitter.

40. The network element according to claim 39 characterized in that the signaling carrying the status variables is transferred at handover of a channel between the network element and the receiver.

41. The network element according to any of claims 32–40 characterized by receive means for receiving signaling carrying receiver receive status.

42. The network element according to any of claims 32–41 characterized by circuitry for updating the network element transmit status according to the receive status of the receiver.

43. The network element according to claim 41 or 42 characterized in that the receive status includes the sequence number of the next in-sequence PU expected to be received.

44. The network element according to any of claims 32–43 characterized in that it is involved in a handover of a channel between the network element and the receiver.

45. The network element according to any of claims 28, 33, 40, 41, 44 characterized in that the channel is an HSDPA channel or an HS-DSCH.

46. The network element according to any of claims 23-45 characterized in that the first transmitter is, or is included in, a radio network controller.

47. The network element according to any of claims 23-46 characterized in that the second transmitter is, or is included in, a radio network controller.

48. The network element according to any of claims 23-47 characterized in that it is a radio network controller, a Node B or a base station.

49. The network element according to any of claims 23-48 characterized in that the communications system is a universal mobile telecommunications system or a WCDMA system.

50. A receiving device for receiving transmissions and retransmissions on a communications channel in a communications system, wherein a retransmission loop between a sender and the receiving device includes two or more concatenated retransmission subloops, the receiving device characterized by transmit means for transferring one or more signals carrying its receive status to a network element.

51. The receiving device according to claim 50 characterized in that the receive status is transmitted for updating of the network element transmit status.

52. The receiving device according to claim 50 or 51 characterized by transmit means for trans-

mitting the receive status to the network element at handover.

53. The receiving device according to any of claims 50–52 characterized in that the receive status is transmitted prior to the receiving device starts receiving transmissions from the network element.

54. The receiving device according to any of claims 50–53 characterized in that the receive status includes the sequence number of the next in-sequence PU expected to be received.

55. The receiving device according to any of claims 50–54 characterized in that the communications channel is an HSDPA channel or an HS-DSCH.

56. The receiving device according to any of claims 50–55 characterized in that the communications system is a universal mobile telecommunications system or a WCDMA system.

57. The receiving device according to any of claims 50–56 characterized in that the receiving device is a user equipment.

58. The receiving device according to any of claims 50–57 characterized in that the network element is a radio network controller, a Node B or a base station.

59. A radio communications system characterized by means for carrying out the method in any of claims 1–22.

60. A radio communications system characterized by a plurality of network elements according to any of claims 23–49.

61. A radio communications system characterized by a plurality of receiving devices according to any of claims 50–58.

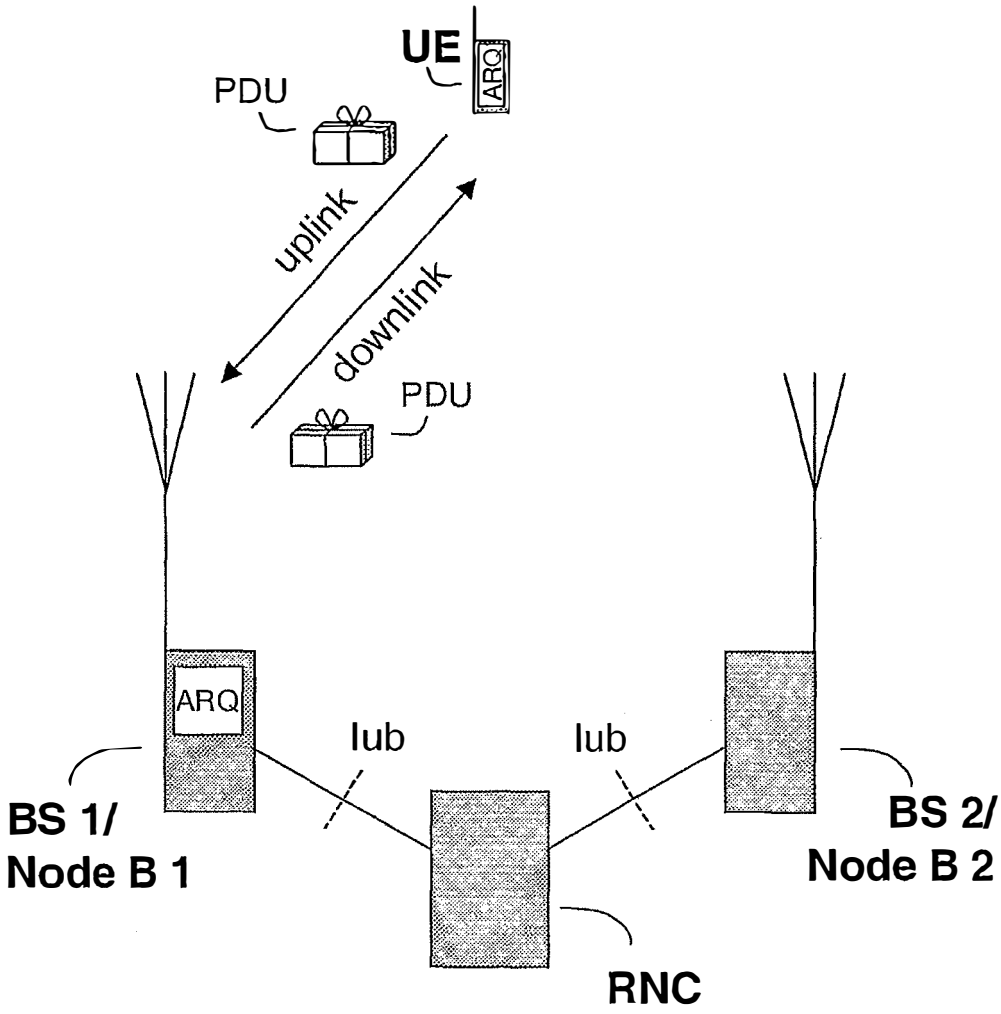

UE
ARQ
PDU
uplink
downlink
PDU
ARQ
Iub
Iub
BS 1/
Node B 1
BS 2/
Node B 2
RNC

Fig. 1

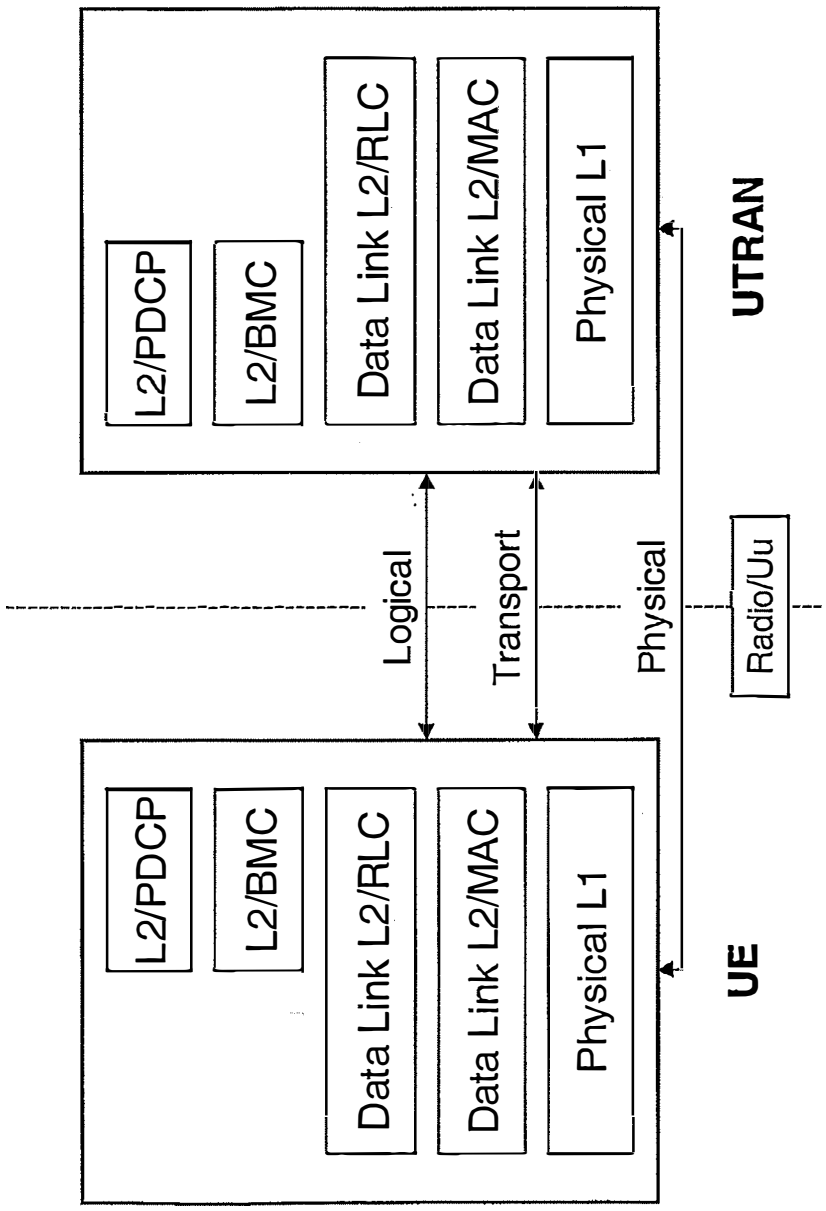

L2/PDCP
L2/BMC
Data Link L2/RLC
Data Link L2/MAC
Physical L1
UTRAN
Logical
Transport
Physical
Radio/Uu
L2/PDCP
L2/BMC
Data Link L2/RLC
Data Link L2/MAC
Physical L1
UE

Fig. 2

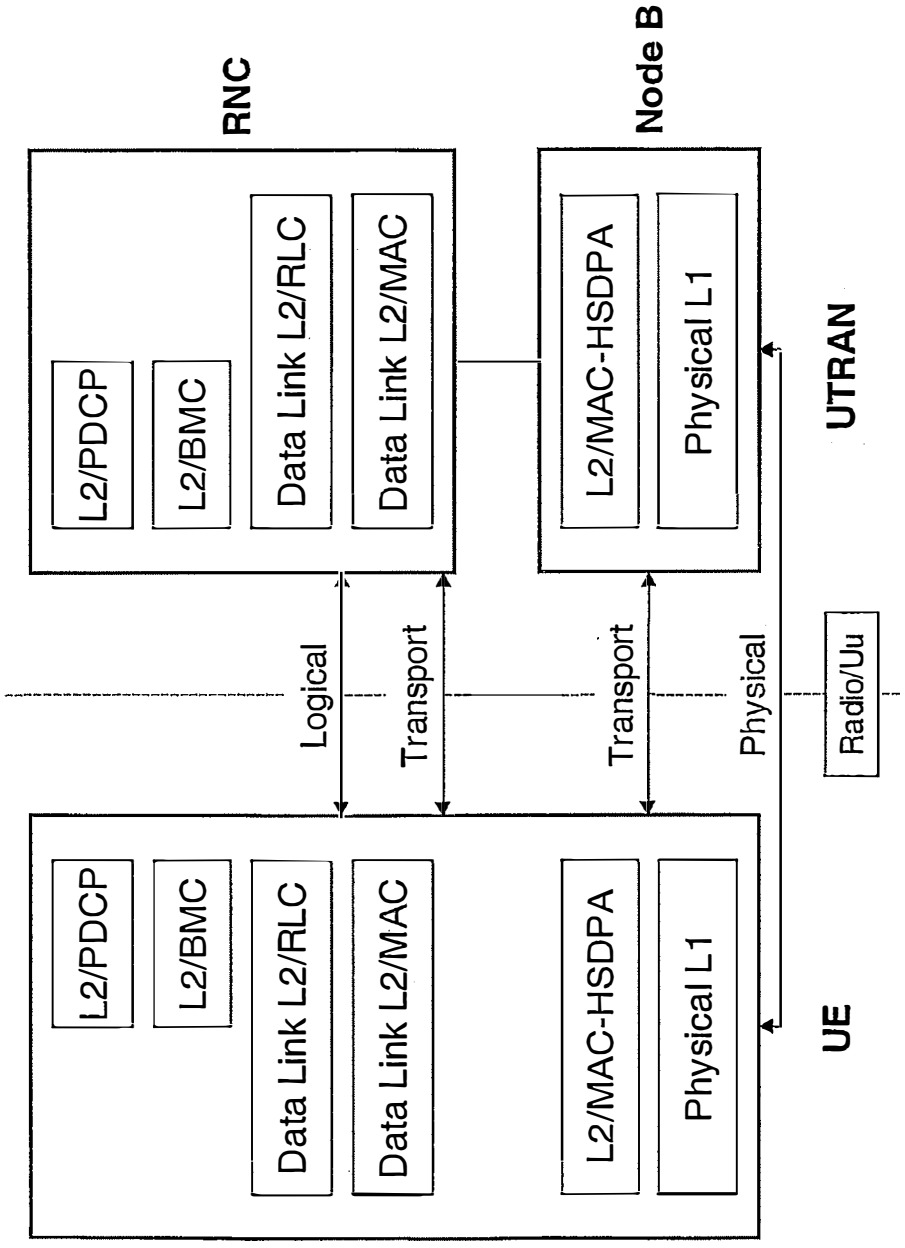

RNC
Node B
L2/PDCP
L2/BMC
Data Link L2/RLC
Data Link L2/MAC
L2/MAC-HSDPA
Physical L1
UTRAN
Logical
Transport
Transport
Physical
Radio/Uu
L2/PDCP
L2/BMC
Data Link L2/RLC
Data Link L2/MAC
L2/MAC-HSDPA
Physical L1
UE

Fig. 3

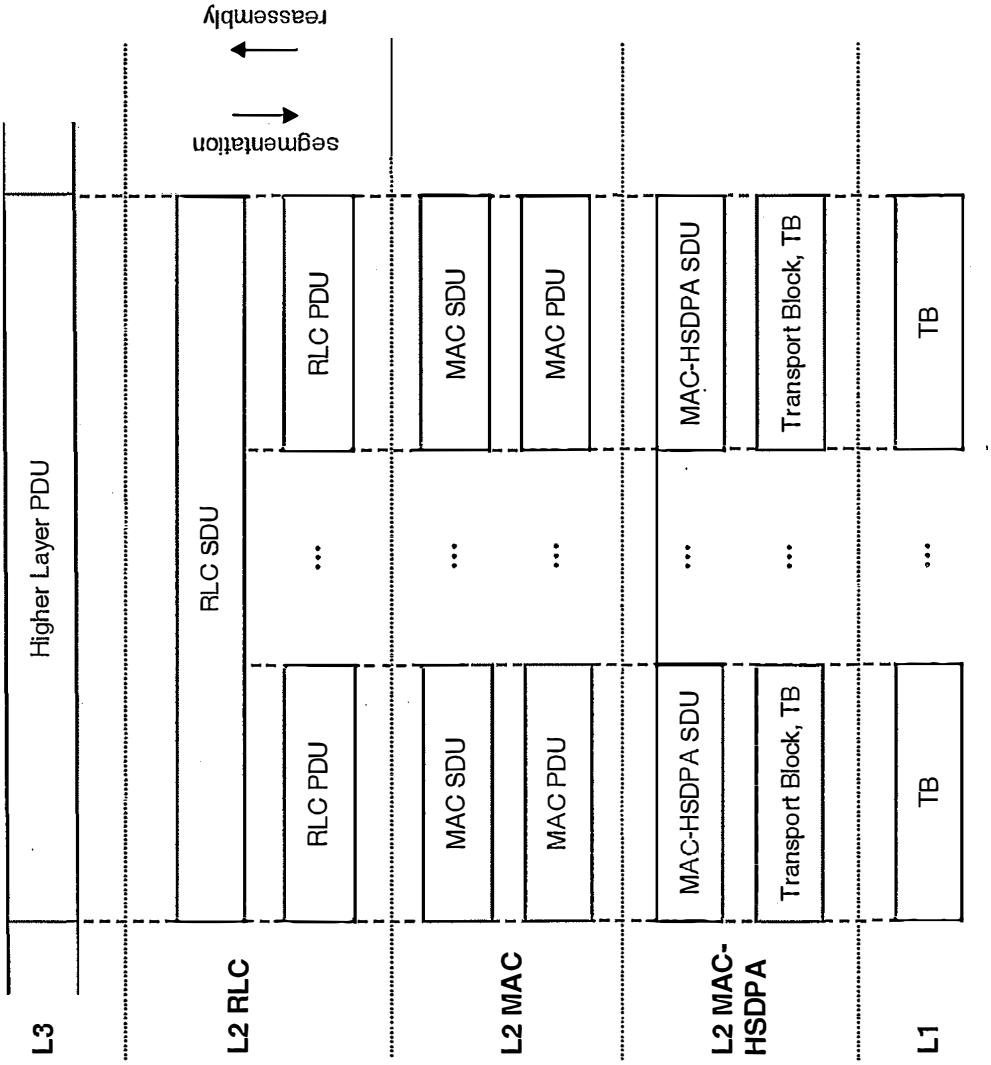

reassembly
segmentation
Higher Layer PDU
RLC SDU
RLC PDU
MAC SDU
MAC PDU
MAC-HSDPA SDU
Transport Block, TB
TB
L3
L2 RLC
L2 MAC
L2 MAC-HSDPA
L1

Fig. 4

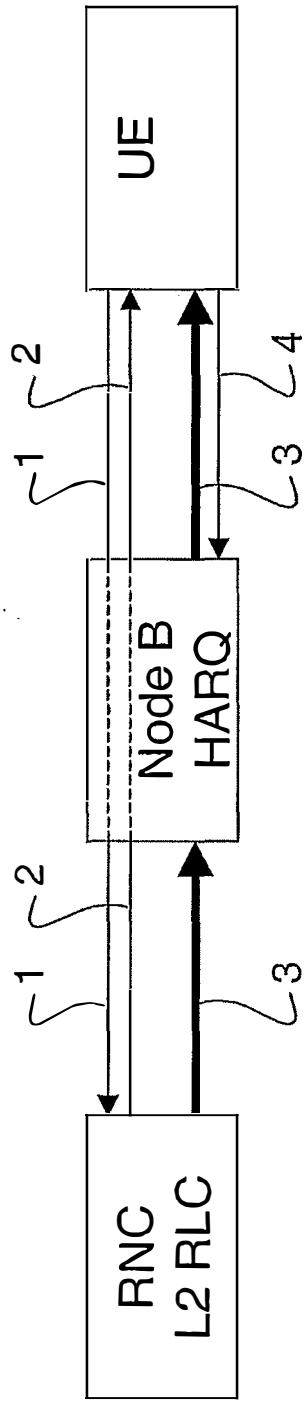


Fig. 5a

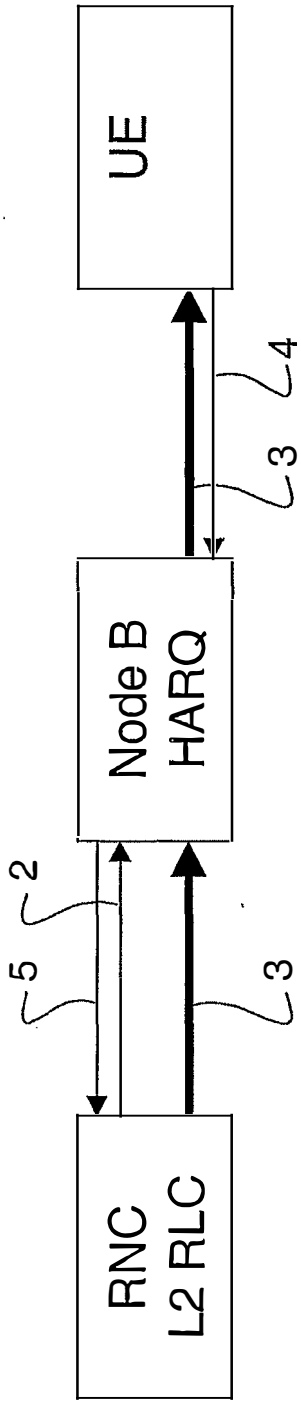


Fig. 5b

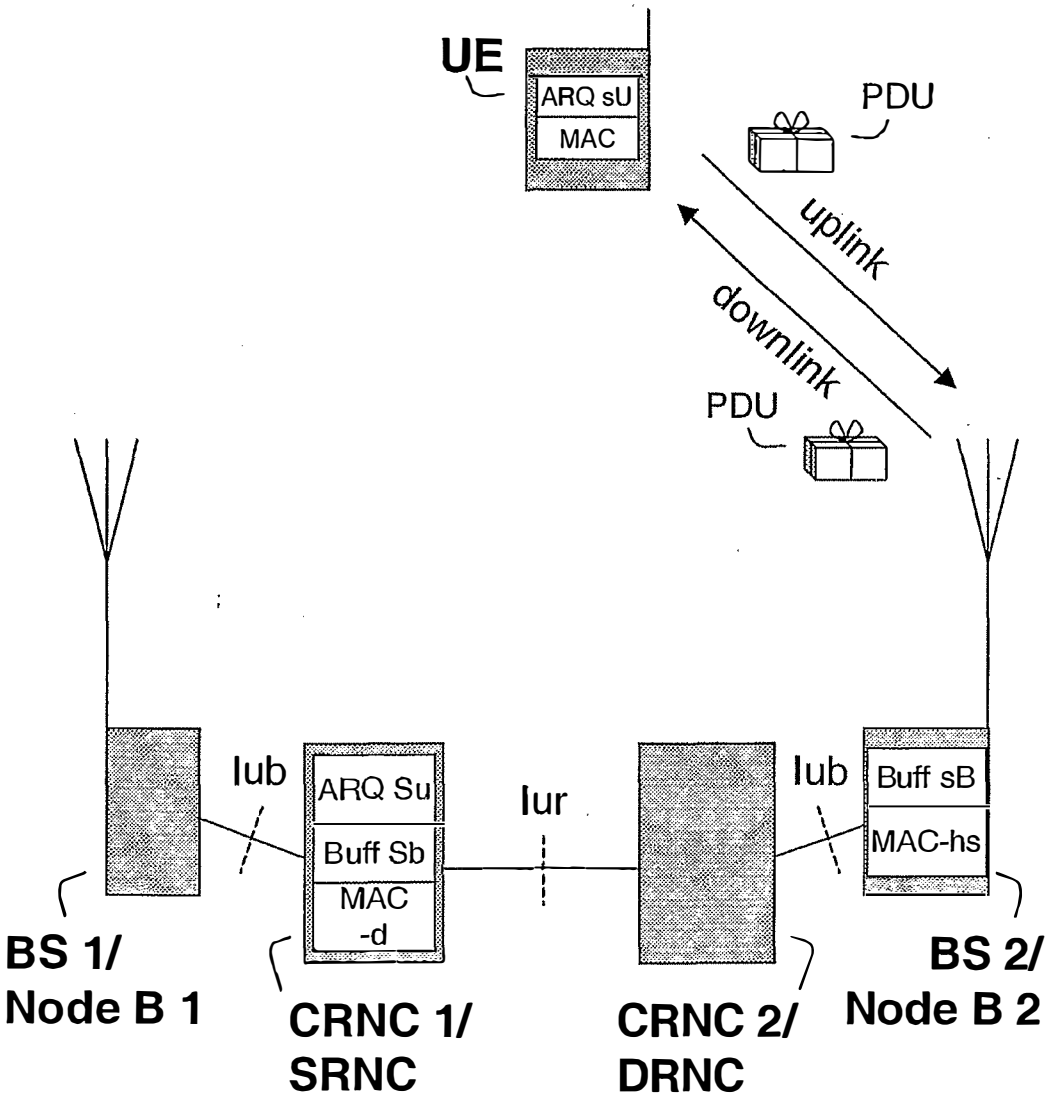

UE
ARQ sU
MAC
PDU
uplink
downlink
PDU
Iub
ARQ Su
Buff Sb
MAC
-d
Iur
Iub
Buff sB
MAC-hs
BS 1/
Node B 1
CRNC 1/
SRNC
CRNC 2/
DRNC
BS 2/
Node B 2

Fig. 6

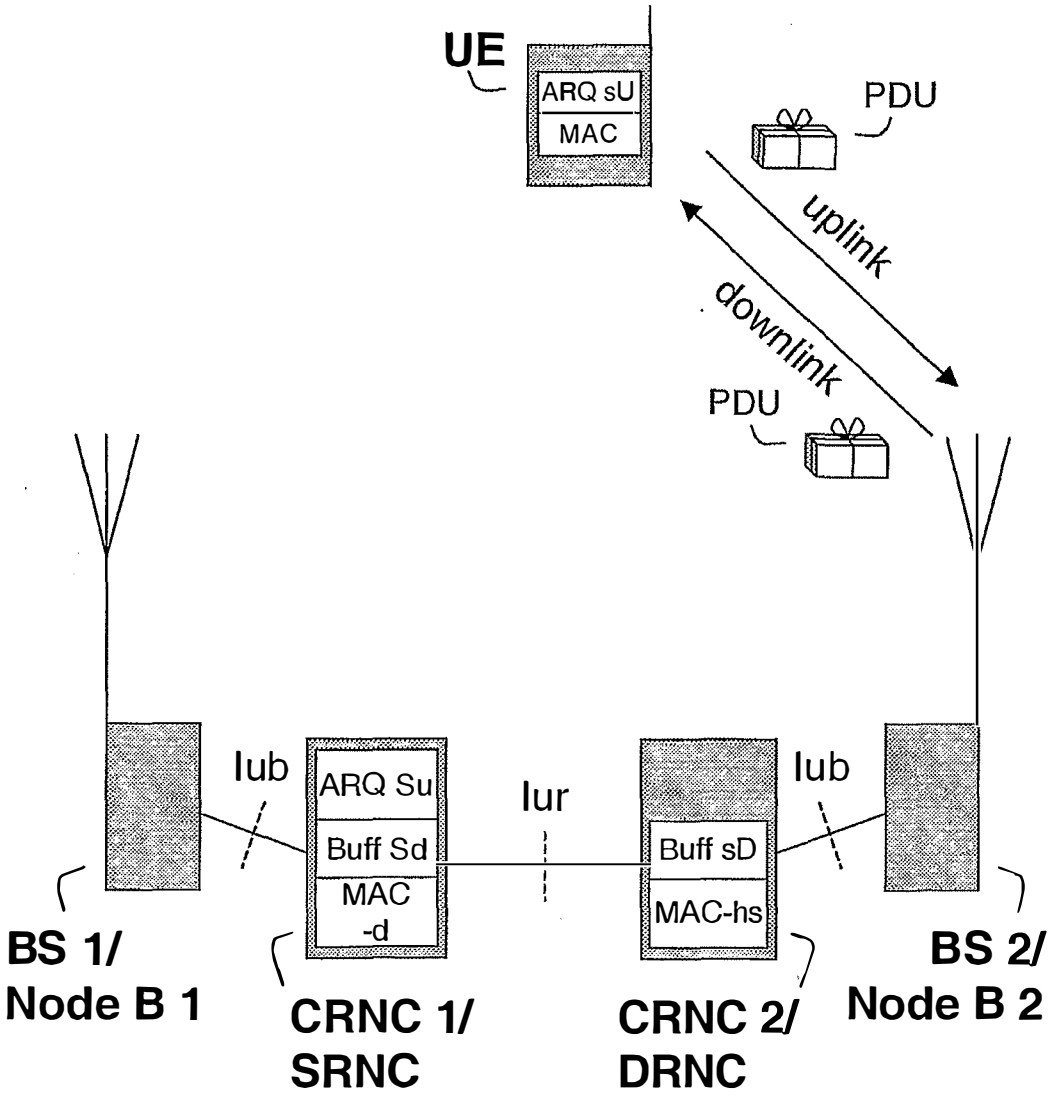

UE
ARQ sU
MAC
PDU
uplink
downlink
PDU
Iub
ARQ Su
Buff Sd
MAC
-d
Iur
Buff sD
MAC-hs
Iub
BS 1/
Node B 1
CRNC 1/
SRNC
CRNC 2/
DRNC
BS 2/
Node B 2

Fig. 7

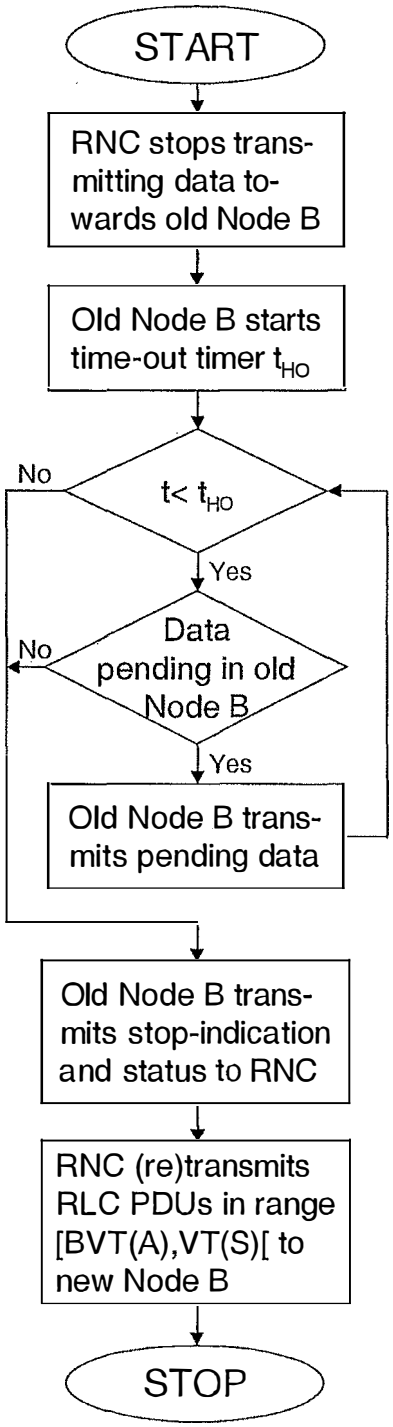

START
RNC stops transmitting data towards old Node B
Old Node B starts time-out timer t_{HO}
No
$t < t_{HO}$
Yes
No
Data pending in old Node B
Yes
Old Node B transmits pending data
Old Node B transmits stop-indication and status to RNC
RNC (re)transmits RLC PDUs in range [BVT(A),VT(S)[to new Node B
STOP

Fig. 8

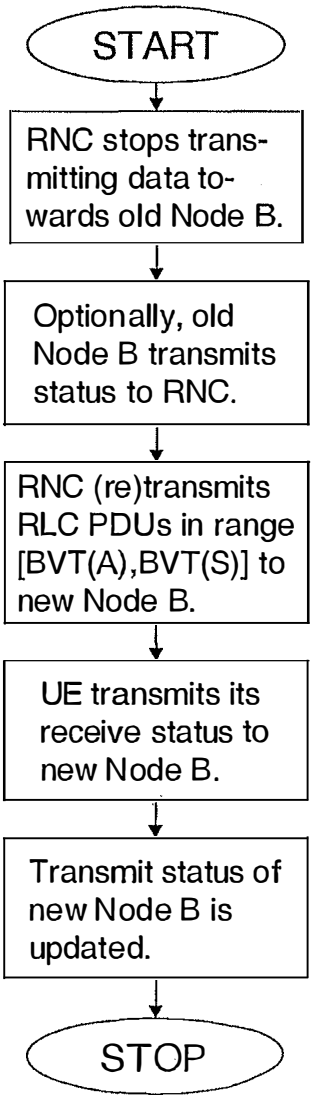

START
RNC stops transmitting data towards old Node B.
Optionally, old Node B transmits status to RNC.
RNC (re)transmits RLC PDUs in range [BVT(A),BVT(S)] to new Node B.
UE transmits its receive status to new Node B.
Transmit status of new Node B is updated.
STOP

Fig. 9

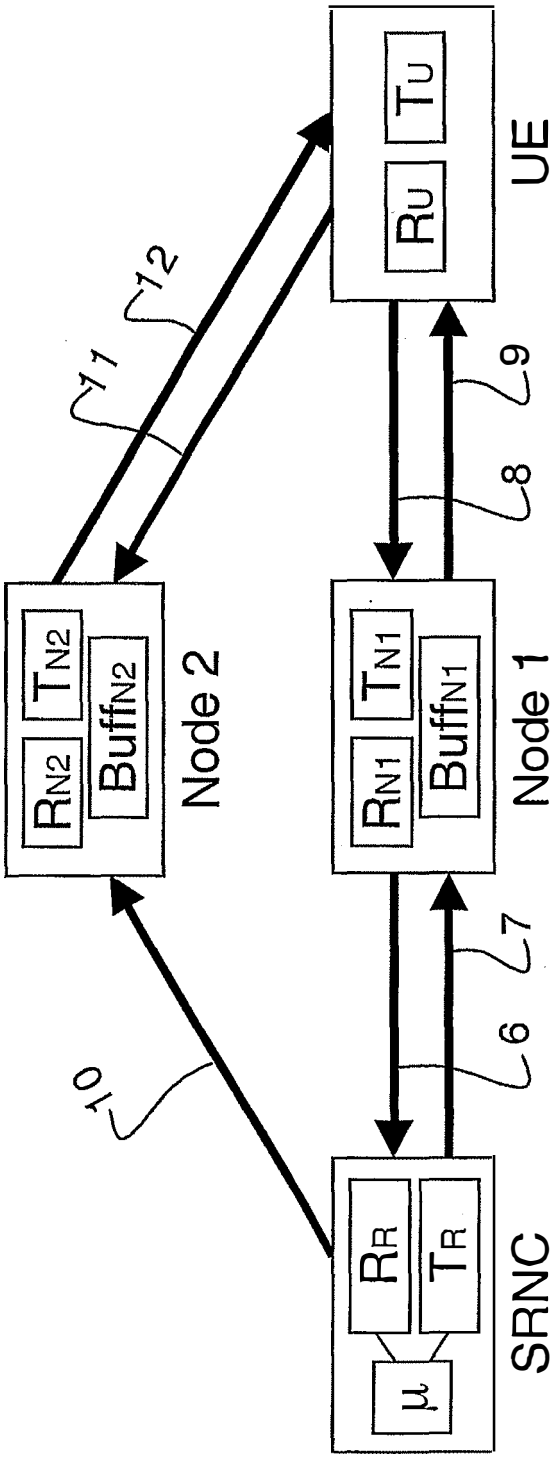

UE
RU
TU
Node 1
RN1
TN1
BuffN1
Node 2
RN2
TN2
BuffN2
SRNC
RR
TR
μ
6
7
8
9
10
11
12

Fig. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 02/02186

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: H04L 1/18
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)

IPC7: H04L, H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

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

EPO-INTERNAL, WPI DATA, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	ENGELS, V. et al. "Radio access to an ATM network with a TDD/TDMA-OFDM system". In: VEHICULAR TECHNOLOGY CONFERENCE, 1997 IEEE 47th, Phoenix, AZ, USA, 4-7 May 1997, Vol. 3, pages 1654 - 1658, INSPEC: 5780602, see paragraph III., B.	1-61
	--	
A	WO 9959354 A2 (NOKIA NETWORKS OY), 18 November 1999 (18.11.99), abstract	1-61
	--	

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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

Date of the actual completion of the international search	Date of mailing of the international search report
13 March 2003	17 -03- 2003
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Åsa Hällgren /OGU Telephone No. +46 8 782 25 00

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 02/02186

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	LEFEVRE, F. et al. "Optimizing UMTS link layer parameters for a TCP connection". In: VEHICULAR TECHNOLOGY CONFERENCE, 2001. VTC 2001 SPRING. IEEE VTS 53rd, Rhodes, Greece, 6-9 May 2001, Vol. 4, pages 2318 - 2322, INSPEC: 7183792, see abstract; paragraph 1-3. --	1-61
A	STEPHANE, A. et al. "Mechanism and hierarchical topology for fast handover in wireless IP networks". In: IEEE COMMUNICATIONS MAGAZINE, November 2000, Vol. 38, Issue 11, pages 112 - 115, ISSN: 0163-6804, INSPEC: 6766392, see abstract --	1-61

INTERNATIONAL SEARCH REPORT
Information on patent family members

30/12/02

International application No.
PCT/SE 02/02186

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9959354 A2	18/11/99	AU 4042299 A	29/11/99
		EP 1078539 A	28/02/01
		FI 107364 B	00/00/00
		FI 981042 A	12/11/99
		JP 2002515708 T	28/05/02

Form PCT/ISA/210 (patent family annex) (July 1998)

Electronic Acknowledgement Receipt

EFS ID:	19853068
Application Number:	13908242
International Application Number:	
Confirmation Number:	5287
Title of Invention:	SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER
First Named Inventor/Applicant Name:	Guodong Zhang
Customer Number:	24374
Filer:	Abhik A. Huq/Carey Kulp
Filer Authorized By:	Abhik A. Huq
Attorney Docket Number:	SIG-2-0674US05
Receipt Date:	13-AUG-2014
Filing Date:	03-JUN-2013
Time Stamp:	15:49:48
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Foreign Reference	ep1217777.pdf	957600 a1608fba65750738ae**d**a20a770623e6157af245ba	no	14
Warnings:					
Information:					

2	Foreign Reference	KR20030003943.pdf	542336 179fda995981ab8340506dadad414ccc56165ccf	no	14
Warnings:					
Information:					
3	Foreign Reference	WO0247317.pdf	718278 d9b3bba7713a631719d58bfd504f562e1365dab1	no	19
Warnings:					
Information:					
4	Foreign Reference	WO02082108.pdf	700914 38bc02d9e0f1a205e3b62d587e8e58f96da15571	no	20
Warnings:					
Information:					
5	Foreign Reference	WO02101966.pdf	991462 005a155a248523dca77e764e75b1cf3d15d57521	no	25
Warnings:					
Information:					
6	Non Patent Literature	Heck.pdf	770239 77b9620375302d3e1546a32171525884970598dd	no	5
Warnings:					
Information:					
7	Non Patent Literature	R1_030979.pdf	223729 023bb4052704778b4615862272055448471a887a	no	9
Warnings:					
Information:					
8	Non Patent Literature	NOKIA_R1_030733.pdf	129896 df8b33911f7c70a97aa8ea77de370566b5fe0ea3	no	4
Warnings:					
Information:					
9	Non Patent Literature	R1_030803.pdf	250672 a840679dafc76d546780a68bc281590f7aacb344	no	11
Warnings:					
Information:					
10	Non Patent Literature	Samsung_R1_030765.pdf	186185 28ddc8796903e98c9e30518e9bdd9df4eb3c762b	no	4
Warnings:					
Information:					

11	Transmittal Letter	IDS.pdf	60560 3f5cb5edb6718ba3c758fadedc88018c252de793	no	3
Warnings:					
Information:					
12	Information Disclosure Statement (IDS) Form (SB08)	SB08.pdf	668312 034e826c2e5e3a1c323aceab8a4e4a7653a8f30f	no	9
Warnings:					
Information:					
13	Non Patent Literature	25_133_V3_19_0.pdf	1201334 c396145f9c83359348516b6956885f35dbc95541	no	148
Warnings:					
Information:					
14	Non Patent Literature	25_133_V3_15_0.pdf	922308 fbffb8080645b2974ca14882ee73c79573fba51f	no	144
Warnings:					
Information:					
15	Non Patent Literature	25_133_V4_10_0.pdf	1175335 170fb0f84fbf28845a882f5714e00848db3d7ed3	no	152
Warnings:					
Information:					
16	Non Patent Literature	25_133_V4_13_0.pdf	1193572 0464866b9afd691e6b492bf6c0bab69ec2922a52	no	155
Warnings:					
Information:					
17	Non Patent Literature	25_133_V5_8_0.pdf	1003010 fbce6c1c0f5fe87a6bc57cdf11e0fb531ecd11c7	no	163
Warnings:					
Information:					
18	Non Patent Literature	25_133_V5_12_0.pdf	1323275 b45a5d29a04707eb67750cafe0d234749474966a	no	171
Warnings:					
Information:					
19	Non Patent Literature	25_133_V6_3_0.pdf	1013367 a0dce94faf050622596e5dcf6925fac4460f0031	no	163
Warnings:					
Information:					

20	Non Patent Literature	25_133_V6_7_0.pdf	1363434 392623949c62da7008b13f90b129f40af275b3f5	no	175
Warnings:					
Information:					
21	Non Patent Literature	25_211_V3_12_0.pdf	907810 ec0de27fa7385aed292049d4856f5f6a21539ec2	no	46
Warnings:					
Information:					
22	Non Patent Literature	25_211_V4_6_0.pdf	907926 542fd58695ac8dc1a13f98980468146 00bd34b44	no	46
Warnings:					
Information:					
23	Non Patent Literature	25_211_V5_5_0.pdf	830298 8153c8da813fdc6732871a001ed72c270f9d2f59	no	51
Warnings:					
Information:					
24	Non Patent Literature	25_211_V5_6_0.pdf	1040357 fc56f972ebf75f2ecda669a8a4c5fec8036e4d9	no	51
Warnings:					
Information:					
25	Non Patent Literature	25_211_V6_2_0.pdf	1041624 d3df59ae3ddafce9b2dc72db3ec1a99c50c459e0	no	51
Warnings:					
Information:					
26	Non Patent Literature	25_214_V3_12_0.pdf	706528 b529a449f7afb537303a1e83da482eaa6739deb3	no	52
Warnings:					
Information:					
27	Non Patent Literature	25_214_v4_6_0.pdf	625024 0f8be155d72e1e446c8e73d8ad9b5e48bbd7e61d	no	53
Warnings:					
Information:					
28	Non Patent Literature	25_214_v5_6_0.pdf	779281 30aefac40169fd7aea9e64234449da780e6e4d83	no	63
Warnings:					
Information:					

29	Non Patent Literature	25_214_V5_9_0.pdf	784266 2fe9667c556b05e5be8de2185d17af64d9a90c7e	no	64
Warnings:					
Information:					
30	Non Patent Literature	25_214_V6_3_0.pdf	797803 d8c00480f67af16c49aa4800e6a0750fb835f9da	no	64
Warnings:					
Information:					
31	Non Patent Literature	25_308_V5_4_0.pdf	363280 02240a884ba6a7dfa4bc3cce4bafe7eac8fc0086	no	28
Warnings:					
Information:					
32	Non Patent Literature	25_308_V5_6_0.pdf	336450 fcad4f7f01f7c9a9e899e35db9a290b13dfcf3ed	no	28
Warnings:					
Information:					
33	Non Patent Literature	25_308_V6_2_0.pdf	336433 a91dd208e0b9db39e1b41dc4ddde8c82ab704d5f	no	28
Warnings:					
Information:					
34	Foreign Reference	_wo0237872.pdf	16015264 d9c6d8a7b390c3fdfbea44a0467df3b4d6cc515	no	16
Warnings:					
Information:					
35	Foreign Reference	WO03_047155.pdf	1982640 60338446b950fb8240bc3eb8092702ce6cf286a4	no	49
Warnings:					
Information:					
36	Non Patent Literature	25_896_V0_4_2.pdf	1737646 77c6321ff4d623c6a1a14b6cef8f53c84cf05823	no	63
Warnings:					
Information:					
		Total Files Size (in bytes):	44588448		

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.

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 217 777 A1

(12) EUROPÄISCHE PATENTANMELDUNG

(43) Veröffentlichungstag:
26.06.2002 Patentblatt 2002/26

(51) Int Cl.[7]: **H04L 1/18**

(21) Anmeldenummer: **00128431.4**

(22) Anmeldetag: **22.12.2000**

(84) Benannte Vertragsstaaten:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR
Benannte Erstreckungsstaaten:
AL LT LV MK RO SI

(71) Anmelder: **SIEMENS AKTIENGESELLSCHAFT**
80333 München (DE)

(72) Erfinder:
- **Dold, Joachim**
  10823 Berlin (DE)
- **Gessner, Christina**
  13587 Berlin (DE)
- **Hillebrand, Frank**
  13587 Berlin (DE)
- **Kuipers, Martin**
  13599 Berlin (DE)
- **Lehmann, Gerald**
  12101 Berlin (DE)
- **Meiling, Axel**
  13597 Berlin (DE)
- **Papoutsis, Georgios**
  10719 Berlin (DE)
- **Plogsties, Jens**
  12524 Berlin (DE)
- **Raji, Fariba**
  10625 Berlin (DE)
- **Schindler, Jürgen, Dr.**
  15555 Berlin (DE)
- **Schniedenharn, Joerg**
  13587 Berlin (DE)
- **Schmitz, Heiko, Dr.**
  13347 Berlin (DE)
- **Wegner, Frank**
  13407 Berlin (DE)

(54) Verfahren und Kommunikationssystem zur Übertragung von Datenpaketen, insbesondere bei Anwendung von Hybrid-ARQ-Verfahren

(57) Die Erfindung bezieht sich auf ein Verfahren zur Übertragung von Datenpaketen (PDU) über eine Schnittstelle in einem Kommunikationssystem (GSM, UMTS) zwischen einer Sendereinrichtung (BS) und einer Empfängereinrichtung (MS), wobei eine Aussendung von bezugslosen Datenpaketen ohne Inhaltsbezug auf vorherige Datenpakete und/oder von inhaltsbezogenen Datenpaketen mit Inhaltsbezug auf vorherige Datenpakete über eine unterteilte Ressource (t) durchgeführt wird und wobei die Aussendung dieser Datenpakete jeweils einem bestimmten Ressourcenelement (Zeitschlitz tx) der Ressource (t) zugeordnet erfolgt.

Zur sichereren Zuordnung eines Datenpakets mit fehlerhafter oder fehlender Sequenznummer wird vorgeschlagen, dass die Zuordnung der Datenpakete (PDU, SQ11) zu den Ressourcenelementen (t2, t6) nach einem vorbestimmten und nicht zufälligen Schema (C1, C2) unter verschiedener Behandlung der bezugslosen und der inhaltsbezogenen Datenpakete (SQ11 bei t2 bzw. SQ11 bei t6) erfolgt. Vorteilhafterweise ermöglicht dies empfängerseitig eine Zuordnung eines empfangenen Datenpakets als entweder ein neues Datenpaket (SQ11 bei t2) ohne Bezug auf den Inhalt eines anderen Datenpakets oder ein Datenpaket (SQ11 bei t6) mit Bezug auf den Inhalt einer vorbestimmbar begrenzten Anzahl bestimmter anderer Datenpakete.

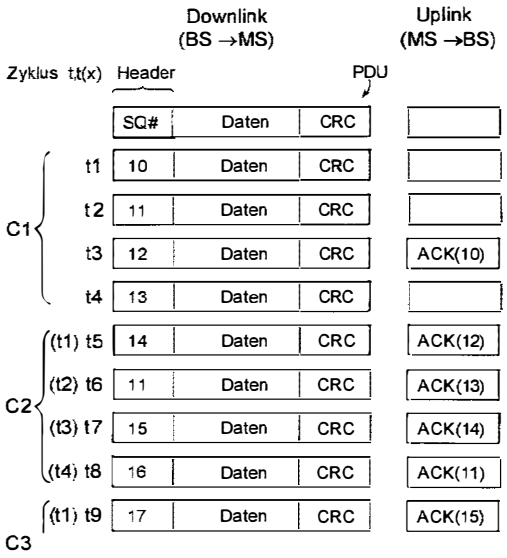


FIG. 2

EP 1 217 777 A1

Beschreibung

[0001] Die Erfindung bezieht sich auf ein Verfahren zur Übertragung von Datenpaketen, insbesondere bei Anwendung von Fehler-Korrekturverfahren, mit den oberbegrifflichen Merkmalen des Patentanspruchs 1 bzw. auf ein Kommunikationssystem zum Durchführen eines solchen Verfahrens.

[0002] Bei digitalen Funk-Kommunikationssystemen, beispielsweise dem Mobilfunksystem GSM (Global System for Mobile Communications), werden Informationen wie beispielsweise Sprache, Bildinformation oder andere Daten mit Hilfe von elektromagnetischen Wellen über eine Funkschnittstelle übertragen. Die Funkschnittstelle dient als eine Verbindung zwischen einer Basisstation und einer Vielzahl von Teilnehmerstationen, wobei die Teilnehmerstationen beispielsweise Mobilstationen oder ortsfeste Funkstationen sein können. Das Abstrahlen der elektromagnetischen Wellen erfolgt dabei mit Trägerfrequenzen, die in einem für das jeweilige System vorgesehenen Frequenzband liegen.

[0003] Um den Bedarf des zur Verfügung stehenden Spektrums an der knappen Ressource "Trägerfrequenz" besser zu decken, wurden synchrone Multiplexverfahren auf der Basis eines frequenz-, zeit- und/oder spreizcodeselektiven Vielfachzugriffs zur Verteilung der Übertragungskapazität eines Kanals auf mehrere Verbindungen eingeführt. Hierzu wird in Absprache zwischen Sender und Empfänger unter Einbeziehung eventueller Vermittlungsknoten ein vorgegebenes Raster aus sende- und empfangssynchronen Frequenzbändern, Zeitschlitzen und/oder Codesequenzen genutzt. Die Sender ordnen die Daten der einzelnen Verbindungen diesem Raster zu und die Empfänger separieren aus dem empfangenen Datenstrom die für sie bestimmten Daten.

[0004] Für die dritte Mobilfunkgeneration UMTS (Universal Mobile Telecommunications System) sind z.B. zwei Modi vorgesehen, wobei ein Modus einen FDD-Betrieb (Frequency Division Duplex) und der andere Modus einen TDD-Betrieb (Time Division Duplex) zugrunde legt. Diese Modi finden ihre Anwendung in unterschiedlichen Frequenzbändern, wobei beide Modi ein codeteilendes sogenanntes CDMA-Teilnehmer-Separierungsverfahren (Code Division Multiple Access) unterstützen.

[0005] Ein weiteres grundsätzliches Verfahren ist die Paketvermittlung. Sie beruht auf der gemeinsamen Nutzung eines Übertragungskanals mit hoher Übertragungskapazität durch mehrere verschiedene Verbindungen. Auch hierfür wird der Übertragungskanal auf der Zeitachse unterteilt, allerdings nicht in feste Zeitschlitze, sondern in adressierte Datenpakete variabler Länge, wobei durch zusätzliche Trennung in Code oder Frequenz auch mehrere Pakete gleichzeitig gesendet werden können. Die Daten werden zeitvariant in Art eines asynchronen Multiplex-Verfahrens übertragen. Jeder Sender kann jederzeit auf die bis dahin ungenutzte Übertragungskapazität zugreifen und seine Daten z.B. nach dem ALOHA-Verfahren, einem stochastischem Zugriffsverfahren, übertragen. Der Sender kann außerdem die effektive Datenrate sowohl dadurch beeinflussen, in welchen zeitlichen Abständen er die Datenpakete sendet, als auch durch deren Länge, Anzahl der verwendeten Codes, verwendete Bitraten oder Frequenzen.

[0006] Große Datenpakete lassen sich oftmals nicht in einem Stück übertragen. Deshalb werden sie vor der eigentlichen Übertragung in kleine Datenpakete, sogenannte Paketdateneinheiten (PDU: Protocol Data Unit) unterteilt. Jedes Datenpaket enthält Nutzdaten und wird in der Regel mit einem Kopfabschnitt (Header) versehen. Außerdem enthält jedes Datenpaket eine Lauf- bzw. Sequenznummer, insbesondere im Kopfabschnitt und ggf. weitere für den Transport erforderliche Angaben. Die Sequenznummer ist ein Identifizierungskennzeichen zur direkten Kennzeichnung eines bestimmten Datenpakets. Insbesondere am Ende der Nutzdaten ist zum Erkennen von Fehlern, die auf der Übertragungsstrecke entstehen, oftmals eine Prüfsumme hinzugefügt, die mittels eines fehlererkennenden Codes (CRC: zyklischer Redundanzcheck-Code) über die Nutzdatenbit berechnet wird. Für den Kopfabschnitt kann eine separate CRC bereitgestellt werden.

[0007] Der Mobilfunkkanal ist einer der ungünstigsten Übertragungskanäle, die in der Nachrichtentechnik vorkommen. Ein Problem sind kurzfristige Empfangspegeleinbrüche und Signalverzerrungen, die hauptsächlich durch eine Mehrwegausbreitung (Fast Fading) der an Hindernissen reflektierten bzw. gebeugten Funkwellen auf der Übertragungsstrecke hervorgerufen werden. Bei der Übertragung eines Datenpakets kann es nicht nur zum Verlust von Daten, sondern auch zum Verlust des Kopfabschnitts kommen. Dadurch läßt sich ein Datenpaket nicht mehr einer Verbindung zuordnen.

[0008] Besonders kritisch ist insbesondere bei digitalen Funk-Kommunikationssystemen, wenn das Identifizierungskennzeichen bzw. die Sequenznummer eines Datenpakets bei der Übertragung verloren geht. Speziell bei ARQ-Fehlerkorrekturverfahren (ARQ: Automatic Repeat reQuest) mit einer Wiederholungsanforderung durch die empfangende Station werden Sequenz-Nummern dazu verwendet, dass die Empfängerseite wiederholte Übertragungen oder ergänzende Informationen zur Korrektur fehlerhaft übertragener Datenpakete anfordern kann. Beim sogenannten "Hybrid-ARQ I" informiert die Empfängerseite die sendende Station direkt oder indirekt über die erfolglos übertragenen Sequenz-Nummern und/oder die Sequenz-Nummern der erfolglos dekodierten Datenpakete, die dann von der sendenden Station nochmals verschickt werden.

[0009] Bei Hybrid ARQ II/III wird das Prinzip einer vorwärtsgerichteten Fehlerkorrektur (FEC: Forward Error Correction) mit ARQ-Verfahren verknüpft, d.h. dem zu übertragenden Datenpaket wird senderseitig Redundanz hinzugefügt, um eine Fehlerkorrektur am Empfän-

IPR2023-01270 Page 173

ger zu ermöglichen. Entsprechende Datenpakete werden auch als kodierte Datenblöcke bezeichnet. Um bei ARQ I/II/III oder ähnlichen Verfahren zu gewährleisten, dass die zur Dekodierung kombinierten und kodierten Datenblöcke zu dem selben Datenpaket gehören, ist es ebenfalls von großer Wichtigkeit, dass bei gestörter Übertragung zumindest die Sequenznummer mit hoher Wahrscheinlichkeit beim Empfänger richtig ankommt und dieser überprüfen kann, ob er die Sequenz-Nummer korrekt empfangen hat. Um den Schutz des Kopfabschnitts zu erhöhen, kann auch dieser mit einer Fehler-Vorwärtskorrektur versehen werden.

[0010] Bei einem Verlust von Daten auf der Übertragungsstrecke, der vom Empfänger in Auswertung der Prüfsumme des CRC bemerkt wird, besteht die Möglichkeit, durch eine Wiederholungsanforderung des Empfängers eine oder alle PDUs eines Datenpaketes sofort wiederholt zu senden. Der Sender muss hierzu nachteilhafterweise eine Kopie der übertragenen Datenpakete oder kodierten Paketdateneinheiten PDU eines Datenpaketes so lange verwalten, bis er für die jeweiligen Dateneinheiten eine Empfangsbestätigung erhalten hat. Der Empfänger benötigt seinerseits nachteilhafterweise einen entsprechend sehr großen Speicher, um fehlerfreie PDUs solange zu speichern, bis alle fehlerhaften Datenpakete oder Paketdateneinheiten PDU wiederholt worden sind und die Nachricht fehlerfrei zusammengesetzt werden kann.

[0011] Erstreckt sich die Prüfsumme des CRC über Daten und Kopfabschnitt, so kann bei einem Fehler außerdem nicht eindeutig bestimmt werden, ob nur Daten oder die für eine Wiederholungsanforderung wichtige Sequenznummer falsch übertragen wurden.

[0012] Ist auf der Empfängerseite eine Sequenznummer nicht korrekt empfangen worden oder konnte die Richtigkeit der Sequenznummer nicht erfolgreich überprüft werden, dann kann normalerweise mit den bisher verwendeten Verfahren der kodierte Datenblock nicht mehr benutzt werden, um durch Kombination mit anderen kodierten Datenblöcken die Dekodierung des Datenpaketes zu unterstützen. Wird ein kodierter Datenblock verwendet, bei dem die Richtigkeit der Sequenznummer nicht bestätigt werden konnte, so besteht bei den bisher verwendeten Verfahren die Gefahr, dass kodierte Datenblöcke kombiniert werden, die nicht zum gleichen Datenpaket gehören. Mit sehr großer Wahrscheinlichkeit bleibt jeder Decodierungsversuch, der einen nicht zum Datenpaket gehörenden kodierten Datenblock mit einschließt, erfolglos. Das kann dazu führen, dass alle nachfolgenden Versuche einer Dekodierung des Datenpaketes unter Einbeziehung neuer kodierter Datenblöcke erfolglos bleiben. In diesen Fall muss mit den bisher verwendeten Verfahren ein kodierter Datenblock, dessen Sequenznummer auf der Empfängerseite unklar ist, verworfen werden. Ferner ist es bei Hybrid-ARQ-Verfahren ein nachteilhafter Umstand, dass mit jeder zusätzlichen Übertragung von kodierten Datenblöcken die Anforderung an die notwendige Kanalqualität für eine erfolgreiche Dekodierung des gesamten Datenpakets (PDU) sinkt, da sich der Kodiergewinn erhöht, während hingegen die Anforderung an die Übertragung der Sequenznummer im Header steigt, da sich die Anzahl der übertragenen Datenblöcke und damit die Anzahl der Header mit einer Sequenznummer durch jede Übertragung eines kodierten Datenblocks erhöht und dabei jeweils eine zusätzliche fehlerfreie Detektion der Sequenznummer erforderlich ist, da für eine richtige Zuordnung der empfangenen Datenblöcke alle Sequenznummern fehlerfrei dekodiert werden müssen.

[0013] Da der Header einer fehlerhaft empfangenen PDU eventuell nicht decodiert werden kann und somit der Empfänger nicht in der Lage ist, den Sender anzuweisen, diese PDU wiederholt zu senden, gibt es Konzepte, bei denen der Header nicht mit den Nutzdaten in einem Verkehrskanal, sondern getrennt in einem Kontrollkanal mit höherem Fehlerschutz übertragen wird. Dieser Kontrollkanal, zum Beispiel bei Übertragung in Abwärtsrichtung (Downlink) der FACH (Fast Associated Control Channel), benötigt, da er sich unter Umständen nicht im gleichen zeitlichen Gefüge wie der Verkehrskanal befindet, nachteilhafterweise eine zusätzliche Identifizierungs-Signalisierung, um den Teilnehmer im System ausfindig zu machen und ihm den Header zuweisen zu können. Des weiteren wird dieser Kontrollkanal mit einer endlichen Kapazität von vielen Teilnehmern im System gleichzeitig genutzt, was zu einer Überlastung der Ressource führen kann.

[0014] Die in diesem Zusammenhang bisher vorgeschlagenen Verbesserungsmethoden, zielen auf eine sicherere Übertragung der Sequenznummer als solcher ab oder schlagen verbesserte Methoden zur Überprüfung der Richtigkeit der empfangenen Sequenznummer vor.

[0015] Die Aufgabe der Erfindung besteht darin, ein Verfahren bzw. ein Kommunikationssystem vorzuschlagen, bei denen mit geringem Aufwand auch die Sequenznummer einer Paketdateneinheit sicherer bestimmt werden kann.

[0016] Diese Aufgabe wird durch das Verfahren mit den Merkmalen des Patentanspruchs 1 bzw. das Kommunikationssystem gemäß den Merkmalen des Patentanspruchs 16 gelöst.

[0017] Vorteilhafte Ausgestaltungen sind Gegenstand von abhängigen Ansprüchen.

[0018] Vorteilhafterweise ermöglicht ein Verfahren zur Übertragung von Datenpaketen über eine Schnittstelle in einem Kommunikationssystem, z.B. GSM, UMTS, zwischen einer Sendereinrichtung und einer Empfängereinrichtung, bei einer Aussendung von bezugslosen Datenpaketen ohne Inhaltsbezug auf vorherige Datenpakete und von inhaltsbezogenen Datenpaketen mit Inhaltsbezug auf vorherige Datenpakete über eine unterteilte Ressource, wobei die Aussendung dieser Datenpakete jeweils einem bestimmten Ressourcenelement der Ressource zugeordnet erfolgt, eine verbesserte Zuordbarkeit eines aufgrund z.B. einer fehler-

IPR2023-01270 Page 174

haften oder verloren gegangenen Identifizierungskennzeichnung nicht mehr eindeutig zuordbaren Datenpakets durch eine Zuordnung zu einem jeweiligen der Ressourcenelemente nach einem vorbestimmten und nicht zufälligen Schema unter verschiedener Behandlung der bezugslosen und der inhaltsbezogenen Datenpakete. Vorbestimmt bedeutet dabei, dass das Schema sender- und empfängerseitig bekannt ist. Dabei kann das Schema der Empfängerseite von der Senderseite aus vorzugsweise erst vor Beginn einer Übertragung von Datenpaketen oder z.B. einem Verbindungsaufbau mitgeteilt werden.

[0019] Die Zuordnung der Datenpakete senderseitig vorzunehmen und mittels des Schemas empfängerseitig eine Zuordnung empfangener Datenpakete als ein bezugsloses Datenpaket oder zu einer begrenzten Anzahl, insbesondere eines bestimmten vorherigen inhaltsbezogenen Datenpakets durchzuführen, ermöglicht eine deutlich veringerte Anzahl der Zuordnungsmöglichkeiten des Datenpakets. Im Idealfall handelt es sich lediglich um die Möglichkeit eines gänzlich neuen Datenpaketes oder um den Empfang eines bereits in Arbeit befindlichen Datenpaketes. In letzterem Fall kann es sich wiederum um eine Wiederholungssendung eines nicht bestätigten Datenpakets oder insbesondere um eine Paketdateneinheit eines redundant kodierten Datenpakets handeln. Der Empfänger steht nicht mehr vor dem Problem einer großen Vielzahl von Zuordnungsmöglichkeiten, die eine versuchsweise Zuordnung nicht eindeutig identifizierbarer Datenpakete de facto ausschließen läßt.

[0020] Als Ressource eine in Zeitschlitze aufgeteilte Zeitachse bietet ein einfaches Zuordnungsschema, wobei Zeitschlitze als Ressourcenelemente nicht notwendig die in Tele-Kommunikationssystemen bereits bekannten Zeitschlitze sein müssen. Als Ressource ein in eine Vielzahl von Frequenzkanälen aufgeteiltes Frequenzband und/oder als Ressource eine Vielzahl von Codes bei einem Codespreizverfahren zu verwenden bietet alternative oder ergänzende Einteilungsmöglichkeiten.

[0021] Als Datenpaket bietet sich insbesondere ein Datenpaket mit einem eindeutigen Identifizierungskennzeichen, insbesondere einer Datenpaketnummer oder Sequenznummer an, da so auf bestehende Datenstrukturen aufgebaut werden kann. Dies gilt insbesondere, wenn als Datenpaket ein Datenpaket mit einem Kopfabschnitt, der das bestimmte Identifizierungskennzeichen aufweist, verwendet wird.

[0022] Das Schema eine zyklische Zuordnung zu den Ressourcenelementen durchführen zu lassen ermöglicht eine besonders einfache Art der Zuordnung der Ressourcenelemente.

[0023] Eines der inhaltsbezogenen, zu einem gesandten Datenpaket zugeordneten Datenpakete nach einer negativen oder nicht innerhalb einer vorgegebenen Zeitdauer eingetroffenen Empfangsbestätigung bei einem späteren, nach dem Schema eindeutig zugeordneten Ressourcenelement zu übertragen, ermöglicht eine gezielte Sendung bzw. Neusendung, wodurch die Kapazität der Ressource ideal ausgenutzt werden kann.

[0024] Als inhaltsbezogene Datenpakete können insbesondere Datenpakete mit gleichem Inhalt eines Datenblocks eines vorherigen bzw. zuvor gesendeten Datenpakets und/oder Datenpakete mit einem zum Datenblockinhalt eines vorherigen Datenpakets zugeordneten Datenblockinhalt übertragen werden.

[0025] Falls zu einem bestimmten Ressourcenelement entsprechend ein weiterer kodierter Datenblock mit Identifizierungskennzeichen zu einem zumindest teilweise übertragenen Datenpaket übertragen werden soll, dann kann besonders ressourcenschonend ein weiterer Datenblock vom ältesten bisher nicht erfolgreich übertragenen Datenpaket übertragen werden. Inhaltsbezogene Datenpakete mit zugeordnetem Datenblockinhalt können vorteilhafterweise auch kodierte Datenpakete zu einem vorherigen Datenpaket sein. Die inhaltsbezogenen Datenpakete können zur Erhöhung der Sicherheit ferner gemäß einem Fehlererfassungsoder Fehlerkorrekturverfahren wie einem ARQ-Verfahren in für sich bekannter Weise verarbeitet werden. Insbesondere können diese Fehlererfassungs- oder Fehlerkorrekturverfahren auch über den Kopfabschnitt erstreckt werden.

[0026] Empfängerseitig trotz eines nicht fehlerfrei dekodierbar oder bestimmbar zuzuordnenden Datenpakets einen Kombinierungs- oder Dekodierungsversuch mit einem anderen Datenpaket vorzunehmen wird möglich, da dieses Datenpaket gemäß dem Schema einer beliebig stark begrenzbaren Anzahl von Kombinationsmöglichkeiten mit vorherigen Datenpaketen zugeordnet werden kann.

[0027] Falls zu einem bestimmten Ressourcenelement (t(x + iN)) ein weiterer inhaltsbezogener Datenblock zu einem zumindest teilweise übertragenen Datenpaket (PDU) übertragen werden soll, dann ist dies vorteilhafterweise ein weiterer Datenblock vom ältesten bisher nicht erfolgreich übertragenen Datenpaket als inhaltsbezogenes Datenpaket, da durch eine solche Reihenfolge eine besonders schnelle und ressourcensparende Abarbeitung möglich ist.

[0028] Einen Grenzwert der für eine Verbindung verfügbaren Anzahl von Ressourcenelementen der Ressource festzulegen, gibt die Möglichkeit, nur noch bereits übertragenen Datenpaketen zugeordnete Datenpakete zu übertragen, solange die Anzahl der als mehrere bzw. weitere Datenpakete zu übertragenden Datenpakete, die zu solchen bereits übertragenen Datenpaketen zugeordnet sind, den Grenzwert oder einen festgelegten Wert mit Bezug auf den Grenzwert überschreitet. Dadurch kann der erforderliche Speicherraum auf ein gewünschtes Maß beschränkt werden.

[0029] Als die Schnittstelle bieten sich eine Luftschnittstelle oder ein elektrisch oder optisch leitendes Medium an, wie sie für sich genommen bekannt sind.

[0030] Besonders vorteilhaft ist entsprechend ein

IPR2023-01270 Page 175

Kommunikationssystem zum Durchführen eines solchen Verfahren, wenn es aufweist: eine Sendereinrichtung, eine Empfängereinrichtung, eine Schnittstelle mit einer unterteilten Ressource zur Übertragung von Datenpaketen zwischen der Sendereinrichtung und der Empfängereinrichtung, eine Sender-Ressourcenzuordnungseinrichtung zum Aussenden von bezugslosen Datenpaketen ohne Inhaltsbezug auf vorherige Datenpakete und/oder von inhaltsbezogenen Datenpaketen mit Inhaltsbezug auf vorherige Datenpakete über die unterteilte Ressource und zum Zuordnen der Aussendung eines jeden dieser Datenpakete zu jeweils einem bestimmten Ressourcenelement der Ressource und eine Empfänger-Ressourcenzuordnungseinrichtung zum Verwalten derart zugeordneter, bei der Empfängereinrichtung eingetroffener Datenpakete, wenn die Sender- und die Empfänger-Ressourcenzuordnungseinrichtung zum Zuordnen der Datenpakete zu den Ressourcenelementen nach einem vorbestimmten und nicht zufälligen Schema unter verschiedener Behandlung der bezugslosen und der inhaltsbezogenen Datenpakete ausgebildet sind.

[0031] Ein solches Kommunikationssystem kann insbesondere ein für sich bekanntes Funk-Kommunikationssystem mit zumindest einer Basisstation als Sendereinrichtung und zumindest einer stationären und/oder mobilen Datenendeinrichtung, insbesondere mobilen Teilnehmerstation als Empfängereinrichtung sein.

[0032] Das Kommunikationssystem kann vorteilhafterweise als ein Tele-Kommunikationssystem oder Datennetz ausgebildet sein.

[0033] Ein solches Verfahren ist somit besonders vorteilhaft, da am Empfänger als Identifizierungskennzeichen auch die Sequenznummer, die sich insbesondere im Header befindet, mit geringem Kombinationsaufwand kombiniert und decodiert werden kann. Außerdem sinkt vorteilhafterweise die Anforderung an die notwendige Kanalqualität bei Anwendung eines solchen Verfahrens nicht nur für die Übertragung des Datenblocks sondern auch für die Detektion der Sequenznummer bei jeder wiederholten Übertragung (re-transmission). Dabei ist es insbesondere unerheblich, ob die Sequenznummer von Anfang an oder erst nach der letzten Übertragung fehlerfrei dekodiert werden konnte.

[0034] Das Verfahren kann auch mit verschiedenartigen anderen Verfahren zur Kombinierung, Codierung oder sonstiger Datenverarbeitung kombiniert werden. Ein Beispiel für ein einbindbares Verfahren umfasst z. B. kodierte Datenblöcke, bei denen die Sequenznummer nicht erfolgreich dekodiert werden konnte, nicht zu verwerfen, sondern für eine spätere Kombination zwischenzuspeichern. Mit steigender Anzahl von nicht zugeordneten bzw. nicht identifizierten kodierten Datenblöcken steigt der Kombinationsaufwand mit folgenden Datenblöcken allerdings überproportional.

[0035] Eine Möglichkeit der Einteilung der Ressource Zeit ist die Unterteilung eines Zeitintervalls in unterschiedliche Zeitschlitze und der Vorgabe, dass zu einem Datenpaket gehörenden Datenblöcke nur in bestimmten Zeitschlitzen gesendet werden können, wird der empfängerseitige Kombinationsaufwand von bisher nicht erfolgreich dekodierten Sequenznummern und Datenblöcken erheblich reduziert, d.h. auf im bevorzugten Fall bis zu zwei Möglichkeiten reduziert.

[0036] Durch die Möglichkeit der Kombination von empfangenen Sequenznummern in einem Zeitschlitz kann auch der Kodiergewinn bei der Dekodierung der Sequenznummer, insbesondere des Headers, bei wiederholter Sendung erhöht werden, d.h. mit jeder emeuten Sendung sinkt das für eine fehlerfreie Dekodierung notwendige Verhältnis von Signalleistung zu Interferenzleistung (C/I), so wie es auch bei der für sich bekannten Dekodierung der Datenblöcke der Fall ist.

[0037] Durch dieses Verfahren wird die erneute Sendung von Datenblöcken (re-transmission) der Datenpakete bevorzugt, bei denen die Übertragung bereits begonnen wurde.

[0038] Die Nutzung der auf der Luftschnittstelle bereitgestellten Übertragungskapazität für eine paketorientierte Übertragung wird durch dieses Verfahren optimiert. Bei guter Kanalqualität bzw. bei fast fehlerfreier Übertragung wird der erreichbare Datendurchsatz durch dieses Verfahren insbesondere nicht vermindert.

[0039] Eine Anwendung ist auch bei leitungsgebundenen Kommunikationssystemen möglich. Insbesondere ist die Anwendung auch bei leitungsgebundenen Schnittstellen zwischen Sender und Empfänger möglich, wobei als Leitung insbesondere metallische oder optische Leiter Verwendung finden können.

[0040] Ein Ausführungsbeispiel und Modifikationen werden nachfolgend anhand der Zeichnung näher erläutert. Es zeigen:

Fig. 1 eine einfache Form einer Funkschnittstelle zwischen zwei kommunizierenden Stationen und

Fig. 2 den Aufbau von aufeinanderfolgend übertragenen PDUs mit Angabe der Sequenz-Nummer im jeweiligen Kopfabschnitt.

[0041] Wie aus Fig. 1 ersichtlich, ist das nachfolgend beschriebene Verfahren insbesondere in einem Kommunikationssystem, z.B. einem Mobilfunksystem anwendbar. Das beispielhaft dargestellte Mobilfunksystem als ein für sich bekanntes Funk-Kommunikationssystem weist eine Vielzahl von Netzelementen auf, insbesondere netzseitig Mobilvermittlungsstellen MSC, Einrichtungen RNM zum Zuteilen von funktechnischen Ressourcen, als Sende-/Empfangseinrichtungen Basisstationen BS und teilnehmerseitig in der untersten Hierarchieebene als Sende/Empfangseinrichtungen Teilnehmerstationen MS.

[0042] Die Mobilvermittlungsstellen MSC, die untereinander vernetzt sind und von denen hier nur eine dargestellt ist, stellen den Zugang zu einem Festnetz oder einem anderen Funknetz her. Weiterhin sind diese Mo-

IPR2023-01270 Page 176

bilvermittlungsstellen MSC mit jeweils zumindest einer Einrichtung RNM zum Zuteilen von funktechnischen Ressourcen verbunden. Jede dieser Einrichtungen RNM ermöglicht wiederum eine Verbindung zu zumindest einer Basisstation BS. Eine solche Basisstation BS kann über eine Funkschnittstelle V eine Verbindung zu Teilnehmerstationen, z.B. mobilen Stationen MS oder anderweitigen mobilen und stationären Endgeräten aufbauen. Durch jede Basisstation BS wird zumindest eine Funkzelle Z gebildet. Bei einer Sektorisierung oder bei hierarchischen Zellstrukturen werden pro Basisstation BS auch mehrere Funkzellen Z versorgt.

[0043] In Fig. 1 ist beispielhaft eine bestehende Verbindung V zur Übertragung von Nutzinformationen und Signalisierungsinformationen zwischen einer mobilen Station MS und einer Basisstation BS dargestellt. Übertragungen in Aufwärtsrichtung UL (Uplink) erfolgen von der Basisstation BS zur mobilen Station MS, Übertragungen in Abwärtsrichtung DL (Down Link) in umgekehrter Richtung. Weiterhin ist ein Organisationskanal (FACH oder BCCH: Broadcast Control CHannel) dargestellt, der zur Übertragung von Nutz- und Signalisierungsinformationen mit einer definierten Sendeleistung von jeder der Basisstationen BS für alle mobilen Stationen MS im Bereich der Funkzelle Z bereitgestellt wird.

[0044] Gemäß einem in Fig. 2 skizzierten Ausführungsbeispiel weisen die Datenpakete bzw. Datenblökke PDU (Paket Data Unit) einen Kopfabschnitt bzw. Header auf. In jedem Header ist die Datenpaketenummer bzw. Sequenznummer SQ# dieses Datenpakets eingetragen. Dem Header folgt der Abschnitt mit den eigentlichen Nutz- bzw. Anwenderdaten des Datenpakets. Vorteilhafterweise schließt an den Anwenderdatenabschnitt der Paketdateneinheit PDU ein CRC-Abschnitt an, der eine empfängerseitige Fehlerüberprüfung ermöglicht. Der Header der Paketdateneinheit PDU kann zusammen mit der Paketdateneinheit PDU im Transportkanal übertragen werden, was auch als "Inband signalling" bezeichnet wird. Hier von Bedeutung ist allerdings nur die Tatsache, dass jedes Datenpaket unabhängig vom Aufbau durch ein Identifizierungskennzeichen bestimmbar ist.

[0045] Zur verbesserten bzw. sichereren Bestimmung der Sequenznummer SQ# wird eine nachfolgend beschriebene Abfolge von Versendung und Zwischenspeicherung der Paketdateneinheiten beschrieben.

[0046] Das vorgeschlagene Verfahren führt eine (erste) Regel ein, zu welchen Zeitpunkten bzw. in welcher Reihenfolge bei Bedarf die wiederholte Sendung (retransmisson) von einzelnen Datenpaketen oder Paketdateneinheiten, insbesondere Sequenznummer und kodierten Datenblöcken zu erfolgen hat. Dadurch wird der Kombinationsaufwand mit schon bereits empfangenen und gespeicherten, aber nicht erfolgreich dekodierten Sequenznummern und kodierten Datenblöcken wesentlich verringert.

[0047] In Fig. 2 ist die zeitliche Abfolge von beispielhaften Paketdateneinheiten PDU über die Schnittstelle V dargestellt, wobei die Zeit in der Darstellung von oben nach unten zunimmt. In der linken Spalte ist eine fortlaufende Zeiteinheit tx (x = 1, 2, 3, ...) dargestellt, wobei jede Zeiteinheit tx nachfolgend als Zeitschlitz bezeichnet wird und jeder Zeitschlitz tx lang genug ist, um innerhalb seiner Dauer eine vollständige Paketdateneinheit übertragen zu können. Die Zeitschlitze tx sind wiederum in Gruppen bzw. Zyklen C1, C2, ... aus hier beispielhaft jeweils vier Zeitschlitzen (1 - 4, 5 - 8) untergliedert.

[0048] In der mittleren Spalte sind die in den jeweiligen Zeitschlitzen tx in Abwärtsrichtung (DL) versendeten Paketdateneinheiten PDU dargestellt. In der rechten Spalte sind die in den jeweiligen Zeitschlitzen tx in Aufwärtsrichtung (UL) versendeten Empfangsbestätigungen (ACK bzw. NACK) zu den empfängerseitig eingetroffenen Paketdateneinheiten PDU dargestellt.

[0049] Die maximale Anzahl der sich in der Übertragung befindenden Datenpakete wird als Fenstergröße (WS: Windowsize) bezeichnet. Das Identifikationsmerkmal des Datenblocks, die Sequenznummer SQ#, besitzt somit allgemein einen Wertebereich von 0 bis (WS - 1). Die Fenstergröße legt fest, wieviel Speicher zum Speichern von bisher nicht erfolgreich dekodierten Datenblöcken sender- und empfängerseitig maximal benötigt würde.

[0050] Die Rundlaufzeit bzw. Rundlaufverzögerung (Round-trip-delay) ist die Zeitspanne zwischen dem Senden eines Datenpakets, ggf. eines kodierten Datenblocks bzw. einer Paketdateneinheit PDU bis zum Eintreffen der Bestätigung ACK bzw. Negativ-Bestätigung (NAK) am Sender über einen Rückkanal. Die minimale Rundlaufverzögerung (RTD_{MIN}) ist die kürzeste mögliche Zeitspanne zwischen der Sendung eines Datenblocks und dem Eintreffen der negativen oder positiven Bestätigung, die sich aufgrund der verwendeten Übertragungsprotokolle und aus den Verarbeitungsgeschwindigkeiten innerhalb der betroffenen Einrichtungen ergibt. Für die Übertragung eines Datenblocks wird eine bestimmte Übertragungszeit TT benötigt. Im folgenden wird eine Zeitspanne TI definiert, die gemäß einer besonders bevorzugten Ausführungsform größer oder gleich der minimalen Rundlaufverzögerung RTD_{MIN} gewählt wird, d.h. es gilt TI >= RTD_{MIN}. Bei später beschriebenen Ausführungsform-Modifikationen wird jedoch auf diese Bedingung verzichtet. Diese Zeitspanne TI entspricht in Fig. 2 den vorstehend genannten Zyklen C1, C2 und wird in N Zeitschlitze tx der Länge TT unterteilt, d.h. es gilt TI = N * TT. Im vorliegenden Fall beträgt die Dauer der Zeitspanne TI bzw. der Zyklen C1, C2, ... jeweils der Dauer von N = 4 aufeinanderfolgenden Zeitschlitzen tx.

[0051] Nachfolgend wird beispielhaft angenommen, dass die empfängerseitige Verarbeitungsdauer maximal der Dauer eines weiteren Zeitschlitzes tx entspricht. Folglich sollte auf das Absenden einer Paketdateneinheit mit der Sequenznummer SQ# = 10 von der Sendereinrichtung BS aus in Abwärtsrichtung im ersten Zeit-

IPR2023-01270 Page 177

schlitz t1 das Bereitstellen der Empfangsbestätigung ACK(10) in der Empfängereinrichtung MS vor Ablauf des zweiten Zeitschlitzes t2 erfolgen. Die Empfangsbestätigung ACK(10) kann dann im dritten Zeitschlitz t3 in Aufwärtsrichtung zur ursprünglichen Sendereinrichtung BS zurück übertragen werden.

[0052] Bei dem vorgeschlagenen Verfahren werden Datenpakete, Paketdateneinheiten PDU und/oder die zu einer Paketdateneinheit PDU gehörenden kodierten Datenblöcke mit zugehöriger Sequenznummer SQx in bestimmten zeitlichen Abständen gesendet. Diese zeitlichen Abstände sollen bei der besonders bevorzugten Ausführungsform, jedoch nicht zwingend, einem variablen Vielfachen des gewählten Zeitintervalls TI entsprechen, sollen hier z.B. der Dauer der Zyklen C1, C2 entsprechen. Mit anderen Worten werden Datenpakete bzw. Paketdateneinheiten PDU, die zu einem bestimmten Datenpaket gehören, insbesondere nur im gleichen Zeitschlitz tx eines Zyklus C1, C2 gesendet.

[0053] Wie aus dem Beispiel der Fig. 2 ersichtlich, trifft bei der Sendereinrichtung BS nach dem Absenden der Paketdateneinheit PDU(10) im ersten dargestellten Zeitschlitz t1 des ersten Zyklus C1 während des dritten Zeitschlitzes t3 die zugehörige positive Empfangsbestätigung ACK(10) ein. Jedoch trifft bei der Sendereinrichtung BS die zu der im zweiten Zeitschlitz t2 abgesendeten Paketdateneinheit PDU(11) gehörende Empfangsbestätigung (ACK(11)) gar nicht ein oder zumindest vor dem zweiten Zeitschlitz t6 (=t2(C2)) des nachfolgenden, zweiten Zyklus C2 nicht ein. Gleichbedeutend mit dem fehlenden Eintreffen einer positiven Empfangsbestätigung ACK() kann eine negative Empfangsbestätigung NACK() gehandhabt werden, da diese auf einen fehlenden oder fehlerhaften Empfang bei der Empfängereinrichtung MS hinweist. Entsprechend wird im zweiten Zeitschlitz t6 des zweiten Zyklus C2 eine erneute Übertragung (re-transmission) der Paketdateneinheit mit der Sequenznummer SQ11 vorgenommen.

[0054] Wird in der Sendereinrichtung BS vor dem Beginn eines Zeitschlitzes tx, z.B. dem Zeitschlitz t5 (=t1 (C2)) im zweiten Zyklus eine entsprechende positive Empfangsbestätigung ACK(10) empfangen, so wird in diesem Zeitschlitz t5 eine neue Paketdateneinheit PDU (14) des entsprechenden Datenpakets, eines neuen Datenpakets oder ein neues Datenpaket versendet.

[0055] Weiterer vorteilhafter Bestandteil des Verfahrens ist eine zweite Regel: Wenn zu einem bestimmten Zeitpunkt t(x + iN) entsprechend erster Regel ein weiterer kodierter Datenblock mit Sequenznummer gesendet werden soll (re-transmission), dann wird ein weiterer Datenblock vom ältesten bisher nicht erfolgreich übertragenen Datenpaket gesendet werden, d.h. von dem Datenpaket, bei dem die Sendung erster Datenblöcke in dem betreffenden Zeitschlitz tx zeitlich am weitesten zurückliegt.

[0056] D.h. insbesondere, dass Regel 1 besagt, dass die Übertragung eines weiteren Datenblocks (re-transmission) zu diesen Zeitpunkt tx geschehen kann, aber nicht muss. Dies bedeutet, dass zu einem Zeitpunkt tx entweder der erste Datenblock eines neuen Datenpakets oder ein weiterer Datenblock des ältesten Datenpakets, was noch nicht erfolgreich übertragen worden ist, gesendet werden kann. Daher gibt es bei z.B. ARQ-Verfahren an der Empfängerseite bei diesem einfachen Verfahrensablauf nur zwei Möglichkeiten, welchem Datenpaket ein empfangener kodierter Datenblock zugeordnet werden kann und mit welcher eventuell zuvor nicht fehlerfrei dekodierten und gespeicherten Sequenznummer SQ# ein weiterer Dekodierungsversuch vorgenommen werden kann. Folglich kann folgende Vorgehensweise am Empfänger implementiert werden: Wenn ein Datenblock empfangen worden ist, so wird zuerst versucht, die Sequenznummer SQ# zu dekodieren und die CRC überprüft. Liegen für diese Sequenznummer SQ# bereits empfangene Datenblöcke vor, so kann eine Dekodierung unter Einbeziehung bereits empfangener Datenblöcke versucht werden. Wurde die Sequenznummer nicht fehlerfrei dekodiert, so kann trotzdem eine gemeinsame Kombination/Dekodierung mit der bereits empfangenen und für diesen Zeitschlitz ältesten empfangenen Sequenznummern SQ# versucht werden. Gibt es kein sinnvolles Ergebnis, so kann es sich um einen fehlerhaften oder bedingt einen neuen Datenblock handeln. Zur Kombination können auch weitere Daten zu bisher nicht erfolgreich dekodierten oder erfolgreich dekodierten und gleichen Sequenznummern herangezogen werden. Durch das eingeführte Verfahren kann eine wiederholte Sendung (retransmission) in einem Zeitschlitz nur zu einem (dem ältesten) Datenpaket mit gleicher Sequenznummer gehören, was den Kombinationsaufwand von bis zu insbesondere N möglichen Sequenznummern SQ# auf hier maximal zwei Sequenznummern SQ# reduziert.

[0057] Bei erfolgreicher Dekodierung der Sequenznummer SQ# kann dann eine Dekodierung der dazugehörigen Datenblöcke versucht werden. War dieses auch erfolgreich, so kann eine Bestätigung unter Angabe der Sequenznummer SQ# über einen Rückkanal an den Sender übertragen werden und die zu diesem Datenpaket gehörenden gespeicherten Sequenznummern SQ# und Datenblöcke können im Sender gelöscht werden. Nach entsprechender Verarbeitung können auch empfängerseitige redundante Daten gelöscht werden.

[0058] Im anderen Fall kann eine Negativ-Bestätigung mit aber auch ohne Sequenznummer SQ# gesendet werden, wenn bis dahin die Sequenznummer nicht fehlerfrei dekodiert werden konnte. Insbesondere kann auch eine Negativbestätigung mit Angabe der Ressource oder des Ressourcenelementes (tx) übertragen werden.

[0059] Dieses Verfahren kann unabhängig vom eigentlichen Dekodierverfahren für die Dekodierung von Sequenznummer SQ# (Header) und Datenblöcken verwendet werden, d.h. es können z.B. auch Kopfabschnitt-bezogene H-ARQ-Verfahren von Typ I/II/III verwendet werden. Auch ist das Verfahren unabhängig von

IPR2023-01270 Page 178

der eigentliche Dekodierung zu sehen, d.h. unabhängig davon, ob maximum ratio combining und/oder Faltungscodierung oder Turbocodierung oder andere Kodierverfahren einzeln oder in Kombination verwendet werden.

[0060] Bei einer anderen Ausführungsform wird die Anzahl von Zeitschlitzen in einem Zyklus Cx so gering gewählt, dass die Dauer eines Zyklus Cx geringer als die Rundlaufverzögerung RTD_{MIN} ist. In einem solchen Fall kann nach dem Aussenden eines Datenpakets beim entsprechenden Zeitschlitz tx(Cx+1) des nächsten Zyklus C(x+1) noch keine Empfangsbestätigung zurück erhalten sein. Daher wird ein neues Datenpaket bzw. eine neue Paketdateneinheit PDU abgesendet. Bei einem solchen modifizierten Verfahren muss empfängerseitig entsprechend nicht nur zwischen zwei Möglichkeiten für die Datenherkunft sondern zwischen drei - oder mehr - Möglichkeiten unterschieden werden. Dies ist aber immer noch vorteilhafter als zwischen einer in der Praxis wesentlich höheren Anzahl (N) an Möglichkeiten unterscheiden zu müssen.

[0061] Ein solches modifiziertes Verfahren kann auch dann verwendet werden, wenn die Dauer eines Zyklus Cx ausreichend lang ist, aber Datenpakete trotzdem nicht im nächsten Zyklus sondem erst zu einem späteren Zeitpunkt abgesendet werden sollen. Ein Grund dafür kann beispielsweise sein, dass empfängerseitig erst eine (Teil-) Verarbeitung von empfangenen Datenpaketen erfolgen soll, bevor eine Empfangsbestätigung zurück gesendet werden soll.

[0062] Gemäß einer noch anderen Ausführungsform ist die Zuweisung der Zeitschlitze nicht notwendig zyklisch erforderlich. Entscheidend ist eine senderseitige Zuweisung bestimmter Ressourcenelemente, insbesondere Zeitschlitze für den Versand bestimmter Datenpakete und der Zeitpunkte für die erneute Versendung. Empfängerseitig muss dann das entsprechende Zuweisungsverfahren bekannt sein.

[0063] Dieses Verfahren ist auch unabhängig von den verwendeten physikalischen Übertragunskanälen anwendbar, es ist auch möglich, den physikalischen Übertragungskanal zu wechseln, solange oben genannte Struktur eingehalten wird. Insbesondere kann das Verfahren auch bei leitungsgebundenen Systemen verwendet werden, bei denen für die Verbindung ein Kabel verwendet wird. Als Kabel können elektrisch oder optisch leitende Materialien verwendet werden.

[0064] Anstelle oder zusätzlich zu dem Übertragen von Datenpaketen über eine Ressource, die in vorstehend beschriebene Zeitschlitze tx unterteilt ist, können für die Übertragung auch weitere Ressourcen verwendet werden.

[0065] So ist es für sich bekannt, zwischen zwei oder mehr Stationen über eine Schnittstelle V mehrere Verbindungen aufzubauen. Dabei werden die verschiedenen Verbindungen V auf eine Vielzahl von Frequenzkanälen verteilt. Weiterhin ist es für sich bekannt, für die verschiedenen Verbindungen bzw. Übertragungen von Datenpaketen verschiedene Codes in Verbindung mit einer Codespreizung (CDMA) zu verwenden.

[0066] Als Ressource für die Zuweisung bestimmter Datenpakete und deren Wiederholungssendung oder für die Zuweisung der Versendung von Paketdateneinheiten zu einem Datenpaket kann entsprechend neben der in Zeitschlitze aufgeteilten Zeitachse als Ressource auch ein in eine Vielzahl von Frequenzkanälen aufgeteiltes Frequenzband oder eine Vielzahl von Codes bei einem Codespreizverfahren dienen. Den verschiedenen Datenpaketen können so z.B. verschiedene Codes Frequenzen bzw. zugewiesen werden.

[0067] Im Fall der Codespreizung kann beispielsweise einem ersten Datenpaket (SQ10) und allen Re-Transmissionen und/oder allen kodierten Paketdateneinheiten mit gleicher bzw. dazu gehörender Sequenznummer ein erster Code (A) zugewiesen werden. Einem zweiten Datenpaket (SQ11) und allen Re-Transmissionen und/oder allen kodierten Paketdateneinheiten mit gleicher bzw. dazu gehörender Sequenznummer (11) ein zweiter Code (B) zugewiesen werden, usw.

[0068] Insbesondere ist auch eine Kombination der verschiedenen Ausführungsformen möglich.

[0069] Die vorstehenden Verfahren können insbesondere in Tele-Kommunikationssystemen eingesetzt werden. Aber auch der Einsatz in beliebigen anderen Systemen mit einer Übertragung von mit einem Identifizierungskennzeichen versehenen Datenpaketen ist möglich. Dazu zählen als Kommunikationssysteme insbesondere auch reine Datendienste, wie z.B. lokale Netzwerke.

Patentansprüche

1. Verfahren zur Übertragung von Datenpaketen (PDU) über eine Schnittstelle (V, UL, DL; FACH,BCCH) in einem Kommunikationssystem (GSM, UMTS) zwischen einer Sendereinrichtung (BS) und einer Empfängereinrichtung (MS),

   - wobei eine Aussendung von bezugslosen Datenpaketen ohne Inhaltsbezug auf vorherige Datenpakete und/oder von inhaltsbezogenen Datenpaketen mit Inhaltsbezug auf vorherige Datenpakete über eine unterteilte Ressource (t) durchgeführt wird und
   - wobei die Aussendung dieser Datenpakete (PDU) jeweils einem bestimmten Ressourcenelement (tx) der Ressource (t) zugeordnet erfolgt,

   dadurch gekennzeichnet,
   dass die Zuordnung der Datenpakete (PDU) zu den Ressourcenelementen (t2, t6) nach einem vorbestimmten und nicht zufälligen Schema (C1, C2) unter verschiedener Behandlung der bezugslosen und der inhaltsbezogenen Datenpakete (SQ11 bei t2 bzw. SQ11 bei t6) erfolgt.

IPR2023-01270 Page 179

2. Verfahren nach Anspruch 1, bei dem
die Zuordnung der Datenpakete (PDU) senderseitig erfolgt und mittels des Schemas (t1, t5; t2(C1) zu t2(C2)) empfängerseitig eine Zuordnung empfangener Datenpakete (PDU) als ein bezugsloses Datenpaket (PDU; SQ11 bei t2) oder zu einer begrenzten Anzahl, insbesondere eines bestimmten vorherigen inhaltsbezogenen Datenpakets (SQ11 bei t6) durchgeführt wird.

3. Verfahren nach Anspruch 1 oder 2, bei dem
als Ressource eine in Zeitschlitze (tx) aufgeteilte Zeitachse (t) und/oder als Ressource ein in eine Vielzahl von Frequenzkanälen aufgeteiltes Frequenzband und/oder als Ressource eine Vielzahl von Codes bei einem Codespreizverfahren verwendet wird.

4. Verfahren nach einem vorstehenden Anspruch, bei dem
die Datenpakete (PDU) mit einem jeweiligen Identifizierungskennzeichen (SQ#) übertragen werden.

5. Verfahren nach Anspruch 4, bei dem
als Datenpaket (PDU) ein Datenpaket mit einer Datenpaketnummer oder Sequenznummer (SQ#) als das bestimmte Identifizierungskennzeichen übertragen wird.

6. Verfahren nach Anspruch 4 oder 5, bei dem
als Datenpaket (PDU) ein Datenpaket mit einem Kopfabschnitt, der das bestimmte Identifizierungskennzeichen (SQ#) aufweist, übertragen wird.

7. Verfahren nach einem vorstehenden Anspruch, bei dem
das Schema eine zyklische Zuordnung zu den Ressourcenelementen (t(x+N)) durchführt.

8. Verfahren nach einem vorstehenden Anspruch, bei dem Datenpakete (SQ11) nach einer negativen oder nicht innerhalb einer vorgegebenen Zeitdauer eingetroffenen Empfangsbestätigung (ACK(), NACK()) bei einem späteren gemäß dem Schema eindeutig zugeordneten Ressourcenelement (t6 bzw. t2(C2)) übertragen werden.

9. Verfahren nach einem vorstehenden Anspruch, bei dem
als inhaltsbezogene Datenpakete (PDU) Datenpakete (SQ11 bei t6) mit gleichem Inhalt eines Datenblocks eines vorherigen Datenpakets (SQ11 bei t2) und/oder Datenpakete (SQ11 bei t6) mit einem zum Datenblockinhalt eines vorherigen Datenpakets (SQ11 bei t2) zugeordneten Datenblockinhalt übertragen werden.

10. Verfahren nach Anspruch 9, bei dem
als inhaltsbezogene Datenpakete (PDU) mit zugeordnetem Datenblockinhalt kodierte Datenpakete zu diesem Datenpaket übertragen werden.

11. Verfahren nach einem vorstehenden Anspruch, bei dem
die inhaltsbezogenen Datenpakete (PDU) gemäß einem Fehlererfassungs- oder Fehlerkorrekturverfahren, vorzugsweise einem ARQ-Verfahren verarbeitet werden.

12. Verfahren nach einem vorstehenden Anspruch, bei dem empfängerseitig trotz eines nicht fehlerfrei dekodierbar oder bestimmbar zuzuordnenden Datenpakets ein Kombinierungs- oder Dekodierungsversuch mit einem Datenpaket vorgenommen wird, das diesem Datenpaket gemäß dem Schema zuzuordnen ist.

13. Verfahren nach einem vorstehenden Anspruch, bei dem
falls zu einem bestimmten Ressourcenelement (t(x + iN)) ein weiterer inhaltsbezogener Datenblock zu einem zumindest teilweise übertragenen Datenpaket (PDU) übertragen werden soll, dann ein weiterer Datenblock vom ältesten bisher nicht erfolgreich übertragenen Datenpaket als inhaltsbezogenes Datenpaket übertragen wird.

14. Verfahren nach einem vorstehenden Anspruch, bei dem

- ein Grenzwert der für eine Verbindung verfügbaren Anzahl (WS) von Ressourcenelementen (tx) der Ressource (t) festgelegt wird und
- solange die Anzahl der als inhaltsbezogene Datenpakete (PDU) zu übertragenden Datenpakete, die zu bereits übertragenen Datenpaketen zugeordnet sind, den Grenzwert oder einen festgelegten Wert mit Bezug auf den Grenzwert überschreitet, nur noch solche zugeordneten Datenpakete übertragen werden.

15. Verfahren nach einem vorstehenden Anspruch, bei dem
als die Schnittstelle eine Luftschnittstelle (V, UL, DL; FACH,BCCH) oder ein elektrisch oder optisch leitendes Medium verwendet wird.

16. Kommunikationssystem, insbesondere zum Durchführen eines Verfahren nach einem vorstehenden Anspruch, aufweisend:

- eine Sendereinrichtung (BS),
- eine Empfängereinrichtung (MS),
- eine Schnittstelle (V, UL, DL; FACH,BCCH) mit einer unterteilten Ressource (t) zur Übertragung von Datenpaketen (PDU) zwischen der

IPR2023-01270 Page 180

Sendereinrichtung (BS) und der Empfängereinrichtung (MS),

- eine Sender-Ressourcenzuordnungseinrichtung (X) zum Aussenden von bezugslosen Datenpaketen ohne Inhaltsbezug auf vorherige Datenpakete und/oder von inhaltsbezogenen Datenpaketen mit Inhaltsbezug auf vorherige Datenpakete über die unterteilte Ressource (t) auf der Schnittstelle (V) und zum Zuordnen der Aussendung eines jeden dieser Datenpakete (PDU) zu jeweils einem bestimmten Ressourcenelement (tx) der Ressource (t) und
- eine Empfänger-Ressourcenzuordnungseinrichtung zum Verwalten derart zugeordneter, bei der Empfängereinrichtung (MS) eingetroffener Datenpakete,

dadurch gekennzeichnet,
dass die Sender- und die Empfänger-Ressourcenzuordnungseinrichtung (X) zum Zuordnen der Datenpakete (PDU) zu den Ressourcenelementen (t2, t6) nach einem vorbestimmten und nicht zufälligen Schema (C1, C2) unter verschiedener Behandlung der bezugslosen und der inhaltsbezogenen Datenpakete (SQ11 bei t2 bzw. SQ11 bei t6) ausgebildet sind.

17. Kommunikationssystem nach Anspruch 16, aufweisend
ein Funk-Kommunikationssystem mit zumindest einer Basisstation (BS) als Sendereinrichtung und zumindest einer stationären und/oder mobilen Datenendeinrichtung (MS) als Empfängereinrichtung.

18. Kommunikationssystem nach Anspruch 16 oder 17, ausgebildet als ein Tele-Kommunikationssystem oder Datennetz.

IPR2023-01270 Page 181

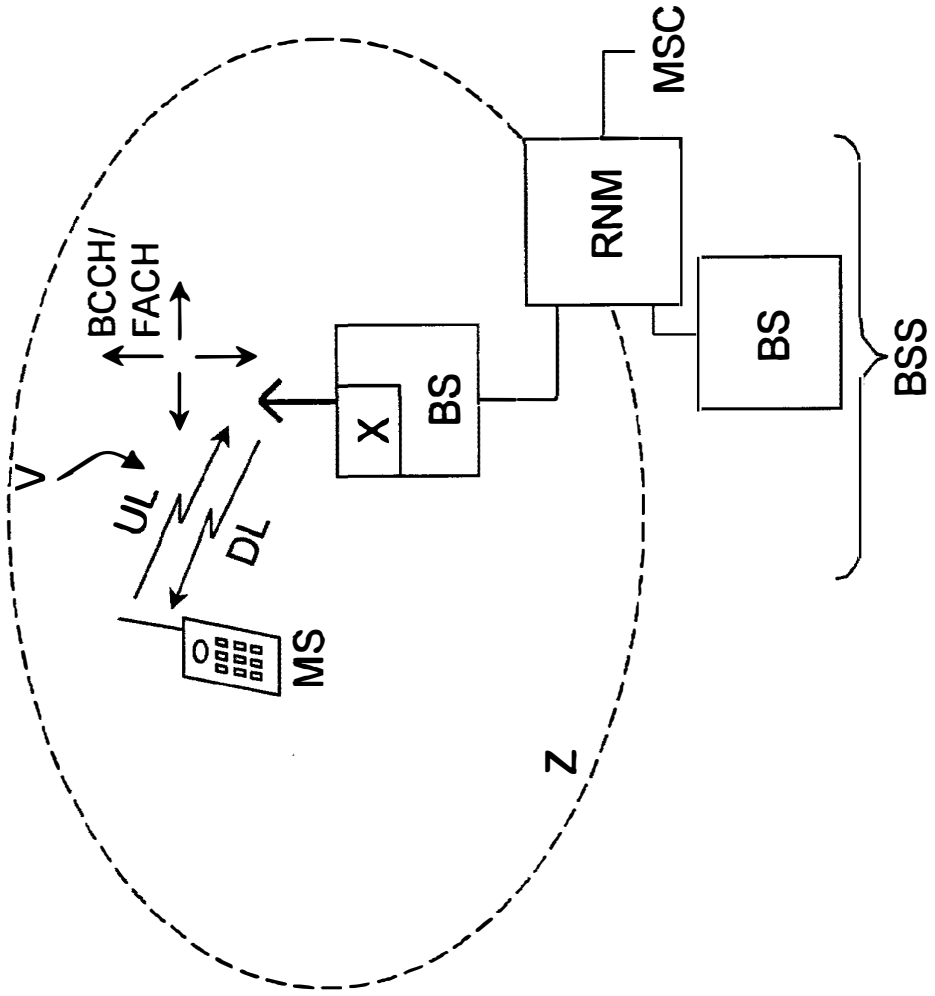


FIG. 1 (Stand der Technik)

IPR2023-01270 Page 182

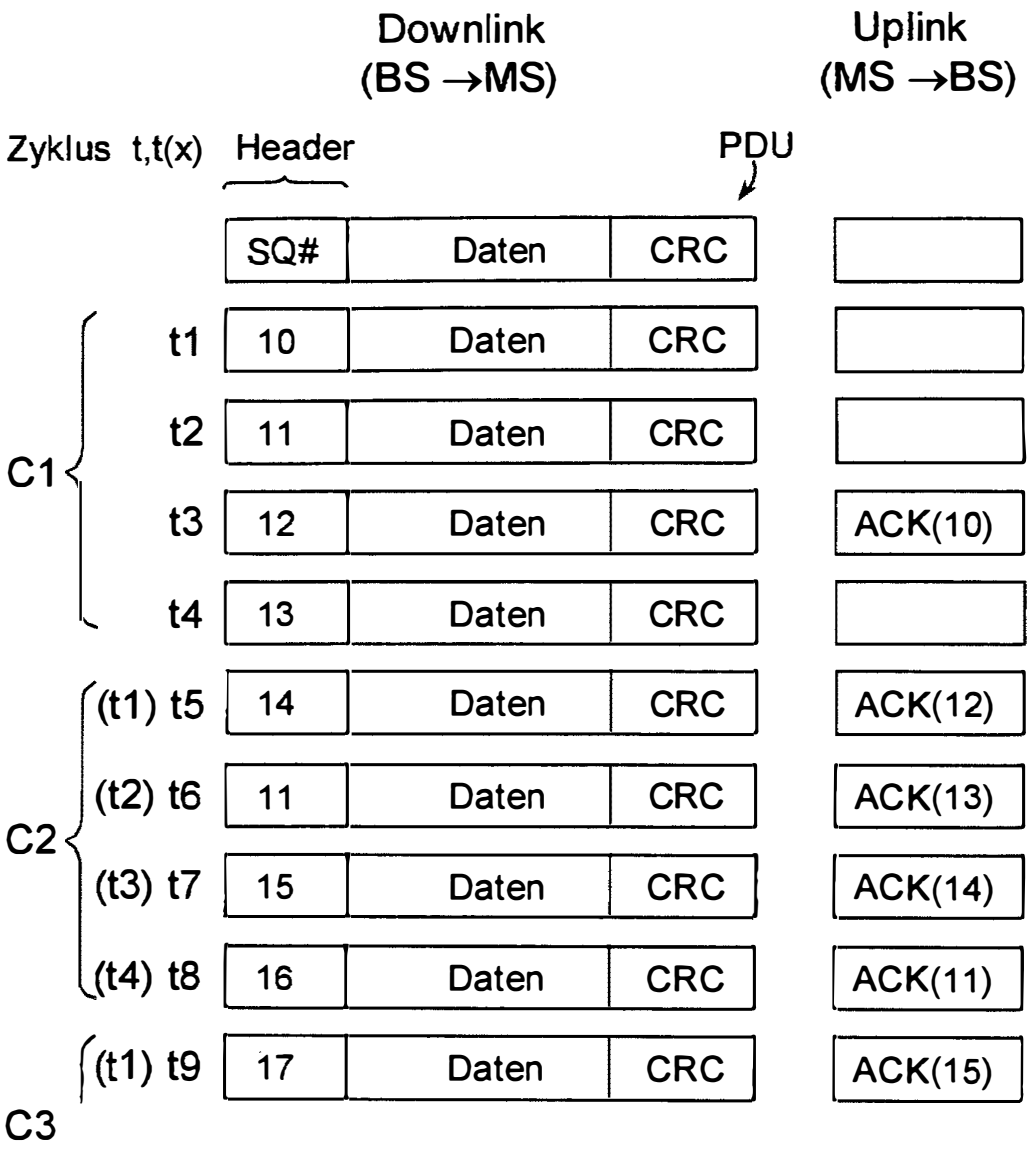


FIG. 2

IPR2023-01270 Page 183

Europäisches Patentamt

EUROPÄISCHER RECHERCHENBERICHT

Nummer der Anmeldung
EP 00 12 8431

EINSCHLÄGIGE DOKUMENTE

Kategorie	Kennzeichnung des Dokuments mit Angabe, soweit erforderlich, der maßgeblichen Teile	Betrifft Anspruch	KLASSIFIKATION DER ANMELDUNG (Int.Cl.7)
X	NACHUM SHACHAM ET AL: "A SELECTIVE-REPEAT-ARQ PROTOCOL FOR PARALLEL CHANNELS AND ITS RESEQUENCING ANALYSIS" IEEE TRANSACTIONS ON COMMUNICATIONS,US,IEEE INC. NEW YORK, Bd. 40, Nr. 4, 1. April 1992 (1992-04-01), Seiten 773-782, XP000297814 ISSN: 0090-6778 * Introduction. * ---	1,16	H04L1/18
A	BRANECI M ET AL: "AMBIGUITY ANALYSIS FOR A HYBRID TYPE II ARQ/FEC PROTOCOL ON A FLUCTUATING RADIO CHANNEL" IEEE INTERNATIONAL CONFERENCE ON COMMUNICATIONS (ICC),US,NEW YORK, IEEE, 8. Juni 1997 (1997-06-08), Seiten 1068-1072, XP000742101 ISBN: 0-7803-3926-6 * das ganze Dokument * ---	1-18	
A	WO 00 45543 A (NOKIA NETWORKS OY ;SIPOLA JUSSI (FI)) 3. August 2000 (2000-08-03) * Seite 6, Zeile 5 - Zeile 16 * * Seite 8, Zeile 5 - Zeile 23 * * Seite 14, Zeile 13 - Seite 15, Zeile 31; Abbildung 4 * -----	1-18	RECHERCHIERTE SACHGEBIETE (Int.Cl.7) H04L

Der vorliegende Recherchenbericht wurde für alle Patentansprüche erstellt

Recherchenort	Abschlußdatum der Recherche	Prüfer
BERLIN	21. Mai 2001	Martínez Martínez, V

KATEGORIE DER GENANNTEN DOKUMENTE

X : von besonderer Bedeutung allein betrachtet
Y : von besonderer Bedeutung in Verbindung mit einer anderen Veröffentlichung derselben Kategorie
A : technologischer Hintergrund
O : nichtschriftliche Offenbarung
P : Zwischenliteratur

T : der Erfindung zugrunde liegende Theorien oder Grundsätze
E : älteres Patentdokument, das jedoch erst am oder nach dem Anmeldedatum veröffentlicht worden ist
D : in der Anmeldung angeführtes Dokument
L : aus anderen Gründen angeführtes Dokument

& : Mitglied der gleichen Patentfamilie, übereinstimmendes Dokument

EPO FORM 1503 03.82 (P04C03)

IPR2023-01270 Page 184

ANHANG ZUM EUROPÄISCHEN RECHERCHENBERICHT ÜBER DIE EUROPÄISCHE PATENTANMELDUNG NR. EP 00 12 8431

In diesem Anhang sind die Mitglieder der Patentfamilien der im obengenannten europäischen Recherchenbericht angeführten Patentdokumente angegeben.
Die Angaben über die Familienmitglieder entsprechen dem Stand der Datei des Europäischen Patentamts am
Diese Angaben dienen nur zur Unterrichtung und erfolgen ohne Gewähr.

21-05-2001

Im Recherchenbericht angeführtes Patentdokument	Datum der Veröffentlichung	Mitglied(er) der Patentfamilie	Datum der Veröffentlichung
WO 0045543 A	03-08-2000	AU 2425299 A	18-08-2000

EPO FORM P0461

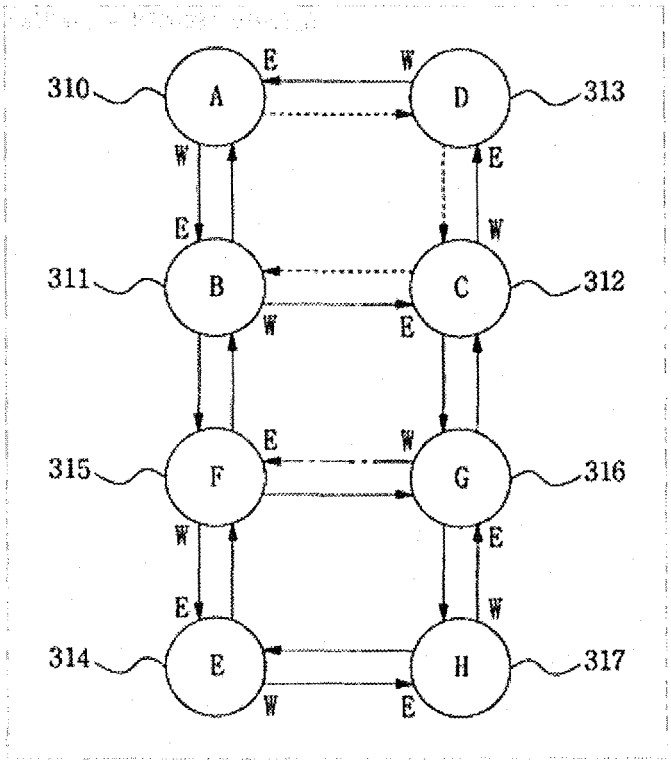
Für nähere Einzelheiten zu diesem Anhang : siehe Amtsblatt des Europäischen Patentamts, Nr.12/82

IPR2023-01270 Page 185

1) Family number: 28978286 (KR20030003943A) © PatBase

Title: DUAL NODE CONNECTION METHOD FOR SYNCHRONOUS OPTICAL TRANSMISSION SYSTEM

Abstract:
Source: KR20030003943A PURPOSE: A dual node connection method for a synchronous optical transmission system is provided to transmit an inter-network traffic through a ring type network in case that inter-different two ring type networks are configured in an SDH(Synchronous Digital Hierarchy) network. CONSTITUTION: A network 1 sets a node B as a primary node, and sets a node C as a secondary node(S410). A network 2 sets a node F as a primary node, and sets a node G as a secondary node(S420). If a DNI(Dual Node Interconnection) channel setup is completed, a traffic transmission procedure is performed by a type set according to situation of the integrity of each network or a traffic transmission fault(S430).



Family:	Publication number	Publication date	Application number	Application date
	KR20030003943 A	20030114	KR20010039813	20010704

Priority: KR20010039813 20010704

Assignee(s): (std): LG ELECTRONICS INC

(19) 대한민국특허청(KR)
(12) 공개특허공보(A)

(51) 。Int. Cl. [7]
H04L 12/43

(11) 공개번호 특2003- 0003943
(43) 공개일자 2003년01월14일

(21) 출원번호 10- 2001- 0039813
(22) 출원일자 2001년07월04일

(71) 출원인 엘지전자 주식회사
서울특별시 영등포구 여의도동 20번지 LG트윈타워

(72) 발명자 홍성웅
경기도군포시금정동876율곡아파트349- 904

(74) 대리인 홍성철

심사청구 : 없음

(54) 동기식 광전송 시스템의 듀얼 노드 접속방법

요약

본 발명은 동기식 디지털 계위 네트워크에 서로 다른 두 개의 환형 네트워크가 구성되어 있을 경우에 이러한 환형 네트워크를 통해 네트워크간 트래픽을 전송하기에 적당하도록 한 것으로, 이러한 본 발명은, 전송 네트워크상의 각 환형 네트워크에 대해 2개의 노드를 선택하여 프라이머리 노드와 세컨더리 노드를 각각 설정하는 단계와; 상기 각 네트워크간 트래픽 전송채널을 이중노드 상호접속 채널로 설정하여, 상기 프라이머리 노드는 분기/통과 스키마를 사용하고 상기 세컨더리 노드는 프라이머리 노드를 통과한 트래픽 채널을 분기시키는 스키마를 사용하며, 하나의 환형 네트워크에서 프라이머리 노드와 세컨더리 노드를 통해 송신된 트래픽에 대해 해당 네트워크에 연결되어 있는 다른 환형 네트워크의 프라이머리가 저속라인을 통해 수신되는 트래픽과 세컨더리 노드를 거쳐 고속라인을 통해 수신되는 트래픽 중 품질이 양호한 트래픽을 선택하게 되는 단계를 포함하여 이루어져, 네트워크의 자원의 운용효율 증대와 잔존성 향상을 가능케 한다.

대표도

도 3

명세서

도면의 간단한 설명

도1은 일반적인 전송시스템의 구성도.

IPR2023-01270 Page 187

도2는 종래의 동기식 광전송 네트워크의 노드 접속도.

도3은 본 발명의 실시예에 따른 동기식 광전송 시스템의 듀얼 노드 접속방법이 적용된 네트워크 구성도.

도4는 본 발명의 실시예에 따른 동기식 광전송 시스템의 듀얼 노드 접속방법의 순서도.

도5는 도4에서 각 환형 네트워크 무결점시의 순서도.

도6은 도4에서 노드F의 트리뷰터리 수신측 장애시의 순서도.

도7은 노드B의 EAST 수신측 장애시의 순서도.

발명의 상세한 설명

발명의 목적

발명이 속하는 기술 및 그 분야의 종래기술

본 발명은 동기식 광전송 시스템의 듀얼 노드 접속방법에 관한 것으로, 보다 상세하게는 동기식 디지털 계위(SDH) 네트워크에 서로 다른 두 개의 환형 네트워크가 구성되어 있을 경우에 이러한 환형 네트워크를 통해 네트워크간 트래픽을 전송하는데 적당하도록 한 동기식 광전송 시스템의 듀얼 노드 접속방법에 관한 것이다.

일반적으로 전송시설은 공간, 페어 케이블(Paired Cable), 동축케이블, 광케이블 등의 전송매체들과 이들 매체들을 따라서 설치되는 전자장치들로 구성되어 있으며, 전자장치는 전송되는 신호를 증폭, 재생하는 역할을 하며, 전송시스템에는 여러 가지 형태의 단국장치들이 교환기와 전송로 사이에 설치된다.

도1에는 일반적인 전송시스템의 개략적인 구성도가 도시되어 있다.

도1에 따르면, 전송시스템은 전송단국장치, 중계장치, 다중화/역다중화, 분배장치를 포함하여 이루어진다. 이러한 전송설비에서 전송단국장치 및 중계장치는 전송시스템을 구성하는 것으로, 정보전송을 위한 네트워크상에서 노드가 된다.

동기식 광전송 시스템간의 네트워크의 경우, 각 노드는 MSSPRING((Multiplex Section Shared Protection RING)을 사용하는 환형으로 구성되어 있다. 그래서 각각의 환형 네트워크가 DNI(Dual Node Interconnection, 또는 이중노드 상호접속) 기능을 사용할 수 없는 경우, 환형 네트워크간 트래픽을 전송하기 위해서는 선형 네트워크를 추가 구성하여야 한다. 즉, 복수개의 환형 네트워크간 트래픽 전송을 위한 선형 네트워크의 추가가 요구되는 것이다.

도2는 종래의 동기식 광전송 네트워크의 노드 접속도이다.

도2에서 A, B, C, D로 이루어지는 환형 네트워크를 네트워크1이라 하고, E, F, G, H로 이루어지는 환형 네트워크를 네트워크2라 칭하기로 한다. 이때 A를 비롯하여 H 등의 각 노드는 2.5G SDH 장비로 구성된다. 더불어 노드 A와 노드 E를 연결하는 추가적인 선형 네트워크를 네트워크3이라 칭한다.

그리고 각 환형 네트워크는 MSSPRING 스키마를 사용한다고 가정한다.

예를 들어, 네트워크1의 노드 A에서 네트워크2의 노드 E로 트래픽을 전송하기로 한다면, 종래의 환형 네트워크에서는 DNI 기능을 지원하지 않기 때문에 노드 A와 노드 E를 연결하는 네트워크3을 통해서 트래픽이 전송되어야 한다.

그런데 선형 네트워크가 무결점 상태인 경우에는 별다른 문제가 없지만, 선형 네트워크를 구성하는 두 개의 장비간 송/수신 광 케이블이 모두 절단된 경우에는 안정된 트래픽 전송을 기대할 수 없다. 선형 네트워크는 환형 네트워크와 같은 자가 복구 능력이 없기 때문에 전송선로의 결점으로 인해 트래픽 전송장애가 발생할 가능성이 가중된다.

IPR2023-01270 Page 188

이처럼 두 개의 환형 네트워크가 구성된 상태에서 하나의 환형 네트워크에서 다른 환형 네트워크로 트래픽을 전송하고자 할 경우, 이미 구성되어진 환형 네트워크를 통해서는 트래픽 전송을 할 수 없기 때문에 새로운 선형 네트워크를 추가 구성하여야만 트래픽 전송이 가능케 되는 것이다.

따라서 종래기술은 추가적인 선형 네트워크를 구성하기 위한 추가 비용 부담이 요구되는 문제점이 있다.

그리고 하나의 환형 네트워크에서 다른 환형 네트워크로 전송하려는 트래픽 양이 적을 경우, 추가된 선형 네트워크의 트래픽 용량이 낭비되는 결과를 초래하게 된다.

또한, 선형 네트워크에서 각 장비간에 연결되어 있는 광 케이블이 절단된 경우, 자가 복구 능력이 없기 때문에 원하는 위치까지 트래픽을 전송할 수 없게 된다.

발명이 이루고자 하는 기술적 과제

본 발명은 상기와 같은 종래의 문제점을 해소하기 위해 창출된 것으로, 본 발명의 목적은 동기식 디지털 계위(SDH) 네트워크에 서로 다른 두 개의 환형 네트워크가 구성되어 있을 경우에 이러한 환형 네트워크를 통해 네트워크간 트래픽을 전송하도록 한 동기식 광전송 시스템의 듀얼 노드 접속방법을 제공하는 데 있다.

발명의 구성 및 작용

상기 목적을 달성하기 위한 본 발명의 동기식 광전송 시스템의 듀얼 노드 접속방법은, 전송 네트워크상의 각 환형 네트워크에 대해 2개의 노드를 선택하여 프라이머리 노드와 세컨더리 노드를 각각 설정하는 단계와; 상기 각 네트워크간 트래픽 전송채널을 이중노드 상호접속 채널로 설정하여, 상기 프라이머리 노드는 분기/통과 스키마를 사용하고 상기 세컨더리 노드는 프라이머리 노드를 통과한 트래픽 채널을 분기시키는 스키마를 사용하며, 하나의 환형 네트워크에서 프라이머리 노드와 세컨더리 노드를 통해 송신된 트래픽에 대해 해당 네트워크에 연결되어 있는 다른 환형 네트워크의 프라이머리가 저속라인을 통해 수신되는 트래픽과 세컨더리 노드를 거쳐 고속라인을 통해 수신되는 트래픽 중 품질이 양호한 트래픽을 선택하게 되는 단계를 포함하는 것을 그 특징으로 한다.

이러한 구성에 따른 본 발명은 환형 네트워크간 트래픽을 전송할 경우에 새로운 선형 네트워크를 구성하지 않는다.

본 발명에서는 각각의 환형 네트워크를 구성하는 노드 중에서 다른 환형 네트워크로 전송하고자 하는 트래픽이 있는 노드에서 특정 채널을 선택하여 그 채널에 환형 네트워크간 전송 트래픽을 할당하여 전송하도록 한다. 트래픽을 전송할 노드에서 선택한 특정채널을 통해 전송되는 트래픽은 다른 환형 네트워크로 전송된다.

환형 네트워크를 구성하고 있는 노드 중에서 두 개의 특정 장비를 선택하여 이 노드가 다른 환형 네트워크와 트래픽을 송수신할 수 있도록 함으로써 선형 네트워크를 채택하지 않고도 환형 네트워크간 트래픽 전송이 이루어지도록 한다.

그래서 서로 다른 두 개의 환형 네트워크간 연결 설정에 있어서, 각 환형 네트워크의 두 개 노드를 상호 연결시킨다. 하나의 환형 네트워크에서 똑같은 전송 트래픽을 두 개의 장비를 통해 전송함으로써, 환형 네트워크간 연결 설정 중에서 하나의 광 케이블이 절단되어도 여분의 광 케이블을 통해 트래픽이 전송될 수 있다.

이처럼 환형 네트워크간 연결설정이 복수로 확보되어 트래픽 전송이 안정화되고 네트워크의 잔존성(Survivability) 이 향상된다. 그리고 동기식 전송 시스템의 환형 네트워크간 트래픽 전송채널의 트래픽 자가 복구 능력을 향상시킬 수 있다.

따라서 동기식 전송시스템의 환형 네트워크간 트래픽 전송채널 구성시, 종래 추가적인 선형 네트워크 구성으로 인한 비용 부담과 트래픽 자원 낭비를 줄일 수 있다.

IPR2023-01270 Page 189

그리고 환형 네트워크간 연결설정은 네트워크내 두 개의 노드를 선택하여 설정한다. 두 개의 노드 중에서 하나를 프라이머리 노드라 하고, 다른 하나는 세컨더리 노드라 칭한다. 이때 환형 네트워크간 트래픽 전송이 이루어지는 특정 채널을 이중노드 상호접속 채널(또는 DNI 채널)이라 한다.

DNI 채널을 통한 트래픽 전송기능을 완벽하게 수행하기 위해서 DNI 채널 설정시 프라이머리 노드는 분기/통과(Drop/Continue) 스키마를 사용하고, 세컨더리 노드는 프라이머리 노드에서 연결된 DNI 채널을 그대로 분기시키는 분기 스키마를 사용한다.

더불어 DNI 채널을 위해 설정된 프라이머리 노드는 서비스 선택(Service Selection) 기능을 포함하여 운용된다.

서비스 선택 기능은 환형 네트워크를 구성하여 보호 스위칭(Protection Switching)을 수행하는 스키마 중 MSSPRING을 사용하면서 DNI 기능을 수행해야 하는 경우에 적용되는 경로 스위칭 체계이다.

서비스 선택은 일반적인 경로 스위치 규준(Path Switch Criteria)을 기본하여 이루어진다. 일반적인 경로 스위치는 하나의 장비에서 똑같은 트래픽을 WEST, EAST 양방향으로 고속 라인을 통해 송신하면, 그 트래픽을 수신하는 장비에서 고속 라인을 통해 수신되는 두 개의 똑같은 트래픽 중 품질이 더 좋은 트래픽을 선택하는 체계이다.

이와는 달리 본 발명의 서비스 선택은 하나의 환형 네트워크에서 프라이머리 노드와 세컨더리 노드를 통해 송신한 트래픽을 이 네트워크와 연결되어 있는 다른 네트워크의 프라이머리 노드에서 저속 라인을 통해 수신되는 트래픽과 세컨더리 노드를 거쳐 고속 라인을 통해 수신되는 트래픽 중 품질이 더 우수한 트래픽을 선택하는 체계이다.

이하, 첨부도면을 참조하여 본 발명에 따른 바람직한 실시예를 설명한다.

도3은 본 발명의 실시예에 따른 동기식 광전송 시스템의 듀얼 노드 접속방법이 적용된 네트워크 구성도이고, 도4는 본 발명의 실시예에 따른 동기식 광전송 시스템의 듀얼 노드 접속방법의 순서도이며, 도5는 도4에서 각 환형 네트워크 무결점시의 순서도이고, 도6은 도4에서 노드F의 트리뷰터리 수신측 장애시의 순서도이며, 도7은 노드B의 EAST 수신측 장애시의 순서도이다.

도3에 따르면, 전송 네트워크상에는 복수의 환형 네트워크가 구성된다.

본 실시예에서 서로 다른 네트워크는 각각 MSSPRING 스키마를 사용하는 환형으로 구성되어 있고, 각각의 환형 네트워크가 DNI 기능을 사용하여 안정적이고 신뢰성 있는 환형 네트워크간 트래픽 전송을 수행하게 된다. 환형 네트워크내의 각 노드간 트래픽 전송절차는 알려진 바와 같다.

예를 들어 환형 네트워크상의 각 노드는 2.5G SDH 장비로 구현될 수 있다. 여기서 4개의 노드 A(310), B(311), C(312), D(313)로 구성되는 환형 네트워크를 '네트워크1'이라 칭하고, 4개의 노드 E(314), F(315), G(316), H(317)로 구성되는 환형 네트워크를 '네트워크2'이라 칭하기로 한다.

네트워크1과 네트워크2간에는 MSSPRING 스키마가 적용된다.

도4에 따르면, 네트워크1에서 네트워크2로 트래픽을 전송하는 경우에 있어서의 전송 절차는 다음과 같다.

네트워크1과 네트워크2에 대해 2개씩의 노드를 프라이머리 노드와 세컨더리 노드로 각각 설정한다. 즉 네트워크1에서는 노드 B(311)를 프라이머리 노드로 설정하고, 노드 C(312)를 세컨더리 노드로 설정한다. 네트워크2에서는 노드 F(315)를 프라이머리 노드로 설정하고, 노드 G(316)를 세컨더리 노드로 각각 설정하여 운용한다. 이와 같이 DNI 채널이 설정된다(S410~S420).

DNI 채널 설정이 이루어지면 각 네트워크의 무결점 또는 트래픽 전송 장애 등의 상황에 따라 설정된 방식으로 트래픽 전송절차를 수행한다. 이 판단의 기준을 '채널 상황'이라 약칭하기로 한다(S430).

IPR2023-01270 Page 190

단계 S430에서 예정될 수 있는 채널 상황은 '각 환형 네트워크 무결점', '노드 F의 트리뷰터리 수신측 장애', 또는 '노드 B의 EAST 수신측 장애' 등이다. 예시된 채널 상황은 다른 채널 상황의 예정을 배제하지 않는다. 그러므로 운용환경에 따라 다양한 채널 상황을 설정하고 그에 따른 제어로직을 구현하여 본 발명을 적용할 수 있다.

단계 S430의 채널 상황에 따라 분기되어 수행되는 하부루틴을 살펴본다. 이때 첨부도에서 'TS'는 타임슬롯을 지시하는 것으로, 'TS1'은 타임슬롯1을 의미하도록 표시된다. 이하에서 타임슬롯1은 워킹 타임슬롯(Working Time Slot) 이며, 타임슬롯25는 프로텍션 타임슬롯(Protection Time Slot) 이다.

도5에 따르면, 채널 상황이 '각 환형 네트워크 무결점' 상태인 경우에 노드 A(310) 에서 결합되는 트래픽이 WEST 방향의 출력측 타임슬롯1(또는 TS1)에 할당되도록 설정한다. 이 결합된 트래픽은 노드 A(310) 와 노드 B(311) 사이를 연결하는 광 케이블의 타임슬롯1(TS1)에 할당되어 전송된다(S510).

노드 B(311)는 프라이머리 노드이므로 분기/통과 스키마를 사용하여 EAST 방향의 수신측 타임슬롯1을 통하여 수신되는 트래픽을 분기시키는 한편, 해당 트래픽을 세컨더리 노드인 노드 C(312)로 통과시킨다(S520).

그리고 노드 C(312)는 EAST 방향의 수신측 타임슬롯1을 통하여 수신되는 트래픽을 분기시킨다(S530).

노드 B(311)와 노드 C(312) 의 트리뷰터리를 통해 송신되는 트래픽은 네트워크간 상호접속을 통해 네트워크1에서 네트워크2로 전송된다(S540).

네트워크2에서 노드 G(316)는 세컨더리 노드이므로 트리뷰터리 방향의 수신측 타임슬롯을 통해 수신되는 트래픽을 WEST 방향의 출력측 타임슬롯1에 할당되도록 설정한다. 그래서 노드 G(316)를 통해 수신된 트래픽은 노드 G(316)와 노드 F(315) 사이를 연결하는 광 케이블의 타임슬롯1에 할당되어 전송된다(S550).

그러면 프라이머리 노드인 노드 F(315)가 트리뷰터리 방향의 수신측 타임슬롯을 통해 수신되는 트래픽과 노드 G(316)를 통해 수신되는 트래픽 중의 어느 하나를 선택한다. 이때 트리뷰터리에서 수신된 트래픽이 선택되어 WEST 방향의 출력측 타임슬롯1에 할당되도록 설정된다. 노드 F(315)에서 선택된 트래픽은 노드 F(315)와 노드 E(314) 사이를 연결하는 광 케이블의 타임슬롯1에 할당되어 전송된다(S560).

노드 E(314)는 EAST 방향의 수신측 타임슬롯1을 통하여 수신되는 트래픽을 분기시킨다(S570).

채널 상황이 '각 환형 네트워크 무결점'일 경우에는 이와 같은 트래픽 전송절차가 수행된다. 트래픽 전송이 이루어지면 채널 상황의 판정 단계로 복귀한다.

더블어 도6에 따르면, 단계 S430에서 채널 상황이 '노드 F의 트리뷰터리 수신측 장애'로 판정되는 경우가 있다. 네트워크2에서 노드 F의 트리뷰터리 수신측 장애 발생에 따른 하부루틴은 다음과 같이 트래픽 전송절차를 수행한다.

우선, 각 환형 네트워크 무결점 상태의 트래픽 전송절차중 초기 절차의 일부를 수행한다.

즉 노드 A(310)에서 결합되는 트래픽이 WEST 방향의 출력측 타임슬롯1(또는 TS1)에 할당되도록 설정하고 그 트래픽을 노드 A(310)와 노드 B(311) 사이를 연결하는 광 케이블의 타임슬롯1(TS1)에 할당하여 전송한다(S610).

노드 B(311)는 분기/통과 스키마를 사용하여 EAST 방향의 수신측 타임슬롯1을 통하여 수신되는 트래픽을 분기시키는 한편, 해당 트래픽을 세컨더리 노드인 노드 C(312)로 통과시킨다(S620).

그리고 노드 C(312)는 EAST 방향의 수신측 타임슬롯1을 통하여 수신되는 트래픽을 분기시킨다(S530).

노드 B(311)와 노드 C(312) 의 트리뷰터리를 통해 송신되는 트래픽은 네트워크간 상호접속을 통해 네트워크1에서 네트워크2로 전송된다(S640).

IPR2023-01270 Page 191

네트워크2에서 노드 G(316)는 세컨더리 노드이므로 트리뷰터리 방향의 수신측 타임슬롯을 통해 수신되는 트래픽을 WEST 방향의 출력측 타임슬롯1에 할당되도록 설정한다. 그래서 노드 G(316)를 통해 수신된 트래픽은 노드 G(316)와 노드 F(315) 사이를 연결하는 광 케이블의 타임슬롯1에 할당되어 전송된다(S650).

그러면 프라이머리 노드인 노드 F(315)는 트리뷰터리 방향의 수신측 타임슬롯을 통해 수신되는 트래픽과 노드 G(316)를 통해 수신되는 트래픽 중에서 어느 하나를 선택한다. 이때 선택되는 트래픽은 장비 G(316)를 통해 수신되는 트래픽이 되며, 이 트래픽은 WEST 방향의 출력측 타임슬롯1에 할당되도록 설정된다. 노드 F(315)에서 선택된 트래픽은 노드 F(315)와 노드 E(314) 사이를 연결하는 광 케이블의 타임슬롯1에 할당되어 전송된다. 이때의 전송절차는 채널 상황이 '각 환형 네트워크 무결점' 상태의 전송절차와는 다르다(S660).

이어서 '각 환형 네트워크 무결점' 상태의 전송절차와 동일한 과정이 수행된다.

즉 노드 E(314)는 EAST 방향의 수신측 타임슬롯1을 통하여 수신되는 트래픽을 분기시킨다(S670).

채널 상황이 '노드 F의 트리뷰터리 수신측 장애'일 경우는 이와 같은 트래픽 전송절차가 수행된다.

그리고 도7에 도시된 바와 같이 단계 S430에서 채널 상황이 '노드 B의 EAST 수신측 장애'일 경우에 노드 A(310)에서는 결합되는 트래픽이 WEST 방향의 출력측 타임슬롯1에 할당된다(S710).

이때 노드 B(311)의 EAST 수신측 장애로 인한 MSSPRING 네트워크의 즉각적인 링 스위칭(Ring Switching)에 의해 EAST 방향의 출력측 타임슬롯25에도 똑같은 트래픽이 할당되어진다(S720).

단계 S720에서 할당된 트래픽은 노드 A- D- C- B를 연결하는 광 케이블의 타임슬롯25에 할당되어 전송된다(S730).

이어서 노드 B(311)는 링 스위칭에 의해 EAST 방향의 수신측 타임슬롯1을 통해서 수신되는 트래픽 대신에 WEST 방향의 수신측 타임슬롯25를 통해서 수신되는 똑같은 트래픽을 분기시키는 한편, 해당 트래픽을 세컨더리 노드인 노드 C(312)로 통과시킨다(S740).

이후의 전송절차는 '각 환형 네트워크 무결점' 상태의 전송절차 중 S530~S570까지의 절차와 동일하게 수행된다. 첨부도상에는 이 전송절차가 참조번호 S750~S760으로 표시되어 있다.

이처럼 서로 다른 네트워크가 각각 환형으로 구성되어 있을 경우, 하나의 환형 네트워크에서 다른 환형 네트워크로 트래픽을 전송하고자 할 때에 이미 구성되어 있는 환형 네트워크를 통해 트래픽을 전송함으로써, 종래와 같은 추가적인 선형 네트워크의 구성은 불필요하게 된다.

또한, 자가 복구 능력이 우수한 환형 네트워크를 통해 트래픽이 전송됨으로써 환형 네트워크의 광 케이블 중 어느 한 부분이 절단되더라도 보호 스위칭 스키마를 통해 자신의 환형 네트워크내에서 안전하게 트래픽이 전송될 수 있다.

더불어 자신의 환형 네트워크에서 분기/통과 스키마를 통해 프라이머리 노드와 세컨더리 노드를 통해 똑같은 트래픽을 전송함으로써 서로 다른 환형 네트워크 사이의 프라이머리 노드간 상호접속과 세컨더리 노드간 상호접속 중 어느 한 부분이 접속 실패하게 되어도 다른 환형 네트워크로 트래픽을 안전하게 전송할 수 있게 된다.

이상에서 설명된 실시예는 본 발명의 변화, 변경 및 균등물의 범위에 속한다. 따라서 본 실시예에 대한 기재내용으로 본 발명의 특허청구범위가 한정되지 않는다.

발명의 효과

IPR2023-01270 Page 192

본 발명의 동기식 광전송 시스템의 듀얼 노드 접속방법에 따르면, 종래 선형 네트워크를 구성하는데 소요되던 비용과 트래픽 자원 낭비 문제를 해소함으로써 네트워크의 효율적인 운용을 가능케 하고 자원 활용도를 증대시키는 효과가 있다.

그리고 본 발명을 적용하게 되면 광전송 시스템의 네트워크 자가복구 능력이 우수하게 되어 환형 네트워크의 광 케이블이 일부 절단되는 경우에도 각 네트워크는 자신의 환형 네트워크내에서 트래픽을 안정적으로 전송할 수 있게 되는 효과를 갖는다.

더불어 본 발명의 적용시 서로 다른 환형 네트워크의 상호접속중 일부가 접속 실패하는 경우에도 다른 환형 네트워크로 트래픽을 안전하게 전송할 수 있어 네트워크의 잔존성이 향상되는 효과가 있다.

(57) 청구의 범위

청구항 1.

전송 네트워크상의 각 환형 네트워크에 대해 2개의 노드를 선택하여 프라이머리 노드와 세컨더리 노드를 각각 설정하는 (a) 단계와;

상기 각 네트워크간 트래픽 전송채널을 이중노드 상호접속 채널로 설정하여, 상기 프라이머리 노드는 분기/통과 스키마를 사용하고 상기 세컨더리 노드는 프라이머리 노드를 통과한 트래픽 채널을 분기시키는 스키마를 사용하며, 하나의 환형 네트워크에서 프라이머리 노드와 세컨더리 노드를 통해 송신된 트래픽에 대해 해당 네트워크에 연결되어 있는 다른 환형 네트워크의 프라이머리가 저속라인을 통해 수신되는 트래픽과 세컨더리 노드를 거쳐 고속라인을 통해 수신되는 트래픽 중 품질이 양호한 트래픽을 선택하게 되는 (b) 단계를 포함하는 것을 특징으로 하는 동기식 광전송 시스템의 듀얼 노드 접속방법.

청구항 2.

제 1항에 있어서, 상기 프라이머리 노드는,

서비스 선택 기능에 따라 하나의 환형 네트워크에서 프라이머리 노드와 세컨더리 노드를 통해 송신한 트래픽에 대해, 해당 네트워크와 연결되어 있는 다른 네트워크의 프라이머리 노드에서 저속 라인을 통해 수신되는 트래픽과 세컨더리 노드를 거쳐 고속 라인을 통해 수신되는 트래픽 중 품질이 더 우수한 트래픽을 선택하게 되는 것을 특징으로 하는 동기식 광전송 시스템의 듀얼 노드 접속방법.

청구항 3.

제 1항 또는 제 2항에 있어서,

각 환형 네트워크는 분기/통과 스키마에 따라 프라이머리 노드와 세컨더리 노드를 통해 동일한 트래픽을 전송하며 서로 다른 환형 네트워크간의 프로머리 노드와 세컨더리 노드간에 이중노드 상호접속되어 있는 것을 특징으로 하는 동기식 광전송 시스템의 듀얼 노드 접속방법.

청구항 4.

제 2항에 있어서, 상기 단계 (b)는 서로 연결된 환형 네트워크의 무결점시,

각 네트워크에서 결합되는 트래픽이 워킹 타임슬롯에 할당되어 해당 네트워크의 프라이머리 노드로 전송되면, 프라이머리 노드가 수신 트래픽을 분기/통과시키는 단계와;

IPR2023-01270 Page 193

상기 프라이머리 노드를 통과한 트래픽을 세컨더리 노드가 분기시키는 단계와;

일측 네트워크상의 프라이머리 노드와 세컨더리 노드간 트리뷰터리 송신 트래픽이 다른 일측 네트워크의 프라이머리 노드와 세컨더리 노드로 전송되는 단계와;

상기 트리뷰터리 송신 트래픽을 수신하는 네트워크상에서 세컨더리 노드가 수신 트래픽을 해당 네트워크의 프라이머리 노드로 전송하는 단계와;

상기 트리뷰터리 송신 트래픽을 수신하는 네트워크상에서 프라이머리 노드는 해당 네트워크의 세컨더리 노드에서 수신되는 트래픽과 상기 트리뷰터리에서 수신된 트래픽 중 트리뷰터리측 수신 트래픽을 워킹 타임슬롯에 할당하여 전송하고, 특정 노드에서 상기 전송된 트래픽을 분기시키는 단계를 포함하여 이루어지는 것을 특징으로 하는 동기식 광전송 시스템의 듀얼 노드 접속방법.

청구항 5.

제 2항에 있어서, 상기 단계 (b)는,

서로 연결된 환형 네트워크를 네트워크1과 네트워크2라 할 때 네트워크2의 프라이머리 노드의 트리뷰터리 수신측 장애 발생시,

네트워크1에서 결합되는 트래픽이 워킹 타임슬롯에 할당되어 네트워크1의 프라이머리 노드로 전송되면 네트워크1의 프라이머리 노드가 수신 트래픽을 분기/통과시키며, 네트워크1의 세컨더리 노드가 네트워크1의 프라이머리 노드를 통과한 트래픽을 분기시키는 단계와;

네트워크1의 프라이머리 노드와 세컨더리 노드간 트리뷰터리 송신 트래픽이 네트워크2의 프라이머리 노드와 세컨더리 노드로 전송되며, 상기 트리뷰터리 송신 트래픽을 수신하는 네트워크2에서 세컨더리 노드는 상기 트리뷰터리로 수신된 트래픽을 네트워크2의 프라이머리 노드로 전송하는 단계와;

네트워크2의 프라이머리 노드는 네트워크2의 세컨더리 노드에서 수신되는 트래픽과 트리뷰터리에서 수신된 트래픽 중 네트워크2의 세컨더리 노드를 통해 수신되는 트래픽을 타임슬롯1에 할당하여 전송하고, 지정된 노드에서 상기 전송된 트래픽을 분기시키는 단계를 포함하여 이루어지는 것을 특징으로 하는 동기식 광전송 시스템의 듀얼 노드 접속방법.

청구항 6.

제 2항에 있어서, 상기 단계 (b)는,

서로 연결된 환형 네트워크를 네트워크1과 네트워크2라 할 때 네트워크1에서 프라이머리 노드의 특정 수신측에 장애 발생시,

네트워크1에서 결합되는 트래픽이 워킹 타임슬롯에 할당되어 장애가 발생한 수신측을 통해 네트워크1의 프라이머리 노드로 전송되면, 수신측 장애에 따른 링 스위칭으로 상기 송신 트래픽이 프로텍션 타임슬롯에 할당되어 전송되어 네트워크1의 프라이머리 노드로 수신되는 단계와;

네트워크1의 프라이머리 노드는 링 스위칭된 트래픽을 장애 없는 수신측 타임슬롯을 통해 수신하여 분기/통과시키고 네트워크1의 세컨더리 노드가 네트워크1의 프라이머리 노드를 통과한 트래픽을 분기시키는 단계와;

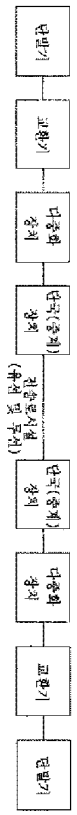
네트워크1의 프라이머리 노드와 세컨더리 노드간 트리뷰터리 송신 트래픽이 네트워크2의 프라이머리 노드와 세컨더리 노드로 전송되며, 상기 트리뷰터리 송신 트래픽을 수신하는 네트워크2에서 세컨더리 노드는 상기 트리뷰터리로 수신된 트래픽을 네트워크2의 프라이머리 노드로 전송하는 단계와;

IPR2023-01270 Page 194

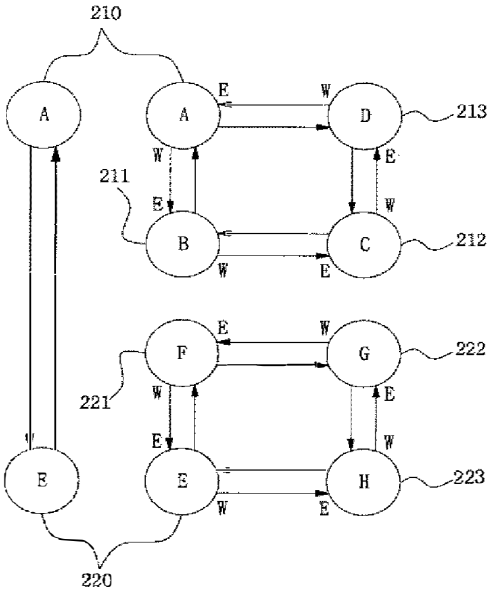
네트워크2의 프라이머리 노드는 네트워크2의 세컨더리 노드에서 수신되는 트래픽과 트리뷰터리에서 수신된 트래픽 중 네트워크2의 세컨더리 노드를 통해 수신되는 트래픽을 타임슬롯1에 할당하여 전송하고, 지정된 노드에서 상기 전송된 트래픽을 분기시키는 단계를 포함하여 이루어지는 것을 특징으로 하는 동기식 광전송 시스템의 듀얼 노드 접속방법.

도면

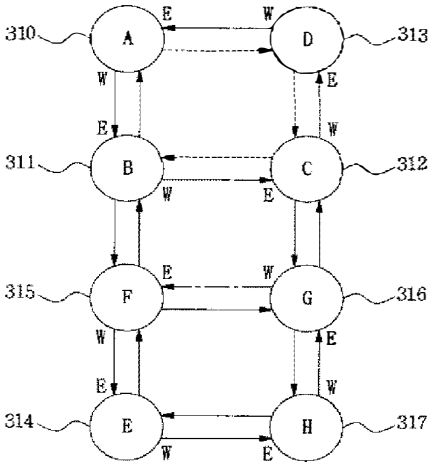
도면 1



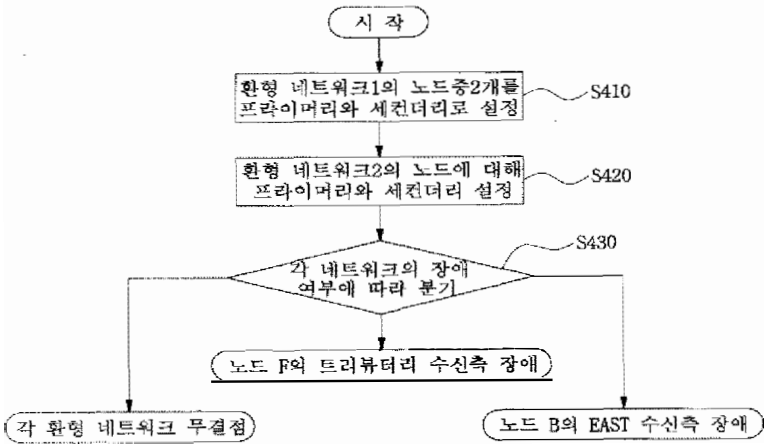
도면 2


210
A
A
E
W
D
213
W
E
211
B
W
E
C
212
F
222
221
E
H
223
220

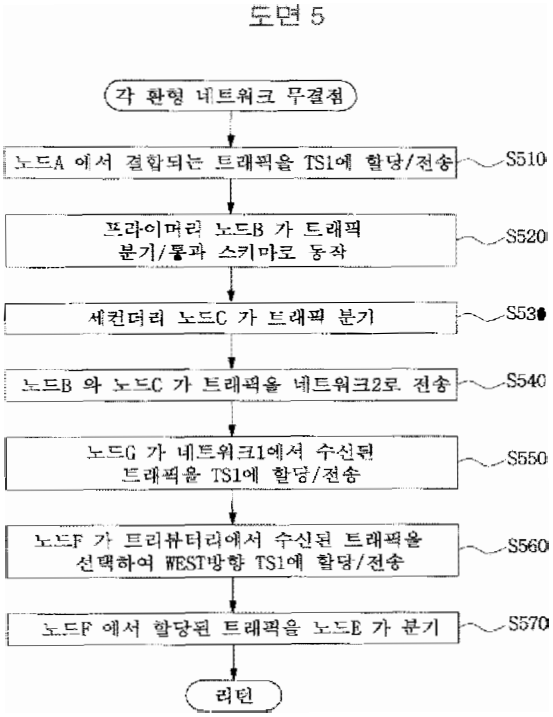
도면 3


310
A
D
313
311
B
C
312
315
F
G
316
314
E
H
317

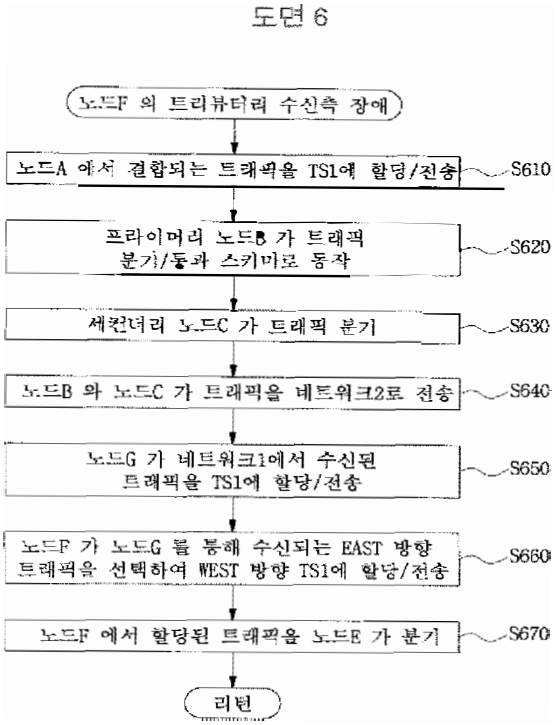
도면 4


시 작
환형 네트워크1의 노드중2개를 프라이머리와 세컨더리로 설정
S410
환형 네트워크2의 노드에 대해 프라이머리와 세컨더리 설정
S420
각 네트워크의 장애 여부에 따라 분기
S430
노드 F의 트리뷰터리 수신측 장애
각 환형 네트워크 무결점
노드 B의 EAST 수신측 장애

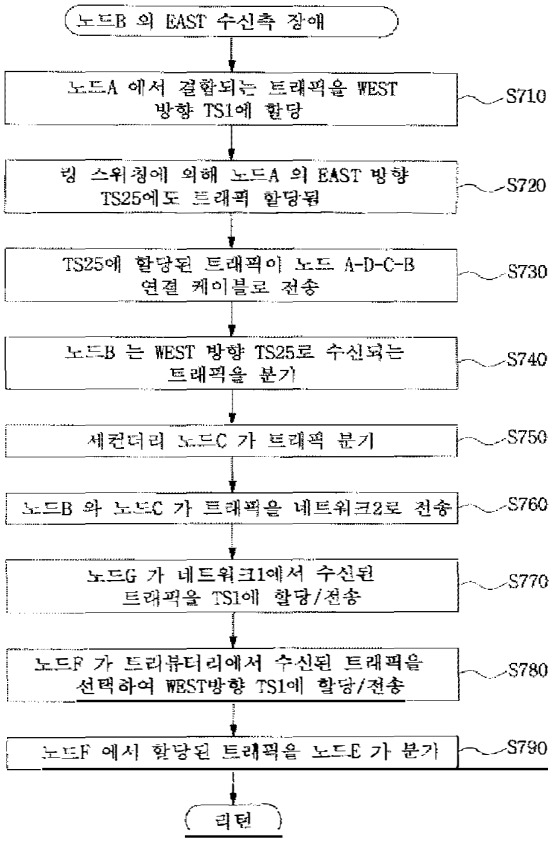
도면 5


각 환형 네트워크 무결점
노드A 에서 결합되는 트래픽을 TS1에 할당/전송
S510
프라이머리 노드B 가 트래픽 분기/통과 스키마로 동작
S520
세컨더리 노드C 가 트래픽 분기
S530
노드B 와 노드C 가 트래픽을 네트워크2로 전송
S540
노드G 가 네트워크1에서 수신된 트래픽을 TS1에 할당/전송
S550
노드F 가 트리뷰터리에서 수신된 트래픽을 선택하여 WEST방향 TS1에 할당/전송
S560
노드F 에서 할당된 트래픽을 노드E 가 분기
S570
리턴

도면 6


노드F 의 트리뷰터리 수신측 장애
노드A 에서 결합되는 트래픽을 TS1에 할당/전송
S610
프라이머리 노드B 가 트래픽 분기/통과 스키마로 동작
S620
세컨더리 노드C 가 트래픽 분기
S630
노드B 와 노드C 가 트래픽을 네트워크2로 전송
S640
노드G 가 네트워크1에서 수신된 트래픽을 TS1에 할당/전송
S650
노드F 가 노드G 를 통해 수신되는 EAST 방향 트래픽을 선택하여 WEST 방향 TS1에 할당/전송
S660
노드F 에서 할당된 트래픽을 노드E 가 분기
S670
리턴

도면 7


노드B 의 EAST 수신측 장애
노드A 에서 결합되는 트래픽을 WEST 방향 TS1에 할당
S710
링 스위칭에 의해 노드A 의 EAST 방향 TS25에도 트래픽 할당됨
S720
TS25에 할당된 트래픽이 노드 A-D-C-B 연결 케이블로 전송
S730
노드B 는 WEST 방향 TS25로 수신되는 트래픽을 분기
S740
세컨더리 노드C 가 트래픽 분기
S750
노드B 와 노드C 가 트래픽을 네트워크2로 전송
S760
노드G 가 네트워크1에서 수신된 트래픽을 TS1에 할당/전송
S770
노드F 가 트리뷰티리에서 수신된 트래픽을 선택하여 WEST방향 TS1에 할당/전송
S780
노드F 에서 할당된 트래픽을 노드E 가 분기
S790
리턴

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
13 June 2002 (13.06.2002)

PCT

(10) International Publication Number
WO 02/47317 A1

(51) International Patent Classification[7]: H04L 1/18, 12/56

(21) International Application Number: PCT/EP01/14136

(22) International Filing Date:
27 November 2001 (27.11.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
0030099.6 9 December 2000 (09.12.2000) GB

(71) Applicant *(for all designated States except US)*: **TELEFONAKTIEBOLAGET LM ERICSSON (publ)** [SE/SE]; S-12625 Stockholm (SE).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **WIGELL, Toomas** [FI/FI]; Venepuuntie 6, FIN-02360 Espoo (FI). **TORSNER, Johan** [FI/FI]; Grindbergsgatan 6 A 3, FIN-02600 Esbo (FI). **SODERSTRÖM, Raul** [SE/SE]; Länghagsvägen 30A, S-02400 Kyrkslätt (SE). **PEISA, Janne** [FI/FI]; Itmämerenkatu 12 B 34, FIN-00180 Espoo (FI). **BARK, Gunnar** [SE/SE]; Mariedalsgatan 104, S-586 65 Linköping (SE). **HELMERSSON, Ke, Wang** [SE/SE]; Spångerumsgatan 33, S-587 25 Linköping (SE). **WIBERG, Niclas** [SE/SE]; Sofielundsvägen 8, S-585 97 Linköping (SE).

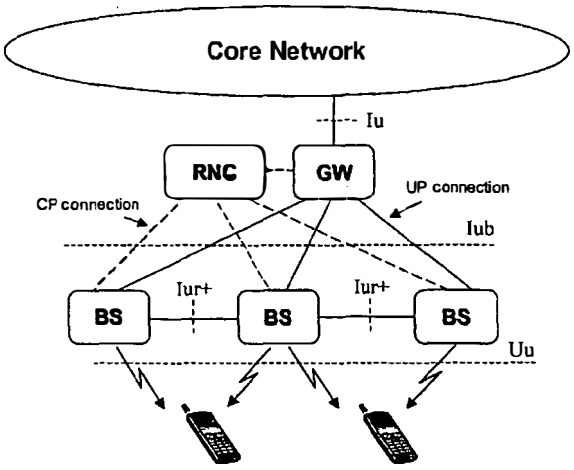
(74) Agents: **LIND, Robert** et al.; Marks & Clerk, 4220 Nash Court, Oxford Business Park South, Oxford, Oxfordshire OX4 2RU (GB).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),

[Continued on next page]

(54) Title: TRANSMISSION CONTROL METHOD IN A RADIO ACCESS NETWORK IMPLEMENTING AN AUTOMATIC REPETITION REQUEST (AQR) PROTOCOL AT THE BASE STATION (AQR)



(57) Abstract: A method of controlling the sending of data packets from a Base Station (BS) of a Radio Access Network (RAN) to a UE, where the BS is one of a set of BSs transmitting identical data to the UE and each said data packet has a sequence number. The method comprises implementing at the BS an Automatic Repetition reQuest (ARQ) mechanism for resending data packets erroneously received by the UE and, upon receipt of an ARQ status message from the UE, advancing a transmission window of the BS so that its lower region covers the packet having the highest sequence number for which an ARQ acknowledgement has nor yet been received. Where a single BS is transmitting in the downlink direction, and a soft handover set exists for an uplink reverse channel, downlink sending buffers of the BSs of the soft handover set may be synchronised by the exchange of ARQ messages between BSs.

WO 02/47317 A1

European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

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.

Transmission Control in a Radio Access Network

Field of the Invention

The present invention relates to controlling the transmission of data in a radio access network of a mobile telecommunications network. More particularly, the invention is concerned with the handling of Automatic Repetition Request (ARQ) messages at mobile terminals and in the radio access network of a mobile telecommunications network.

Background to the Invention

The European Telecommunications Standardisation Institute (ETSI) is currently in the process of standardising a new set of protocols for mobile telecommunications systems. The set of protocols is known collectively as the Universal Mobile Telecommunications System (UMTS). Figure 1 illustrates schematically a UMTS network 1 which comprises a core network 2 and a UMTS Terrestrial Radio Access Network (UTRAN) 3. The UTRAN 3 comprises a number of Radio Network Controllers (RNCs) 4, each of which is coupled to a set of neighbouring Base Stations (BSs) 5 – BSs are often referred to as Node Bs. Each BSs 5 is responsible for communicating with mobile terminals (or User Equipment (UE)) 6 within a given geographical cell, and the controlling RNC 4 is responsible for routing user and signalling data between a BS 5 and the core network 2. The interface between the RNCs is referred to as the Iur interface, whilst that between the BSs and the RNCs is referred to as the Iub interface. The air interface between the UE and the BSs is referred to as the Uu interface. Figure 1 also illustrates the interfaces present in the conventional UTRAN. A general outline of the UTRAN 3 is given in Technical Specification TS 25.401 V3.3.0 (1999-09) of the 3rd Generation Partnership Project, 3GPP.

Under the UTRAN proposals, certain transmission channels (e.g. DCHs and DSCHs) make use of a mechanism known as Automatic Repetition reQuest (ARQ) to facilitate the retransmission of data packets which are either not received, or are received erroneously by a receiving entity, i.e. a UE or a RNC. The sending of an ARQ status message from a receiver may be ordered under this mechanism, the ARQ status

IPR2023-01270 Page 202

message containing one or more ACKs, indicating the successful receipt of a packet, and/or one or more NACKs, indicating that a packet has not been received or has been received incorrectly. It will be appreciated that the retransmission path, involving as it does passage through a BS, can introduce a considerable delay into the retransmission time and can impact significantly on the performance of higher layer protocols (e.g. TCP).

One way to reduce the length of the retransmission path is to implement a new RAN architecture in which the ARQ mechanism is implemented in the BSs and not in the RNCs. Figure 2 illustrates an architecture in which user plane and the time critical part of control plane handling is carried out in the BSs and the Gateway (GW) to the core network, whilst non-time critical control plane handling is carried out in the RNC. A new interface between the BSs is created, this being referred to hereinafter as the Iur+ interface. The interfaces of the new network are also illustrated in Figure 2.

The conventional RAN architecture of Figure 1 employs a mechanism known as soft handover to enhance system performance at cell borders and to facilitate the smooth transfer of UEs between BSs. During a soft handover, data may be sent and received in parallel between two or more BSs and a UE. At the receiver, information is combined at the physical layer before it is passed to the ARQ protocol (at layer 2). As ARQ is handled at the RNC, the retransmission of data causes no problems (other that the problem of retransmission delay already noted). For data transmission in the downlink direction, the RNC collects ARQ status messages returned from a UE (and forwarded by the various BSs involved in the soft handover) and sorts these to determine which data has been correctly received by the UE and which, if any, must be retransmitted. For data transmission in the uplink direction, the RNC is again able to co-ordinate the receipt of data packets sent from the UE and to transmit appropriate ARQ status messages to the UE.

For certain types of downlink channel it is not desirable to transmit data in parallel to a UE from several BSs. However, the soft handover process described may occur for uplink channels, with the (downlink) sending buffers of the soft handover BS set being synchronised in readiness for a hard handover. This situation is also considered here to be a semi-soft handover situation for the downlink channel.

IPR2023-01270 Page 203

Statement of the Invention

The inventors of the present invention have recognised that if the RAN architecture of Figure 2 is introduced, even though the retransmission time for data is reduced, the processing of ARQ status messages transmitted by a UE, and the sending of ARQ status messages to a UE, is no longer co-ordinated by the RNC. Unless the Base Stations of a soft handover set are located at the same sites (sharing a common RLC entity), the lack of co-ordination may result in a significant deterioration in network performance.

Considering first the downlink direction, where a soft handover is occurring and several BSs are transmitting in the downlink direction in parallel, it is possible that the different streams received by the UE will be time shifted from one another. The UE will check the data packets received from all BSs in the soft handover link set, and will issue an ARQ status message (containing ACKs and NACKs) based on correctly and incorrectly received packets. A BS may therefore receive an ARQ status message containing an ACK for a data packet which it has not yet sent. The ACK will be treated by the BS as an error and may cause the BS to enter a protocol deadlock state.

According to a first aspect of the present invention there is provided a method of controlling the sending of data packets from a Base Station (BS) of a Radio Access Network (RAN) to a UE, where the BS is one of a set of BSs transmitting identical data to the UE and each said data packet has a sequence number, the method comprising implementing at the BS an Automatic Repetition reQuest (ARQ) mechanism for resending data packets erroneously received by the UE and, upon receipt of an ARQ status message from the UE, advancing a transmission window of the BS so that its lower region covers the packet having the lowest sequence number for which an ARQ acknowledgement has not yet been received.

Embodiments of the present invention facilitate the implementation of the architecture of Figure 2, in which retransmission delays are reduced due to the location of the ARQ mechanism in the Base Stations. Each BS advances its transmission window for ACKs broadcast by the UE in respect of packets previously sent by that BS and other BSs transmitting to the UE.

IPR2023-01270 Page 204

In order to avoid ambiguity resulting from the wrapping around (i.e. re-use) of PDU sequence numbers and the prolonged low quality of a radio link for a given BS, each BS transmitting to the UE may multicast to the other BS(s) correctly received ARQ status messages. A BS therefore takes into account both ARQ status messages received over the Uu interface and ARQ status messages multicast from the other BS(s) when positioning its transmission window.

In the event that a given BS has managed to send a complete LL SDU to a UE and has received a corresponding ARQ status message broadcast by the UE, that BS will inform other involved BSs by sending the ARQ status message to them. Receipt of this ARQ status message by a BS causes the BS to remove all of the LL PDUs belonging to that SDU from its buffer.

According to a second aspect of the present invention there is provided a method of controlling the sending of data packets from a Base Station of a Radio Access Network (RAN) to a UE, where the BS is one of a set of BSs transmitting identical data to the UE on respective Dedicated Channels (DCHs) and where each data packet has a sequence number, the method comprising implementing at the BS an Automatic Repetition reQuest (ARQ) mechanism for resending data packets erroneously received by the UE, and advancing a transmission window in accordance with the sequence number(s) contained in ARQ status messages multicast from another BS and/or received over the Uu interface from the UE.

According to a third aspect of the present invention there is provided a Base Station for implementing the method of the above first or second aspect of the invention in a Radio Access Network.

Considering now the uplink direction, two possible mechanisms for avoiding problems at a UE caused by the receipt of conflicting ARQ status messages are proposed.

According to a fourth aspect of the present invention there is provided a method of controlling the sending and resending of data packets from a UE to a plurality of Base Stations (BSs) of a Radio Access Network (RAN), wherein, in the event of receipt at the

IPR2023-01270 Page 205

UE of conflicting ARQ status messages, the method comprises selecting one of said BSs and responding only to ARQ status messages generated at that BS and sent to the UE, until receipt of the complete SDU has been acknowledged by the BS.

According to a fifth aspect of the present invention there is provided a method of controlling the sending and resending of data packets forming a LL SDU from a UE to a plurality of Base Stations (BSs) of a Radio Access Network (RAN), the UE implementing an Automatic Repetition reQuest (ARQ) mechanism for resending data packets erroneously received by the RAN, the method comprising receiving ARQ status messages at the UE from a plurality of BSs, identifying missing or erroneously received data packets, and retransmitting the identified data packets to all of the BSs, the BSs exchanging correctly received data packets to provide at least one of the BSs with the complete LL SDU.

Preferably, once a BS has obtained a complete LL SDU, that BS informs other BSs of the soft handover link set by sending an appropriate ARQ sequence message.

According to a sixth aspect of the present invention there is provided User Equipment (UE) arranged to implement the method of the above fourth or fifth aspect of the present invention.

According to a seventh aspect of the present invention there is provided a method of performing a handover of a downlink channel for a UE from a first active Base Station (BS) to a second BS of a Radio Access Network (RAN), the method comprising, prior to handover, sending data packets destined for the UE to the BSs of a soft handover (SHO) link set comprising said first and second BSs, the SHO link set being associated with an uplink reverse channel of the UE, receiving ARQ status messages at the BSs of the SHO link set and using the ARQ status messages to update the sending buffers of the BSs, initiating the handover from the first to the second BS, and commencing transmission of the data packets of the DSCH from the second BS, wherein the transmission commences with the packet succeeding the packet identified by the last received ARQ status message.

IPR2023-01270 Page 206

The invention may be employed where said downlink channel is a Downlink Shared Channel (DSCH). Preferably, said ARQ status messages are received at the BSs of the SHO link set over both the Uu and Iur+ interfaces.

Brief Description of the Drawings

Figure 1 illustrates the interfaces present in a conventional RAN architecture of a mobile telecommunications network;

Figure 2 illustrates the interfaces present in a modified RAN architecture network; and

Figure 3 is a flow diagram illustrating a method of synchronising transmission windows and sending buffers of BSs of the network of Figure 2.

Detailed Description of a Preferred Embodiment

A conventional RAN architecture has already been described with reference to Figures 1. A modified architecture has been described with reference to Figure 2, in which Base Stations (BSs) are connected together over an Iur+ interface. Considering now the modified RAN architecture in which the ARQ mechanism is implemented in the UE and the BSs so that ARQ status messages are terminated at the BSs for downlink transmissions and are initiated at the BSs for uplink transmissions, reference is made to Figure 2 which illustrates the interfaces and certain signalling processes which may exist in this RAN architecture for data transmissions in the downlink direction, i.e. from the network to the UE, during a soft handover.

Each transmitter/receiver entity performs segmentation/concatenation and reassembly between lower layer (LL) and higher layer (HL) Protocol Data Units (PDUs), for example when the RLC ARQ mechanism is used. A HL PDU, which might be an IP packet received from a correspondent host of the UE, is distributed to all BSs included in the active soft handover (SHO) link set of the UE. Each BS has its own transmitter entity with the necessary buffering. The HL PDUs (which are referred to as LL SDUs) are segmented/concatenated if necessary into LL PDUs and placed in the transmission buffer. All of the BSs of the link set send the PDUs to the UE.

IPR2023-01270 Page 207

The UE has a single entity at the physical layer which receives PDUs from all of the BSs. The ARQ entity is notified of correctly and incorrectly received PDUs (NB. the physical layer may be able to construct a correct PDU from several incorrect PDUs). The ARQ entity acknowledges correctly and incorrectly received packets (as well as missing packets) by sending ARQ status messages (containing ACKs and/or NACKs) to the peer ARQ entities at the sending BSs. The sending of an ARQ status message may be triggered, for example, by the ARQ entity at the UE receiving the last in a sequence of PDUs forming a single LL SDU.

Given that the ARQ status messages are generated based on the collective information received at the UE from all participating BSs, it may happen that a given BS may receive an ARQ status message containing an ACK for a PDU which it has not yet sent. In order to avoid a protocol deadlock situation arising at the BS, the transmitter window of the BS is moved so that its lower region covers the PDU having the highest sequence number for which receipt has not yet been acknowledged. Thus, the window for a given BS is positioned based on the PDUs received by the UE from any or all of the BSs, and not just on the PDUs received by the UE from that BS.

In the event that an ARQ status message containing a NACK is received by a BS from the UE, the BS will respond by retransmitting the requested PDU(s).

In an alternative solution to the problem of implementing an ARQ mechanism in the downlink direction for a DCH, the BSs of a soft handover link set may exchange correctly received ARQ status messages (e.g. using multicast procedures), i.e. a BS will multicast an ARQ status message which corresponds to the sending record held by that BS. This enables an ARQ status message which has been correctly received by one BS to be distributed to other BSs which have perhaps not received this message over the Uu interface, or which did receive the message but could not reconcile the message with their own sending records. The exchange of ARQ status messages synchronises the buffers of the various sending BSs, and avoids ambiguity in the LL PDU sequence numbers in the different sending buffers. Figure 3 is a flow diagram further illustrating a stage in this process.

IPR2023-01270 Page 208

Considering now the sending of data in the uplink direction using the RAN architecture of Figure 2, at the UE, the HL PDUs (which again might be IP packets) are segmented and concatenated into lower layer PDUs. The UE sends the LL PDUs to all of the BSs of the SHO link set. These BSs identify the correctly and incorrectly received PDUs (as well as missing PDUs), and return appropriate ARQ status messages to the UE. In the event that the UE receives conflicting ARQ status messages from the BSs, there are two ways in which the UE may proceed in order to avoid a protocol deadlock from arising.

Firstly, the UE may select one of the BS links and retransmit packets according to the ARQ status message received on that link. This selection remains until the BS in question has received a complete LL SDU, whereupon the UE sends an ARQ status message in order to clear the RX buffers at the other BSs of the link set. The link selected may be the link requiring the least resources (i.e. least UL energy) to successfully transmit a LL SDU.

Secondly, the UE may only retransmit packets which have not been received by any of the BSs. One of the BSs of the link set is designated as the "master", whilst the other nodes are designated as slaves. Each of the slave BSs sends received retransmitted packets and forwards these to the master BS over the Iur+ interface. Once the master BS has a complete SDU, the SDU is passed to the higher layers at the master BS.

The above description has been concerned with soft handovers between BSs of the RAN of Figure 2. Whilst soft handover is applied to certain channels such as Dedicated Channels (DCH), it may not be applied to other high bandwidth channels (e.g. DSCHs) which are shared by a number of UEs. Generally, a UE makes use of a DSCH originating at the BS with which the UE has the best radio connection. However, control signalling informing the UE on when to listen to the shared channel may be transmitted on a separate dedicated channel to which soft handover is applied. The corresponding (reverse) uplink channel is used to transmit ARQ status messages, and soft handover is also applied to this channel.

During a soft handover of such a DCH (carrying signalling related to a DSCH), it is possible that even though the UE is able to receive the DSCH from the sole allocated BS, the ARQ status messages are transmitted by the UE at such a low power level that

IPR2023-01270 Page 209

only one BS participating in the soft handover receives them. This BS need not be the same BS which is transmitting the DSCH. Providing a smooth handover of the DSCH is also problematic if the ARQ mechanism is located in the BSs. As all data is buffered at the BSs, changing the BS transmitting the DSCH can result in the dropping of packets and/or the need to transfer a large number of packets between BSs which introduces a delay and increases network traffic. This can in turn result in a loss in performance at the higher layers, e.g. TCP must attend to the retransmission of data. Neither of these problems exist for the conventional architecture of Figure 1.

A solution to this problem, which arises when the ARQ mechanism is located in the BSs, is to multicast all data packets arriving at the RAN to the BSs of the active soft handover (SHO) link set associated with the DCH. However the DSCH data flow is transmitted only from one active BS. The UE sends feedback ARQ status messages to all BSs belonging to the SHO link set. All BSs belonging to the active soft handover link set exchange ARQ status messages over the Iur+ interface. The BS transmitting on the shared channel may receive ARQ status messages from other BSs in the event that the transmitting BS has not itself received these messages (because the quality of its own backward channel is too low). The idle BSs use the ARQ status messages to update their sending buffers, so that the buffers are partially synchronised with the active BS. Thus, when a handover of the DSCH occurs, the new active BS can begin transmitting at, or near, the point where the previously active BS left off. It will be appreciated that problems caused by the failure of the active BS (or indeed the idle BSs) to correctly receive ARQ status messages may be overcome using one of the methods described above.

IPR2023-01270 Page 210

Claims

1. A method of controlling the sending of data packets from a Base Station (BS) of a Radio Access Network (RAN) to a UE, where the BS is one of a set of BSs transmitting identical data to the UE and each said data packet has a sequence number, the method comprising implementing at the BS an Automatic Repetition reQuest (ARQ) mechanism for resending data packets erroneously received by the UE and, upon receipt of an ARQ status message from the UE, advancing a transmission window of the BS so that its lower region covers the packet having the lowest sequence number for which an ARQ acknowledgement has not yet been received.

2. A method according to claim 1, wherein the method is carried out during a soft handover.

3. A method of controlling the sending of data packets from a Base Station of a Radio Access Network (RAN) to a UE, where the BS is one of a set of BSs transmitting identical data to the UE and where each data packet has a sequence number, the method comprising implementing at the BS an Automatic Repetition reQuest (ARQ) mechanism for resending data packets erroneously received by the UE, and advancing a transmission window in accordance with the sequence number(s) contained in ARQ status messages multicast from another BS or received over the Uu interface from the UE.

4. A Base Station for implementing the method of claim 1 or 2 in a Radio Access Network.

5. A method of controlling the sending and resending of data packets from a UE to a plurality of Base Stations (BSs) of a Radio Access Network (RAN), wherein, in the event of receipt at the UE of conflicting ARQ status messages, the method comprises selecting one of said BSs and responding only to ARQ status messages generated at that BS and sent to the UE, until receipt of the complete SDU has been acknowledged by the BS.

IPR2023-01270 Page 211

6. A method of controlling the sending and resending of data packets forming a LL SDU from a UE to a plurality of Base Stations (BSs) of a Radio Access Network (RAN), the UE implementing an Automatic Repetition reQuest (ARQ) mechanism for resending data packets erroneously received by the RAN, the method comprising receiving ARQ status messages at the UE from a plurality of BSs, identifying missing or erroneously received data packets, and retransmitting the identified data packets to all of the BSs, the BSs exchanging correctly received data packets to provide at least one of the BSs with the complete LL SDU.

7. A method according to claim 6, wherein, once a BS has obtained a complete LL SDU, that BS informs other BSs of a soft handover link set by sending an ARQ status message.

8. User Equipment arranged to implement the method of the any one of claims 5 to 7.

9. A method of performing a handover of a downlink channel for a UE from a first active Base Station (BS) to a second BS of a Radio Access Network (RAN), the method comprising, prior to handover, sending data packets destined for the UE to the BSs of a soft handover (SHO) link set comprising said first and second BSs, the SHO link set being associated with an uplink reverse channel of the UE, receiving ARQ status messages at the BSs of the SHO link set and using the ARQ status messages to update the sending buffers of the BSs, initiating the handover from the first to the second BS, and commencing transmission of the data packets of the DSCH from the second BS, wherein the transmission commences with the packet succeeding the packet identified by the last received ARQ status message.

10. A method according to claim 9, wherein ARQ status messages are received at each BS of the SHO link set from the UE and from other BS of the set.

IPR2023-01270 Page 212

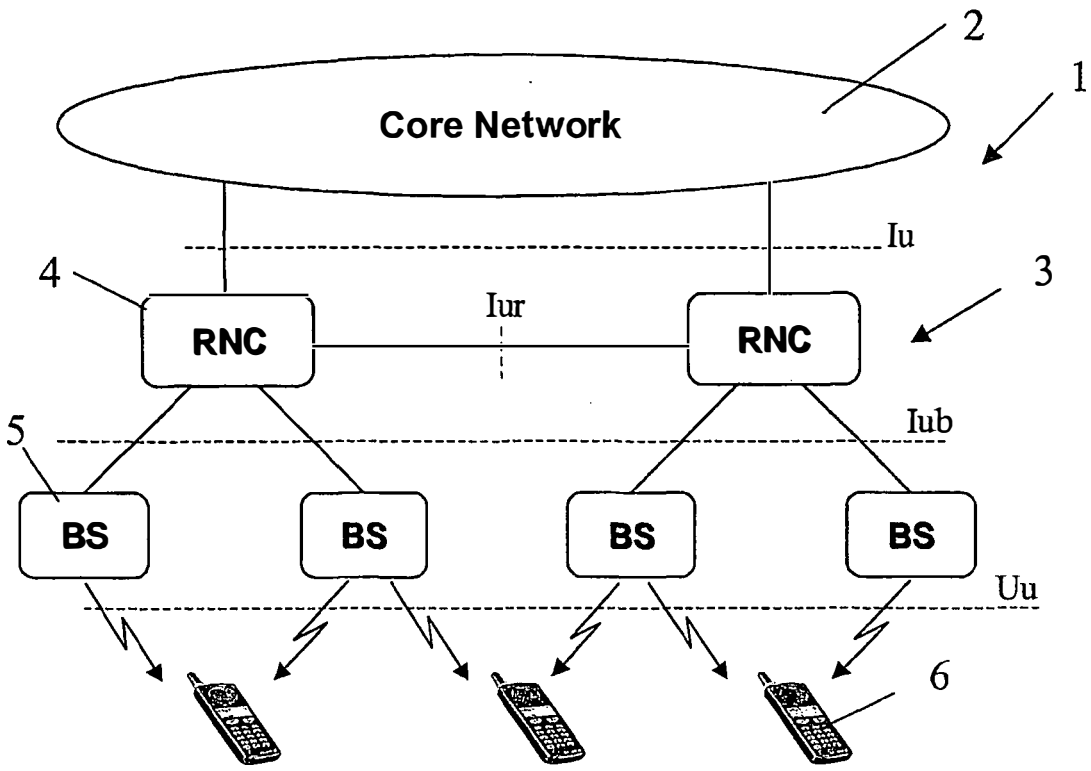


Figure 1

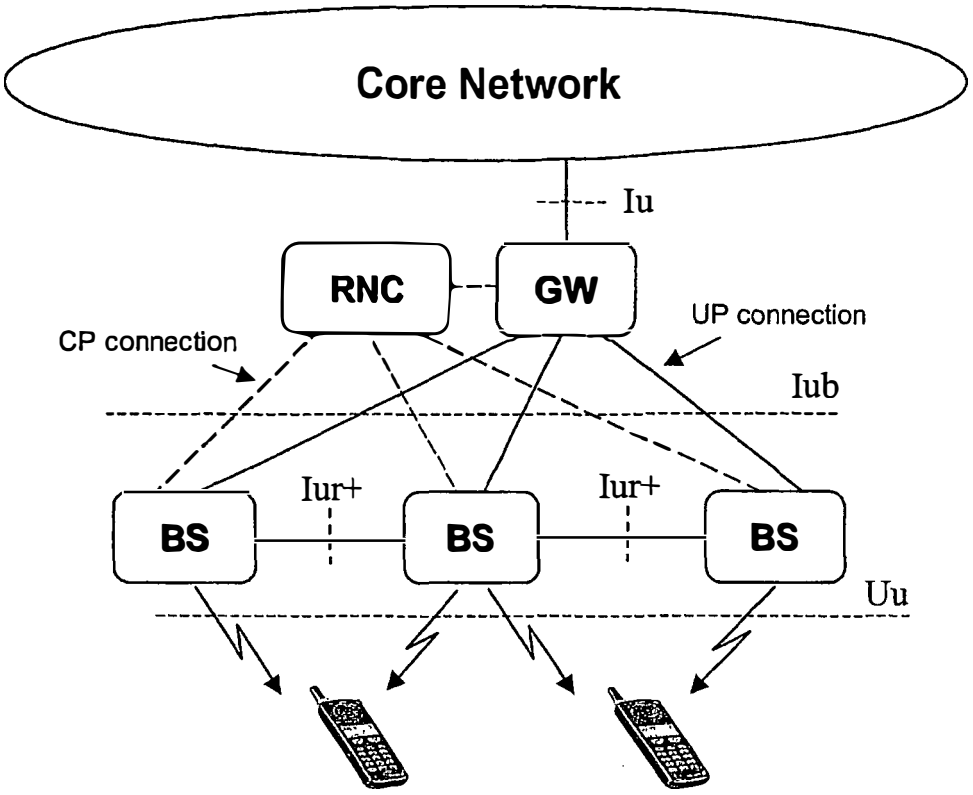

Core Network
Iu
RNC
GW
UP connection
CP connection
Iub
Iur+
Iur+
BS
BS
BS
Uu

Figure 2

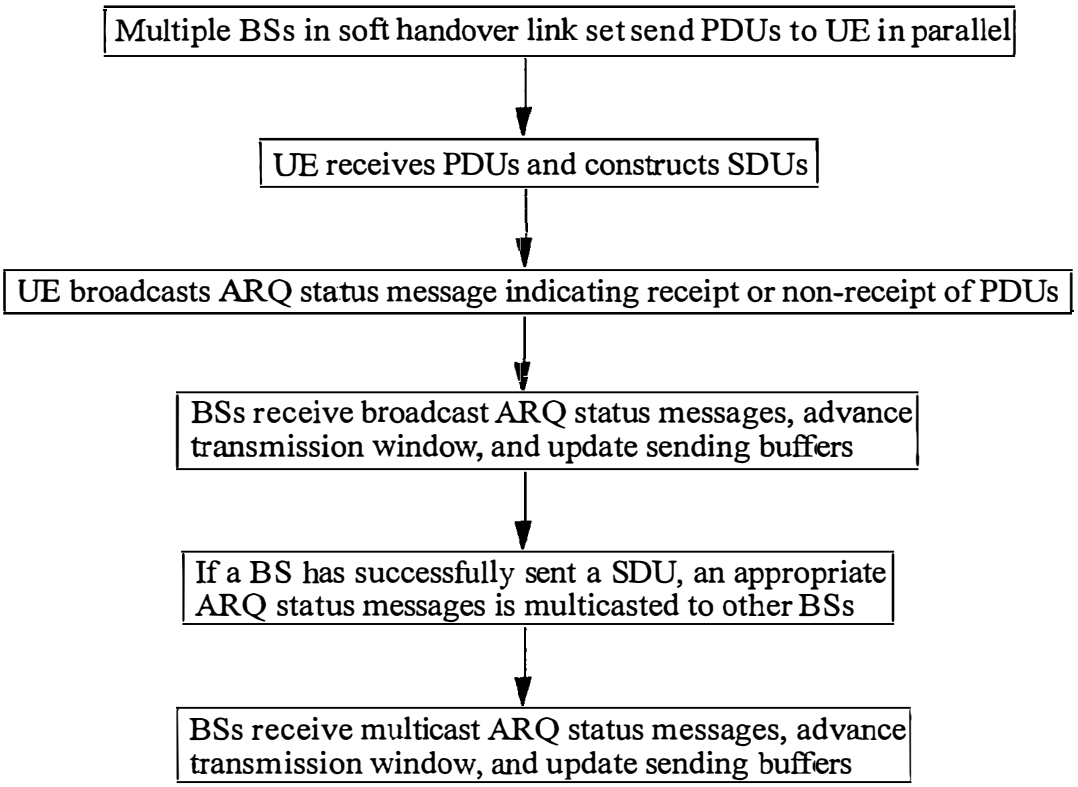

Multiple BSs in soft handover link set send PDUs to UE in parallel
UE receives PDUs and constructs SDUs
UE broadcasts ARQ status message indicating receipt or non-receipt of PDUs
BSs receive broadcast ARQ status messages, advance transmission window, and update sending buffers
If a BS has successfully sent a SDU, an appropriate ARQ status messages is multicasted to other BSs
BSs receive multicast ARQ status messages, advance transmission window, and update sending buffers

Figure 3

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 01/14136

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04L1/18 H04L12/56

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 7 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 practical, search terms used)
EPO-Internal, WPI Data, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 695 053 A (AT & T CORP) 31 January 1996 (1996-01-31) column 4, line 50 -column 5, line 2 column 5, line 33 -column 6, line 23 column 7, line 8 - line 16 column 7, line 29 -column 8, line 33 figures 1,2 --- -/--	1-10

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in 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 document 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 April 2002	29/04/2002

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Marselli, M

Form PCT/ISA/210 (second sheet) (July 1992)

IPR2023-01270 Page 216

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	BALAKRISHNAN H ET AL: "IMPROVING RELIABLE TRANSPORT AND HANDOFF PERFORMANCE IN CELLULAR WIRELESS NETWORKS" WIRELESS NETWORKS,US,ACM, vol. 1, no. 4, 1 December 1995 (1995-12-01), pages 469-481, XP000543510 ISSN: 1022-0038 abstract page 469, right-hand column, line 16 -page 470, left-hand column, line 15 ---	1-10
X	WO 99 23844 A (QUALCOMM INC) 14 May 1999 (1999-05-14)	1-4,9,10
A	page 6, line 33 -page 7, line 2 page 11, line 1 - line 10 page 19, line 33 -page 21, line 22 page 49, line 9 - line 16 figure 2 ---	5-8
A	EP 1 056 258 A (ERICSSON TELEFON AB L M) 29 November 2000 (2000-11-29) page 2, line 36 - line 55 page 5, line 35 - line 55 page 7, line 41 -page 8, line 23 figure 4 -----	1-10

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP 01/14136

Patent document cited in search report		Publication date	Patent family member(s)		Publication date
EP 0695053	A	31-01-1996	US	5570367 A	29-10-1996
			CA	2145782 A1	29-01-1996
			CN	1123980 A	05-06-1996
			EP	0695053 A2	31-01-1996
			JP	8065355 A	08-03-1996
WO 9923844	A	14-05-1999	AU	1303299 A	24-05-1999
			BR	9813885 A	26-09-2000
			CA	2306868 A1	14-05-1999
			CN	1286000 T	28-02-2001
			EP	1029419 A2	23-08-2000
			HU	0100629 A2	28-06-2001
			JP	2001522211 T	13-11-2001
			NO	20002228 A	03-07-2000
			PL	342656 A1	02-07-2001
			TR	200001200 T2	21-11-2000
			WO	9923844 A2	14-05-1999
			ZA	9810003 A	02-08-2000
EP 1056258	A	29-11-2000	EP	1056258 A1	29-11-2000
			AU	4758000 A	18-12-2000
			WO	0074341 A1	07-12-2000
			EP	1180292 A1	20-02-2002

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
17 October 2002 (17.10.2002)

PCT

(10) International Publication Number
WO 02/082108 A1

(51) International Patent Classification[7]: G01R 31/28, G08C 25/02, G06F 7/02, H04B 1/44

(21) International Application Number: PCT/IB02/01033

(22) International Filing Date: 2 April 2002 (02.04.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/280,747 3 April 2001 (03.04.2001) US

(71) Applicant *(for all designated States except US)*: **NOKIA CORPORATION** [FI/FI]; Keilalahdentie 4, FIN-02150 Espoo (FI).

(71) Applicant *(for LC only)*: **NOKIA INC.** [US/US]; 6000 Connection Drive, Irving, Tx 75039 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **CHENG, Mark, W.** [US/US]; 4170 Via Mar de Delfinas, San Diego, CA 92130 (US). **HSU, Liangchi (Alan)** [US/US]; 12368 Carmel County Road #302, San Diego, CA 92130 (US).

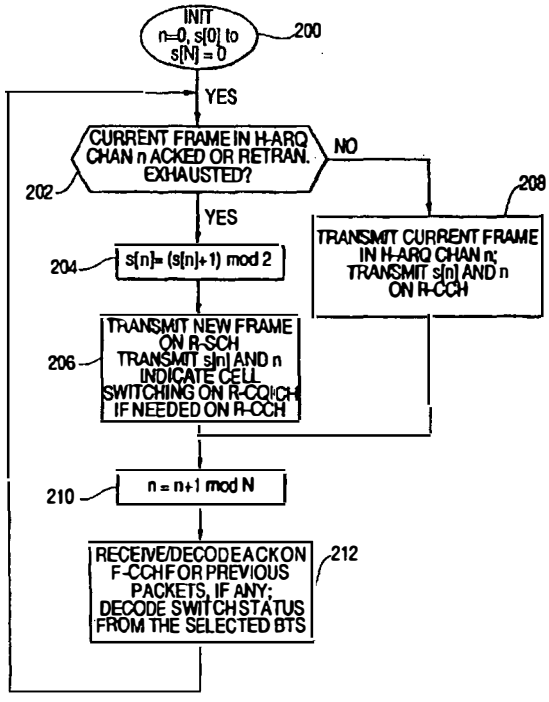
(74) Agents: **STOUT, Donald, E.** et al.; Antonelli, Terry, Stout & Kraus, LLP, Suite 1800, 1300 North Seventeenth Street, Arlington, VA 22209 (US).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent

[Continued on next page]

(54) Title: REVERSE LINK HANDOFF MECHANISM WITH HYBRID-ARQ AND CELL SITE SELECTION IN CDMA2000 1XEV-DV SYSTEMS



(57) Abstract: The invention is a system and process for the transmission of data packets on a reverse link between a mobile station (MS) and cells (a and b). A process for the transmission of data packets on a reverse link between a mobile station and an active group of cells (a and b) in accordance with the invention includes establishing a data channel between the mobile station and a first cell (a) with the data channel being used by the mobile station to transmit data packets to the first cell; transmitting from the mobile station a request to the active set of cells group that a new data channel with a second cell (b) should be established between the mobile station and the second cell with the new data channel to be used by the mobile station to transmit data packets to the second cell; sending any data packet retransmissions and data packet acknowledgements one acknowledgement between the first cell and the mobile station during a cell switch delay, during which handoff occurs, from the first cell to the second cell; and upon an end of the cell switch delay the mobile station data reception is switched from the first cell to the second cell; and wherein the cell switch delay is a time interval from a time that the request to switch is made until starting of reception of data packets from the second cell to the mobile station; and the data channels between the mobile station and the cells and used only by the mobile station to transmit data packets to the first and second cells.

WO 02/082108 A1

(BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

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.

REVERSE LINK HANDOFF MECHANISM WITH HYBRID-ARQ AND CELL SITE SELECTION IN CDMA2000 1XEV-DV SYSTEMS

TECHNICAL FIELD

The invention relates to making of handoffs on reverse link wireless high-speed packet data transmissions, such as in CDMA2000 1xEV-DV and 3GPP HSDPA, between a mobile station and a group of cells.

BACKGROUND ART

Hybrid automatic repeat request (H-ARQ) and cell selection are linking techniques employed by 1xEV-DV forward link services on the shared Forward Packet Data channel (F-PDCH) between cells and mobile stations (MS). Cells comprise base transceiver stations (BTS) in wireless environments which have lower traffic and sectors, which subtend an angular portion of a full periphery such as 120°, having applications in wireless environments which have higher traffic.

For a reverse link soft handoff from one cell to another cell, in a CDMA system, the communication path is maintained during cell switching, without disrupting the original communication path (make before break transfer). Reverse link soft handoff has problems with redundant channel elements and Abis interface (the interface overhead between the base station controller (BSC) and the cells) which significantly affects cell performance.

H-ARQ has been applied to the Supplemental Channel on the reverse link to improve throughput. H-ARQ uses multiple instances of an acknowledgment-based stop-and-wait ARQ protocol for code combining.

Cell selection is a handoff technique that allows the MS to identify an optimal cell (base station to base station, base station to sector or sector to sector) based on a mobile assisted handoff technique (MAHO) measurement. The MS uses the carrier signal strength to interference ratio (C/I) measurements to select the best cell for forward link transmission and indicates to the members of the active set. See L. Jalloul, "Joint 1XTREME proposal for 1XEV-DV", 3GPP2-C50-20001 204-006R1, Kauai Hawaii, December 2000 with further details being set forth in Faisal Shad, "1XTREME Uplink Hybrid ARQ Procedures", 1XTREME MAC Ad-Hoc, March 2000.

IPR2023-01270 Page 221

DISCLOSURE OF THE INVENTION

The present invention is a process and system for the transmission of data packets on a reverse link between a mobile station and a group of selectable cells (base stations or sectors). A request to make a handoff from a first cell to a second cell within a group of selectable cells is transmitted from the mobile station to the active set. During a cell switching delay, occurring between the request and the beginning of reception of data packets from the second cell, data packet retransmissions and acknowledgement are sent between the first cell and the mobile station. After handoff is complete, data packets are transmitted from the mobile station to the second cell.

The present invention uses cell selection to replace reverse link soft handoff. With the H-ARQ improvement, soft handoff on the reverse link wastes air resources especially when the reverse data rate is much higher for 1xEV-DV (around 614 kbps). In addition to 1xEV-DV's quick resumption of data transfer, the invention's use of H-ARQ and cell selection in the reverse link provides the benefits of reducing channel element usage and the Abis interface overhead in comparison with the traditional soft-handoff.

The invention may be without limitation implemented in the BTSs and MSs of CDMA2000 1xEV-DV.

The invention provides data users with better air and network resources utilization in BTSs, such as with 1xEV-DV.

A process for the transmission of data packets on a reverse link between a mobile station and a set of cells in accordance with the invention includes establishing a data channel between the mobile station and a first cell with the data channel being used by the mobile station to transmit data packets to the first cell; transmitting from the mobile station a request to the active set of cells that a new data channel with a second cell should be established between the mobile station and the second cell with the new data channel to be used by the mobile station to transmit data packets to the second cell; sending any data packet retransmissions and data packet acknowledgements between the first cell and the mobile station during a cell switch delay, during which handoff occurs from the first cell to the second cell; and upon an end of the cell switch delay, data transmission by the mobile station is switched from the first cell to the second cell; and wherein the cell switch delay is a time interval from a time that the request to the second cell is made until starting of reception of data packets by the base station from the second cell; and the data channels between the mobile station and the cells are used only by the mobile station to transmit data packets to the first and second cells. During a switchover between receptions of data packets from the first cell to the second cell only a forward control channel may be active between the first cell and the mobile station to transmit the data packet acknowledgements. The

IPR2023-01270 Page 222

cell may comprise a base station or a sector. The cells may in accordance with IS-2000 and the data packets in the reverse link between the mobile station and the cells may be CDMA encoded in accordance with IS-2000. The acknowledgements may be in accordance with the hybrid automatic repeat request (H-ARQ) protocol. The acknowledgments may be transmitted on a forward link common channel on a forward link dedicated channel or on a forward link sub channel time multiplexed with at least one other forward link channel. Control information may be transmitted with the acknowledgments and may comprise congestion control or power control information. Data transmissions between the mobile station and the cells may use the physical layer automatic repeat request (ARQ) protocol. Selection of the cells by the mobile station may be in accordance with 3GPP or 3GPP2. Acknowledgments may be continuously sent from the mobile station to the first cell during the cell switch delay. If the second cell is not ready to receive the data packets after expiration of the cell switch delay, transmission of data packets from the mobile station to the first cell may be terminated. Additional delay time may be added to the cell switch delay time after the expiration of the cell switch delay time to complete the handoff to the second cell.

A system for transmission of data packets on a reverse link in accordance with the invention includes a mobile station; a group of selectable cells; and wherein a data channel is established between the mobile station and a first cell with the data channel being used by the mobile station to transmit data packets to the first cell; a request is transmitted from the mobile station to a active set of cells that a new data channel with a second cell should be established between the mobile station and a second cell with the new data channel to be used by the mobile station to transmit data packets to the second cell; any data packet retransmissions and data packet acknowledgements are sent between the first cell and the mobile station during a cell switch delay, during which handoff occurs, from the first cell to the second cell; upon an end of the cell switch delay, data transmission by the mobile station is switched from the first cell to the second cell; the cell switch delay is a time interval from a time that the request to the second cell is made until starting of reception of data packets by the base station from the second cell; and the data channels between the mobile station and the cells are used only by the mobile station to transmit data packets to the first and second cells. During a switchover between receptions of data packets from the first cell to the second cell only a forward control channel may be active between the first cell and the mobile station to transmit the data packet acknowledgements. The cell may comprise a base station or a sector. The cells may in accordance with IS-2000 and the data packets in the reverse link between the mobile station and the cells may be CDMA encoded in accordance with IS-2000. The acknowledgements may be in accordance with the hybrid automatic repeat request (H-ARQ) protocol. The acknowledgments may be transmitted on a

IPR2023-01270 Page 223

forward link common channel on a forward link dedicated channel or on a forward link sub channel time multiplexed with at least one other forward link channel. Control information may be transmitted with the acknowledgments and may comprise congestion control or power control information. Data transmissions between the mobile station and the cells may use the physical layer automatic repeat request (ARQ) protocol. Selection of the cells by the mobile station may be in accordance with 3GPP or 3GPP2. Acknowledgments may be continuously sent from the mobile station to the first cell during the cell switch delay. If the second cell is not ready to receive the data packets after expiration of the cell switch delay, transmission of data packets from the mobile station to the first cell may be terminated. Additional delay time may be added to the cell switch delay time after the expiration of the cell switch delay time to complete the handoff to the second cell.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 illustrates an example of a cell handoff in accordance with the present invention.

Fig. 2 illustrates an example of reverse link cell selection in accordance with the present invention.

Fig. 3 illustrates a comparison of radio resources used by the prior art soft-handoff versus the use of radio resources by the present invention.

Fig. 4 illustrates MS procedures used by the present invention.

Fig. 5 illustrates BS procedures used by the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

Fig. 1 shows an example of cell switching between cells a and b by the MS within an active set of cells. Cells are in accordance with their description above. The base station controller (BSC) uses a radio link protocol, such as the indicated RLP3 and contains a selection and distribution unit SDU. The BSC is connected to a packet data serving node PDSN. Cell a (the first cell) receives and decodes Supplemental Channel data packets sent from the MS. Switching occurs between cell a and cell b (the second cell) as illustrated. In certain circumstances, the MS decides to request a new cell selection by sending a request on the reverse Channel Quality Indicator channel (R-CQICH) that connectivity to a new cell is desired to be obtained. After the MS requests a new cell selection to cell b chosen from within the active set, the data packets are received and decoded by cell b after a cell switch delay (CSD). The CSD is required for the cell b to allocate network and radio resources R3 and R4 and to complete the data packet retransmission and acknowledgement via cell a's F-CCH (Forward Control Channel) & R-SCH (Reverse Link Supplemental Channel). The CSD is defined as the time duration

IPR2023-01270 Page 224

between the time the MS indicates by a cell switch indication that a cell switch is to occur and the time when the reverse link data reception is ready for receiving data packets from the selected cell b. If cell b is not ready after the expiration of the CSD due to the signaling delay or time latency, additional handoff delay time may be added to the cell switch delay time after the expiration of the cell switch delay time to complete the handoff to the second cell. However, in this circumstance, the data transmission between cell a and the mobile station is dropped after expiration of the CSD.

All cells of the active set are selectable for preferred cell site connection. The active set is for the forward fundamental channel or dedicated control channel updated by the cells based on the pilot strength feedback from the MS. The invention uses a cell selection method on the reverse link supplemental Channel (R-SCH) which is similar to the cell selection on the forward packet data channel. The invention limits the supplemental channel data reception/decoding in the reverse link to only one cell at a time instead of all active set members, which are used during the soft handoff.

Fig. 2 illustrates reverse link cell selection in accordance with the present invention. The H-ARQ protocol is also used as part of the data transmission methodology and uses a combination of error correction techniques in data packets and retransmission of data packets. Packets sent or received by the Reverse Supplemental Channel (R-SCH) and forward control channel
(F-CCH) are shown in each transmission interval from T1 to T6. Without loss of generality, it is assumed that the reception of data packets is switched from cell a to cell b and the data and control channels are both error free. In case of errors, the MS and the currently active cell handle the retransmission.

The serving cell (first cell) a is the cell that serves the MS before the cell switching. The selected cell (second cell) b is defined as the cell chosen for the transmission after the cell switching. The delay between the data transmission and the acknowledgment (ACK) is by example three transmission time intervals. CSD is set at two transmission frames. The time length of the CSD depends on the location of the serving base station or serving sector and the location of the selected base station or the selected sector including location thereof in different cells.

The cell switch is determined by the MS and the indication is bundled inside the "Reverse Control channel" SDU. For 1xEV-DV applications of the invention, the channel is mapped to the "Reverse Quality Indicator channel

IPR2023-01270 Page 225

(R-QIECH). The forward control channel (F-CCH) sends the data packet acknowledgment ACK and possibly switchover status.

The procedure in Fig. 2 highlights the transition of packet transmissions and acknowledgments (ACKS) during the cell switching. There are three phases during the transition from cell a to cell b:

Phase 1 - Pre-switching period: Time duration T1 and T2 are in this phase.

Phase 2 - In-switching period: Time duration T3 to T5 are in this phase.

Phase 3 - Post-switching period: Time duration T6 and beyond are in this phase.

Radio resources required during each phase are illustrated in Fig. 3. R1, R3, R2 and R4 are Abis and channel element resources identified in Fig. 1.

The advantages of cell selection over soft-handoff is two-fold: cell resource efficiency and MS complexity reduction.

The MS also does not need to decode all Forward Control Channels (F-CCH) from all cells in the active set. The MS only decodes one F-CCH from the serving cell. During the cell switching period, the MS decodes at most two cells, one serving, e.g. cell a, and one selected, e.g. cell b of Fig. 1.

The following discussion describes the procedures for both the MS and BTS to fulfill reverse link H-ARQ & cell selection.

Radio Link Cell Site Selection/H-ARQ MS Procedures

The MS defines the following data structures and runs the procedures of Fig. 4 for every transmission time interval (TTI) of ms. as long as there are packets to transmit:

N=number of H-ARQ channels,

k=delay measured in units of TTI ms. between transmission of a H-ARQ channel on the reverse link and the associated ACK on the forward link,

n=current H-ARQ channel being processed (initialized to 0)

and,

int s[N]=one-bit H-ARQ channel sequence number (initialized to '0').

The procedures of Fig. 4 start at the initial point 200 where initialization of parameters n and s set to zero occurs. At point 202, if an ACK='1' has been received from the previous transmission into H-ARQ channel n, or if the maximum number of retransmissions has been exhausted, incrementing of the H-ARQ channel sequence number s(n) mod 2 occurs at point 204 and processing proceeds to point 206. At point 206 transmission of the encoded and modulated frame at the selected modulation and coding (MSC) level occurs. If the reverse link should be transferred to the new selected cell b, the switching status indicated on the Reverse Channel

IPR2023-01270 Page 226

Quality Indicator channel (R-CQICH) for the selected cell b also occurs. Transmission of the current H-ARQ channel n and H-ARQ channel sequence number s(n) on the R-CCH occurs as indicated at point 206. Otherwise, retransmission of the buffered frame associated with the current H-ARQ channel n occurs at point 208. The current H-ARQ channel n and H-ARQ channel sequence number s(n) are transmitted on the Reverse Control Channel in parallel (R-CCH) with the R-SCH as indicated at point 208. At point 210 incrementing of the H-ARQ channel n=n+1 mod N occurs. At point 212 decoding of the ACK sent on the forward control channel F-CCH from the selected cell b occurs. Decoding the F-CCH from the previous serving cell b during the CSD for the scheduled ACKs or NAKs also occurs at 212. Processing back to step 202 occurs.

Radio Link Cell Site Selection/H-ARQ CELL Procedures

Each cell in the active set runs the steps of Fig. 5 every TTI ms. The following data structures are defined:

n=current H-ARQ channel, int s[N]=one-bit H-ARQ channel sequence number (initialized to '1'), and float b[N][Interleaver Size]=H-ARQ channel soft-symbol buffer (initialized to '0').

The procedures of Fig. 5 start at initial point 300 where S is set to 1 and b is set to zero. At point 302, if the cell is not active or no data is received on the H-ARQ channel, the processing proceeds to point 304. At point 304, decoding of the cell switch indication on the CQICH occurs: if the MS indicates a cell switch to this cell and the supplemental channel is granted, the cell is set to active after the cell switch delay; if the MS indicates a cell switch to another cell in the active set, the cell is set to inactive after the cell switching delay; and any scheduled ACK/NAK is transmitted on the F-CCH only before the cell switch delay. If the answer is "yes" at point 302, decoding of the H-ARQ channel n and the associated sequence number s(n) received on the Reverse Control Channel (R-CCH) occurs at point 306. If the H-ARQ channel sequence number s(n) is the same as the previous transmission at point 308, adding the received soft-symbols with the soft-symbols stored in b(n) occurs at point 310.

If the answer is "no" at point 308, processing proceeds to point 312 where the new soft-symbols are stored into b(n). At point 314, decoding of the data frame occurs. If the CRC check is determined to be OK at point 316, passing the decoded frame up to the SDU and scheduling of ACK='1' on the Forward Control Channel (F-CCH) k*TTI ms frames later occurs at point 318. Otherwise, the decoded frame is discarded and scheduling of ACK='0' on the F-CCH k*TTI ms frames later occurs at point 320. Processing then proceeds to point 322 where sending a scheduled ACK/NACK on F-CCH occurs; R-SCH is decoded; and the BTS is set to inactive if indicated by the MS after CDS. Processing returns to point 302 from either of points 304 or 322.

IPR2023-01270 Page 227

A cell is considered active for a MS when the cell has acquired the Reverse supplemental Channel assigned to the MS and is decoding the data received from the Supplemental Channel.

The process of the present invention utilizes cell selection methodology for reverse link high-speed packet data. The invention is, without limitation, applicable to the 3GPP and 3GPP2 standards.

The acknowledgments are preferably in accordance with the hybrid automatic request (H-ARQ) protocol. Transmission of the acknowledgments may be on diverse channels, including a forward link common channel, a forward link dedicated channel, or a forward link set channel time-multiplexed with another forward link channel. The acknowledgement channel can also carry other control information including congestion or power control information.

While the invention has been described in terms of its preferred embodiments, it should be understood that numerous modifications may be made thereto without departing form the scope of the invention. It is intended that all such modifications fall within the scope of the appended claims.

IPR2023-01270 Page 228

CLAIMS

What is claimed is:

1. A process for the transmission of data packets on a reverse link between a mobile station and an active set of cells comprising:

establishing a data channel between the mobile station and a first cell with the data channel being used by the mobile station to transmit data packets to the first cell;

transmitting from the mobile station a request to the active set of cells that a new data channel with a second cell should be established between the mobile station and the second cell with the new data channel to be used by the mobile station to transmit data packets to the second cell;

sending any data packet retransmissions and data packet acknowledgements between the first cell and the mobile station during a cell switch delay, during which handoff occurs from the first cell to the second cell; and

upon an end of the cell switch delay, data transmission by the mobile station is switched from the first cell to the second cell; and wherein

the cell switch delay is a time interval from a time that the request to switch to the second cell is made until starting of reception of data packets by the base station from the second cell; and

the data channels between the mobile station and the cells are used only by the mobile station to transmit data packets to the first and second cells.

2. A process in accordance with claim 1 wherein:

during a switchover between receptions of data packets from the first cell to the second cell only a forward control channel is active between the first cell and the mobile station to transmit the data packet acknowledgements.

3. A process in accordance with claims 1 and 2 wherein:

the cell comprises a base station.

4. A process in accordance with claims 1 and 2 wherein:

the cell comprises a sector.

IPR2023-01270 Page 229

5. A process in accordance with claims 1-4 wherein:
the cells are in accordance with IS-2000 and the data packets in the reverse link between the mobile station and the cells are CDMA encoded in accordance with IS-2000.

6. A process in accordance with claim 1 wherein:
the data packet acknowledgements are in accordance with the hybrid automatic repeat request (H-ARQ) protocol.

7. A process in accordance with claim 1 wherein:
data transmissions between the mobile station and the cells use the physical layer automatic repeat request (ARQ) protocol.

8. A process in accordance with claim 1 wherein:
selection of the cells by the mobile station is in accordance with 3GPP.

9. A process in accordance with claim 1 wherein:
selection of the cells by the mobile station is in accordance with 3GPP2.

10. A process in accordance with claims 1-9 wherein:
data packet acknowledgments are continuously sent from the first cell to the mobile station during the cell switch delay.

11. A process in accordance with claim 6 wherein:
the data packet acknowledgments are transmitted on a forward link common channel.

12. A process in accordance with claim 6 wherein:
the data packet acknowledgments are transmitted on a forward link dedicated channel.

13. A process in accordance with claim 6 wherein:
the data packet acknowledgments are transmitted on a forward link sub channel time multiplexed with at least one other forward link channel.

IPR2023-01270 Page 230

14. A process in accordance with claims 1-13 wherein:

control information is transmitted with the data packet acknowledgments.

15. A process in accordance with claim 14 wherein:

the control information comprises congestion control or power control information.

16. A system for the transmission of data packets on a reverse link comprising:

a mobile station;

a group of selectable cells; and wherein

a data channel is established between the mobile station and a first cell with the data channel being used by the mobile station to transmit data packets to the first cell;

a request is transmitted from the mobile station to an active set of cells that a new data channel with a second cell should be established between the mobile station and a second cell with the new data channel to be used by the mobile station to transmit data packets to the second cell;

any data packet retransmissions and data packet acknowledgements are sent between the first cell and the mobile station during a cell switch delay, during which handoff occurs, from the first cell to the second cell;

upon an end of the cell switch delay, data transmission by the mobile station is switched from the first cell to the second cell;

the cell switch delay is a time interval from a time that the request to the second cell is made until starting of reception of data packets by the base station from the second cell; and

the data channels between the mobile station and the cells are used only by the mobile station to transmit data packets to the first and second cells.

17. A system in accordance with claim 16 wherein:

during a switchover between receptions of data packets from the first cell to the second cell only a forward control channel is active between the first cell and the mobile station to transmit the data packet acknowledgements.

IPR2023-01270 Page 231

18. A system in accordance with claim 16 wherein:
the cells are in accordance with IS-2000 and the data packets in the reverse link between the mobile station and the cells are CDMA encoded in accordance with IS-2000.

19. A system in accordance with claim 16 wherein:
the data packet acknowledgements are in accordance with the hybrid automatic repeat request (H-ARQ) protocol.

20. A system in accordance with claim 16 wherein:
data transmission between the mobile station and the cells uses the physical layer automatic repeat request (ARQ) protocol.

21. A system in accordance with claim 16 wherein:
selection of the cells by the mobile station is in accordance with 3GPP.

22. A system in accordance with claim 16 wherein:
selection of the cells by the mobile station is in accordance with 3GPP2.

23. A system in accordance with claim 16 wherein:
data packet acknowledgments are continuously sent from the first cell to the mobile station during the cell switch delay.

24. A system in accordance with claim 19 wherein:
the data packet acknowledgments are transmitted on a forward link common channel.

25. A system in accordance with claim 19 wherein:
the data packet acknowledgments are transmitted on a forward link dedicated channel.

26. A system in accordance with claims 19 wherein:
the data packet acknowledgments are transmitted on a forward link sub channel time multiplexed with at least one other forward link channel.

IPR2023-01270 Page 232

27. A system in accordance with claims 16-26 wherein:
control information is transmitted with the data packet acknowledgments.

28. A system in accordance with claim 27 wherein:
the control information comprises congestion control or power control information.

29. A process in accordance with claim 1 wherein:
if the second cell is not ready to receive the data packets after expiration of the cell switch delay, transmission of data packets from the mobile station to the first cell is terminated.

30. A process in accordance with claim 29 wherein:
additional delay time is added to the cell switch delay after the expiration of the cell switch delay to complete the handoff to the second cell.

31. A system in accordance with claim 16 wherein:
if the second cell is not ready to receive the data packets after expiration of the cell switch delay, transmission of data packets from the mobile station to the first cell is terminated.

32. A system in accordance with claim 31 wherein:
additional delay time is added to the cell switch delay after the expiration of the cell switch delay to complete the handoff to the second cell.

IPR2023-01270 Page 233

FIG. 1

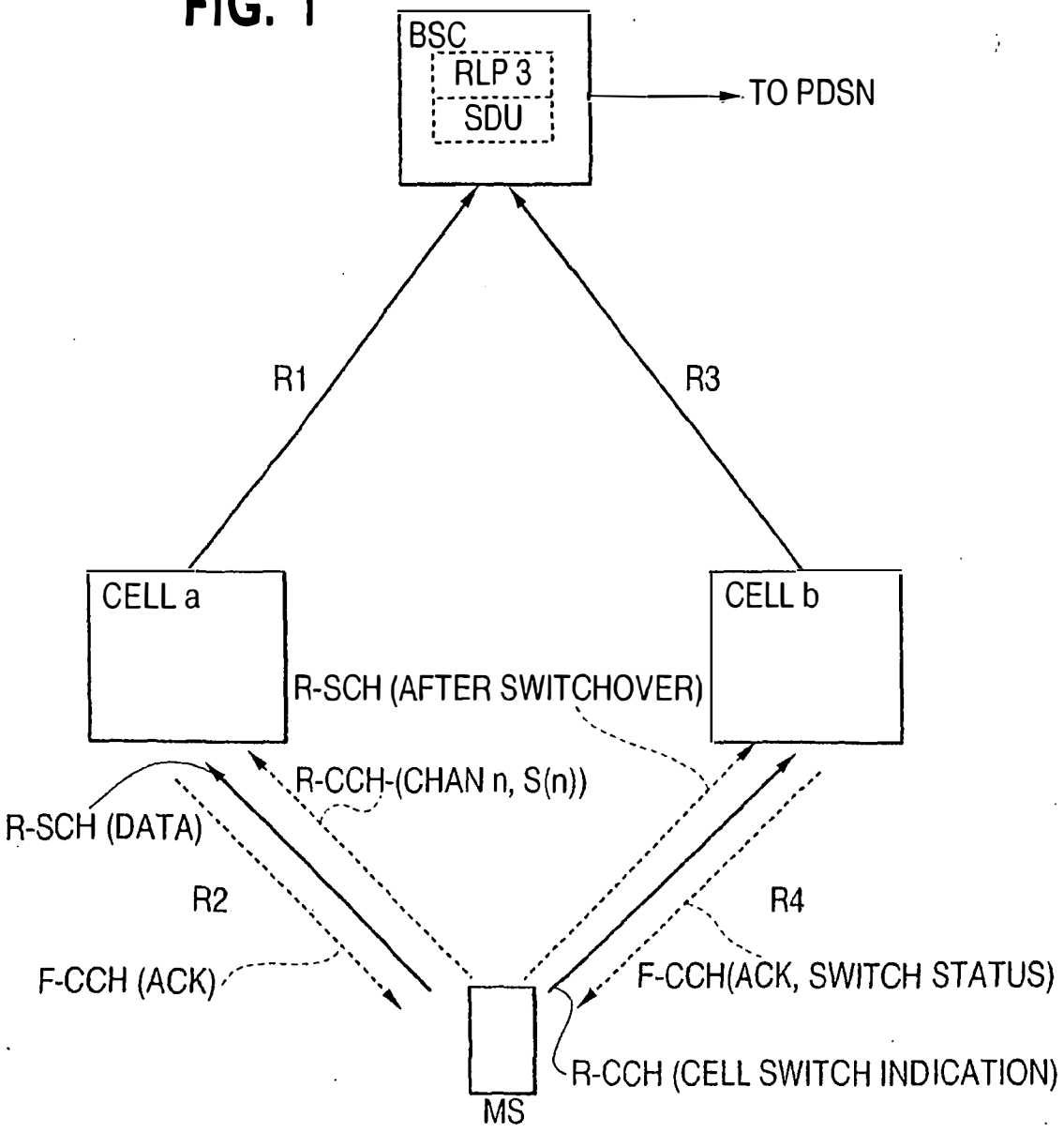

BSC
RLP 3
SDU
TO PDSN
R1
R3
CELL a
CELL b
R-SCH (AFTER SWITCHOVER)
R-CCH-(CHAN n, S(n))
R-SCH (DATA)
R2
R4
F-CCH (ACK)
F-CCH(ACK, SWITCH STATUS)
R-CCH (CELL SWITCH INDICATION)
MS

FIG. 2

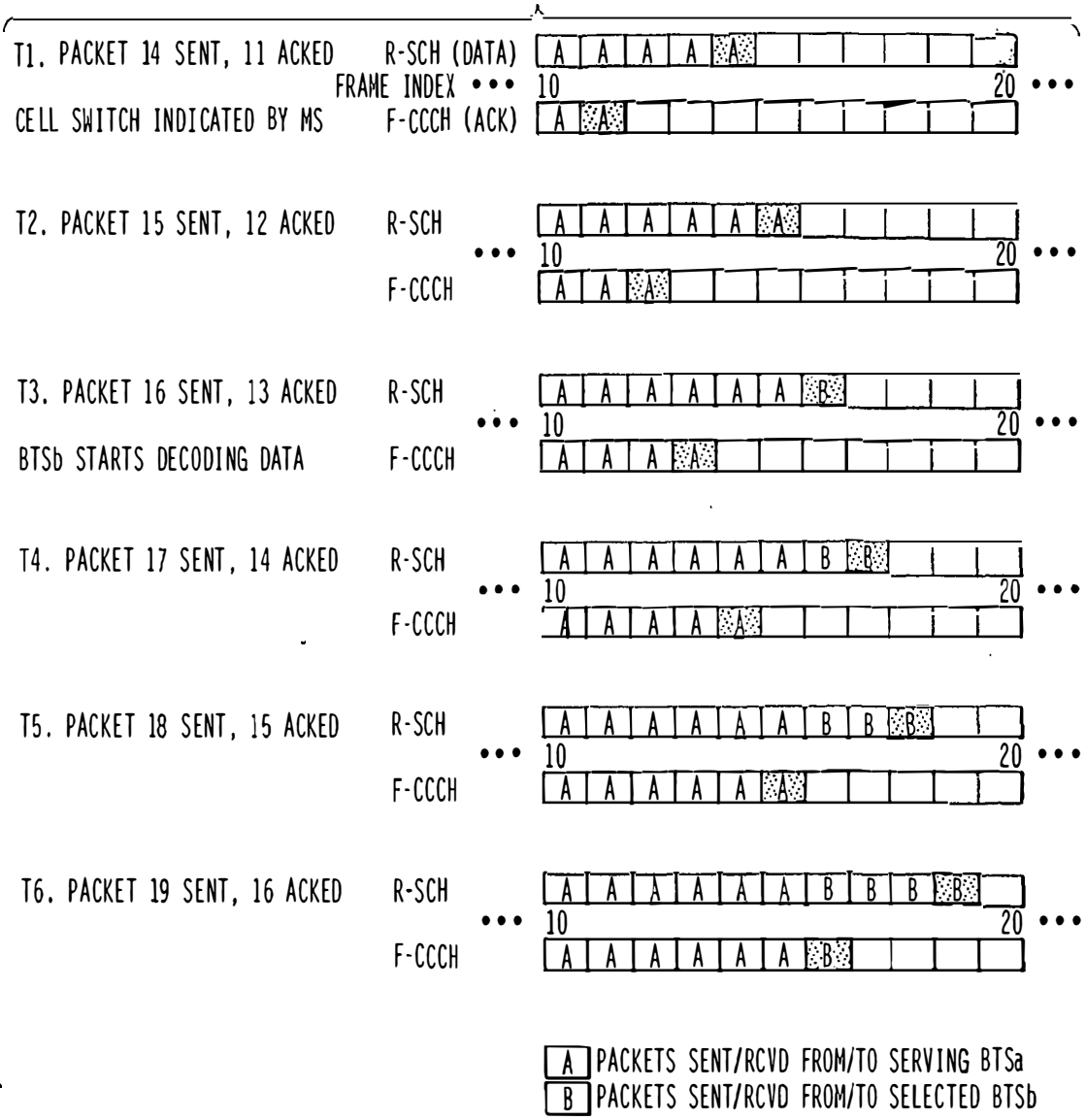


FIG.3

	SOFT-HANDOFF	
P1	R1, R2, R3, R4	R1, R2
P2	R1, R2, R3, R4	R2*, R3, R4
P3	R1, R2, R3, R4	R3, R4

FIG. 4

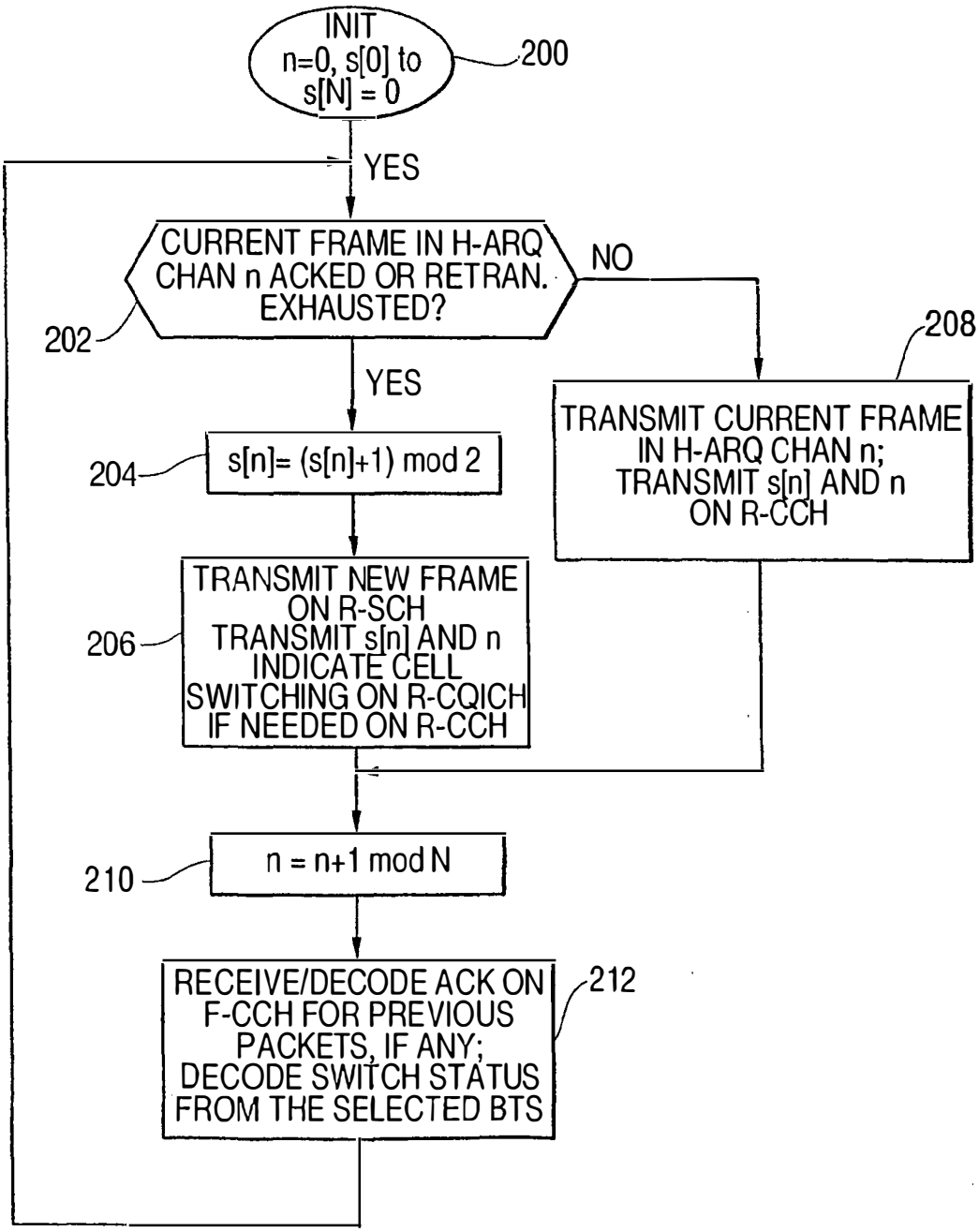
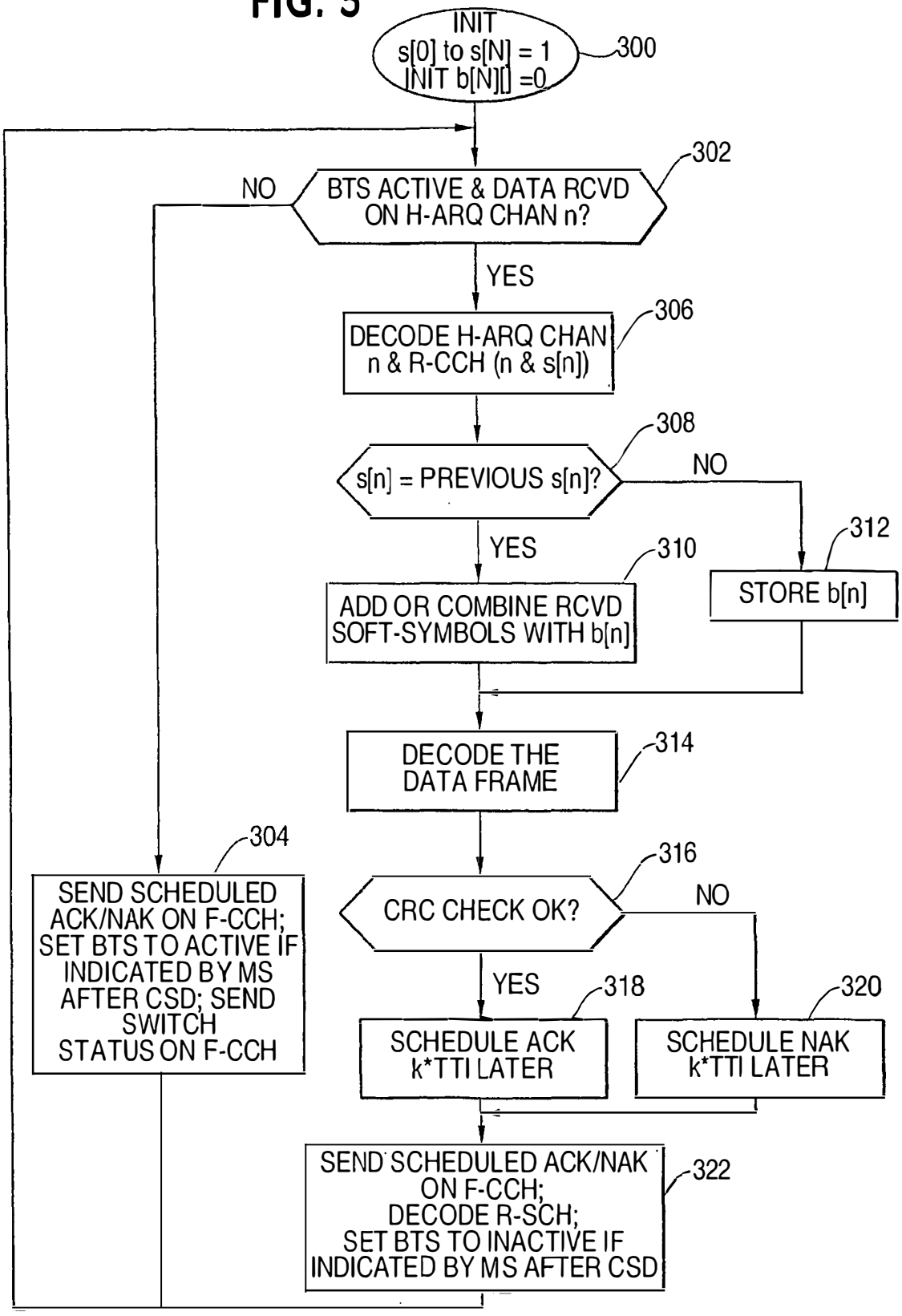

INIT
n=0, s[0] to
s[N] = 0
200
YES
CURRENT FRAME IN H-ARQ
CHAN n ACKED OR RETRAN.
EXHAUSTED?
NO
202
208
YES
TRANSMIT CURRENT FRAME
IN H-ARQ CHAN n;
TRANSMIT s[n] AND n
ON R-CCH
204
s[n]= (s[n]+1) mod 2
TRANSMIT NEW FRAME
ON R-SCH
TRANSMIT s[n] AND n
INDICATE CELL
SWITCHING ON R-CQICH
IF NEEDED ON R-CCH
206
210
n = n+1 mod N
RECEIVE/DECODE ACK ON
F-CCH FOR PREVIOUS
PACKETS, IF ANY;
DECODE SWITCH STATUS
FROM THE SELECTED BTS
212

FIG. 5


INIT
s[0] to s[N] = 1
INIT b[N][] =0
300
302
NO
BTS ACTIVE & DATA RCVD ON H-ARQ CHAN n?
YES
306
DECODE H-ARQ CHAN n & R-CCH (n & s[n])
308
s[n] = PREVIOUS s[n]?
NO
312
YES
310
ADD OR COMBINE RCVD SOFT-SYMBOLS WITH b[n]
STORE b[n]
DECODE THE DATA FRAME
314
304
316
SEND SCHEDULED ACK/NAK ON F-CCH; SET BTS TO ACTIVE IF INDICATED BY MS AFTER CSD; SEND SWITCH STATUS ON F-CCH
CRC CHECK OK?
NO
YES
318
320
SCHEDULE ACK k*TTI LATER
SCHEDULE NAK k*TTI LATER
SEND SCHEDULED ACK/NAK ON F-CCH; DECODE R-SCH; SET BTS TO INACTIVE IF INDICATED BY MS AFTER CSD
322

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB02/01033

A. CLASSIFICATION OF SUBJECT MATTER

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)

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
	ISR MISSING	

☐ 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 document 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
Name and mailing address of the ISA/	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
19 December 2002 (19.12.2002)

PCT

(10) International Publication Number
WO 02/101966 A2

(51) International Patent Classification[7]: H04L

(21) International Application Number: PCT/IB02/01357

(22) International Filing Date: 24 April 2002 (24.04.2002)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/286,037 25 April 2001 (25.04.2001) US

(71) Applicant *(for all designated States except US)*: **NOKIA CORPORATION** [FI/FI]; Keilalahdentie 4, FIN-02150 Espoo (FI).

(71) Applicant *(for LC only)*: **NOKIA INC.** [US/US]; 6000 Connection Drive, Irving, TX 75039 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **CHENG, Mark, W.** [US/US]; 4170 Via Mar de Delfinas, San Diego, CA 92130 (US). **HSU, Liangchi, Alan** [US/US]; 12368 Carmel Country Road #302, San Diego, CA 92130 (US).

(74) Agents: **STOUT, Donald, E.** et al.; Antonelli, Terry, Stout & Kraus, LLP, Suite 1800, 1300 North Seventeenth Street, Arlington, VA 22209 (US).

(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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 AND SYSTEM FOR FORWARD LINK CELL SWITCHING APPROACH WITHOUT ABIS TRAFFIC FLOODING IN CDMA2000-1x EV-DV SYSTEM

(57) Abstract: The invention is a system and a method in a system including a mobile station (MS), a group of active cells including a first serving cell (cell a) and a second target cell (cell b) and a controller of the active cells which switches forward link transmissions of data packets from the controller (BSC) through the first serving cell to the mobile station to forward link transmission of data packets from the controller through a second cell to the mobile station. The method determines at the mobile station that swtiching of forward link transmissions should occur from the first serving cell to the second target cell while forward link transmission of the data packets through the first serving cell to the mobile station are occurring; transmitting an indication to switch the forward link transmission of data packets to the second target cell b from the mobile station to the controller; the controller in response to the indication switches the transmission of data packets from the first serving cell a to the second target cell b; and the second target cell transmits the data packets to the mobile station. A cell switch delay, which may be zero or an integer multiple of a time frame interval required to transmit a data packet on the forward link, provides time to ready the second target cell b to begin transmission of the data packets to the mobile station. The cell switch delay may be determined or configured by the network dependent upon the source and target pilots in the active set are within the same BTS or are in different cells.

WO 02/101966 A2

METHOD AND SYSTEM FOR FORWARD LINK CELL SWITCHING APPROACH WITHOUT ABIS TRAFFIC FLOODING IN CDMA2000-1x EV-DV SYSTEM

TECHNICAL FIELD

This invention relates to wireless high-speed packet data technology, e.g. in CDMA2000 1xEV-DV and 3GPP HSDPA and more specifically, to improving the cell switching techniques for forward radio channels.

BACKGROUND ART

Physical Layer ARQ (HARQ) and cell switching are two link-adaptation techniques that are employed by the 1xEV-DV forward link standard. Cells are comprised of base transceiver stations (BTS) in wireless environments which have lower traffic and sectors, which subtend an angular portion of a full periphery, such as 120°, in wireless environments having higher traffic.

The hybrid automatic repeat request (HARQ) protocol uses an adaptive automatic repeat request (ARQ) technique for retransmission combining.

Cell switching is a handoff technique that allows the mobile terminal (MS) to identify an optimal serving cell pilot channel based on C/I measurement with C/I being a strength ratio of the carrier signal to the interference.

In the 1XTREME/1xEV-DV proposal, fast cell site selection (FCSS) is proposed to ensure mobility. When a mobile moves from one cell to another cell, a central entity Network Convergence Function (NCF) is used to coordinate multiple cells in the active set. During soft handoff, a NCF provides the same data units (PDUs) to all of the cells in the active set (flooding). However, only one cell delivers the PDUs to the MS. When the MS moves from one cell to another in the active set, the MS echoes the most recently received NCF sequence number so that the new cell can resume the data transfer without delay.

CONFIRMATION COPY

IPR2023-01270 Page 240

Fig. 1 shows an example of a prior art cell switching operation. Cell a and cell b both are in the MS's active set. Prior to switching cell a sends the data frames to the MS by the Forward Shared Channel (F-SHCH). Upon a measurement threshold, the MS may decide to request new cell switching by sending a request on R-CCH to request cell switching to cell b. The serving cell a serves the MS, before the cell switching, with the forward and reverse link channels. The target cell b is the cell chosen for the transmission after the cell switching is completed. An active set for the Forward Packet Data Channel is updated to cell a based on the pilot strength feedback from the MS. All cells in the active set (only two have been illustrated for convenience purposes) are eligible for forward link cell switching.

In Fig. 1, the Abis interface (the Abis interface is between the base station controller (BSC) and the cells) flooding occurs during, for example, the soft handoff of 1XTREME/1xEV-DV FCSS procedure. This problem significantly affects the BSC and cell performance. During soft handoff, both Abis links between the BSC and cell a and cell b are active as indicated by the bidirectional arrows therebetween. Flooding involves substantial transmission overhead, memory requirement inside the cells and a centralized management entity which manages the large sequence frame numbering.

After the MS has signalled the BSC with an indication on R-CCH as indicated in Fig. 1 that the MS wants to switch receiving forward link transmissions from cell a to cell be, the BSC transmits the data packets simultaneously to both the serving and target cells until handoff is complete. The simultaneous use of the Abis resources by the BSC for the serving and target cells and the radio resources from the serving and target cells is wasteful especially when data rates are high such as for 1xEV-DV (around 4 Mbps).

DISCLOSURE OF INVENTION

This invention is to a cell switching technique which avoids the prior art flooding of the forward link soft-handoff of Fig. 1. The avoidance of soft handoff provides the benefits of reducing the Abis interface overhead and quick

IPR2023-01270 Page 241

resumption of data transfer and saves the radio resource from being loaded with unnecessary information. The cell-switching technique of the present invention permits base stations including 1xEV-DV cells to provide data users with better network resource utilization and quick resumption of data transfer after switching.

In a system including a mobile station, cells in an active set including first serving and second target cells and a controller of the active cells, a method of switching forward link transmissions of data packets from the controller through the first serving cell to the mobile station to forward link transmission of data packets from the controller through the second target cell to the mobile station in accordance with the invention includes determining at the mobile station that switching of the forward link transmission should occur from the first serving cell to the second target cell while the forward link transmission of the data packets through the first serving cell to the mobile station is occurring; transmitting an indication to switch the forward link transmission of the data packets from the mobile station to the controller; the controller, in response to the indication, switches the transmission of data packets from the first serving cell to the second target cell; and the second target cell transmits the data packets to the mobile station. The first cell may continue transmission of data packets on the forward link to the mobile station for a cell switch delay time period measured from the indication to switch until the completion of the switching. The mobile station may transmit a quality indicator to only the first serving cell during the cell switch delay which is used by the first serving cell to control at least one of a power level of transmission or selection of modulation and a coding type used by the forward link during the cell switch delay in transmitting data packets to the mobile station. The mobile station may transmit acknowledgment information to the first serving cell during the cell switch delay; and the first serving cell may retransmit on the forward link during the cell switch delay packets which were negatively acknowledged. The acknowledgment information may be either an acknowledgment or a negative acknowledgment that data packets of the forward link has been received by the mobile station. The second cell may transmit the

IPR2023-01270 Page 242

data packets to the mobile station after expiration of a cell switch delay period measured from the indication to switch until the completion of the cell switching. The data packets may be transmitted from the cells to the mobile station on a forward shared channel (F-SHCH); and the indication to switch may be transmitted from the mobile station to the group of active cells on the reverse control channel (R-CCH) and a quality indicator may be sent on the reverse control channel to the first serving cell. F-SHCH may be mapped to a forward packet data channel (F-PDCH); and R-CCH may be mapped to a reverse acknowledgment channel (R-ACKCH) and a reverse channel quality indicator channel (R-CQICH). The cell switch delay may be one of zero or an integer multiple of a time frame interval required to transmit a data packet on the forward link. The cell switch delay may be determined or configured by the network dependent upon the servicing and target cells in the active set being in a same base transceiver station or in different base transceiver stations. The indication to switch may be a Walsh code cover of the second target cell base transceiver stations. The second target cell starts transmission of data packets to the mobile station at a time including an additional time delay measured from an end of the cell switch delay period depending on signaling delay or time latency in the system.

A system in accordance with the invention includes a mobile station, cells in an active set including first serving and second target cells, and a controller of the active cells, and wherein switching of forward link transmission of data packets from the controller through the first serving cell to the mobile station to forward link transmission of data packets from the controller through the second target cell to the mobile station occurs by determining at the mobile station that switching of forward link transmission should occur from the first serving cell to the second target cell while forward link transmission of the data packets through the first serving cell to the mobile station is occurring, transmitting an indication to switch the forward link transmission of the data packets from the mobile station to the controller, the controller in response to the indication switches the transmission of data packets from the first serving cell to the second target cell

IPR2023-01270 Page 243

and the second target cell transmits the data packets to the mobile station. The first serving cell may continue transmission of data packets on the forward link to the mobile station for a cell switch delay time period measured from the indication to switch until the completion of the switching. The mobile station may transmit a quality indicator to only the first serving cell during the cell switch delay which is used by the first serving cell to control at least one of a power level of transmission or selection of modulation and coding type used by the forward link to the mobile station during the cell switch delay. The mobile station may transmit acknowledgment information to the first serving cell during the cell switch delay; and the first serving cell may retransmit on the forward link during the cell switch delay packets which were negatively acknowledged. The acknowledgment information may be either an acknowledgement or a negative acknowledgment that data packets of the forward link have been received by the mobile station. The second target cell may transmit the data packets to the mobile station after expiration of a cell switch delay period measured from the indication to switch until the completion of the switch. The data packets may be transmitted from the cells to the mobile station on a forward shared channel (F-SHCH); and the indication to switch may be transmitted from the mobile station to the second target cell on the reverse control channel (R-CCH) and a quality indicator may be sent on the reverse control channel to the first serving cell. The cell switch delay may be one of zero or an integer multiple of a time frame interval required to transmit a data packet on the forward link. The cell switch delay may be determined or configured by the network dependent upon the serving and target cells in the active set being in a same base transceiver station or in different base transceiver stations. The indication to switch may be a Walsh code cover of the second target cell. The second target cell switches transmission of data packets to the mobile station at an end of a time including an additional time delay measured from an end of the cell switch delay period depending on a signaling delay or a time latency in the system.

IPR2023-01270 Page 244

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagram of a prior art forward link cell switching operation which floods the Abis interface;

Fig. 2 is a diagram of forward link data transmission and reverse link feedback during the cell switching according to an embodiment of the present invention;

Fig. 3 is a diagram of communications between a base station controller, a first serving and a second target cell and a mobile station in accordance with the invention.

Fig. 4 is a flowchart of a cell processing according to an embodiment of the present invention; and

Fig. 5 is a flowchart of a MS processing according to an embodiment of the present invention.

Like parts are identified by like identifications throughout the drawings.

BEST MODE FOR CARRYING OUT THE INVENTION

Forward Link Cell Switching

To reduce the Abis interface overhead during cell switching the invention:

1. Limits the data transfer from the BSC to only one cell at a time.
2. Moves buffered data from the serving (first) cell to the target (second) cell for fast data recovery during the switching period.
3. Optionally uses a new sequence numbering format with a bit field of fewer bits than the prior art or an existing radio link protocol (RLP) sequence number optionally may be utilized.

The present invention is useful for 1xEV-DV cell and MS implementation and is also related to 1xEV-DV standardization.

MS switching of data reception from cell to cell in accordance with the invention is described as follows. Each MS is assigned an active set of cells dynamically by the network. Data packets are sent on the forward shared channel (F-SHCH) and acknowledgements are sent on the reverse control

channel (R-CCH). The indication to switch cells is sent on the R-CCH. For 1XTREME, R-CCH is mapped to the "Reverse Acknowledgement Indication Channel" (R-AISCH) and "Transmit Sector Indicator Channel" (R-TSICH). For 1xEV-DV, F-SHCH is mapped to the "Forward Packet Data Channel" (F-PDCH); R-CCH is mapped to "Reverse Acknowledgement Channel" (R-ACKCH); and "Reverse Channel Quality Indicator Channel" (R-CQICH).

The table below defines the timing relationships between T1 and T2 shown in Fig. 2 and described with reference to Fig. 3.

T1	The MS indicates cell switching to target cell b to invoke a cell switching procedure.
T2	T1+CSD where CSD is the cell switching delay required to ready target cell b for the packet data transmission when the R-CQICH transmissions are directed to target cell b after T2.

Figs. 2 and 3 illustrates the transmission of data packets and acknowledgements during cell switching in accordance with the invention. There are three phases during the transition period:

1. Phase 1 - Time duration before T1.
2. Phase 2 - Time duration between T1 and T2.
3. Phase 3 - Time duration after T2.

The table below describes three significant types of transmissions which head three columns entitled "BSC Sends Data to", "MS Receives Data from & Sends CQI" and "CELL that Decodes ACK/NAK" during the phases 1, 2 and 3 as defined above which row identifications therein.

IPR2023-01270 Page 246

	BSC Sends Data to	MS Receives Data from & Sends CQI to	CELL that Decodes ACK/NAK Responses
Phase 1	CELL a	CELL a	CELL a
Phase 2	CELL b	CELL a	CELL a
Phase 3	CELL b	CELL b	CELL b

Data transmission up to the end of phase 1 at time T1 when transmission of data packets occurs only to the first serving cell a. At the beginning of phase 2, the invention switches data packet transmission to second target cell b thus eliminating the flooding of the prior art in Fig. 1 when both Abis resources between the BSC and the first serving and second target cell are active. During the remainder of phase 2 and through phase 3, the data transmission continues from the BSC to target cell b. The MS receives data from and sends CQI to cell a all the way up to the end of phase 2 which is also the end of the CSD described below at which transmission is switched to target cell b. The transmission of CQI up to the end of phase 2 enables cell a to adjust power level on the forward link to continue to change signal strength in response to changing conditions or to select modulation and a coding type used on the forward link. Decoding of ACK/NAK transmissions occurs at serving cell a until the end of phase 2 at which time decoding of ACK/NAK transmissions switches to target cell b. The MS also receives any pending retransmitted frames from serving cell a up to the end of the CSD as described below. The unified sequence number or RLP Sequence Number may be used by target cell b to continue the new frame transmission after switching occurs. The frames sent during phase 1 cannot be retransmitted after entry into phase 3. In that case, the upper layer (e.g. RLP in the BSC) handles the retransmission of the erroneous frames.

The data packets are transmitted by the target (second) cell to the MS after the CSD. The CSD is required for the target cell to allocate network and radio resources and for the serving (first) cell to complete any pending data

IPR2023-01270 Page 247

packet retransmissions and their acknowledgements. The CSD equals M*Xms where M is zero or a positive integer and X is a time duration of transmission of a data frame. The CSD time duration is between when the MS generates an indication for cell switching from target cell a to serving cell b is to occur and the time when the forward link packet data transmission is ready or occurs from the target cell (for example, cell b). If the target cell is not ready after the expiration of the CSD due to signaling delay or time latency, additional handoff delay time may be needed in addition to the CSD to complete the handoff to the target cell. However, in this circumstance, the data transmission between the serving cell and the MS indicated at time T2 at the end of phase 2 in Fig. 2 is dropped after expiration of the CSD regardless of whether the handoff is complete. The value of CSD can be determined or configured by the network depending upon the serving and target cells in the active set being in a same base transceiver station or in different base transceiver stations. The additional handoff delay is determined by the traffic load of the target cell and the transport capacity of the cells. The second target cell switched transmission of data packets to the mS at a time including an additional time delay measured from an end of the CSD period depending on a signaling delay or a time latency in the system. The indication to switch may be a Walsh code cover of the second target cell.

Fig. 3 illustrates the sequence of transmissions between the BSC, serving cell a and target cell b and the MS. The forward link and reverse link transmissions occur between the BSC and the MS through serving cell a throughout phase 1. The reverse link transmission between the serving cell a and the BSC are only generally discussed to the extent necessary to understand the invention. The switch indication is transmitted from the MS to the active group of cells indicating that target cell b has been determined by the MS to be the target cell. The switch indication is represented by a Walsh cover of the target cell b. A Walsh cover is an identification of the cell b in the wireless system. Phase 1 ends when the indication to switch to target cell b is received by the BSC. At the beginning of phase 2, as indicated in the column of Fig. 2 entitled, "BSC Sends Data to", the transmission of forward link data to serving

IPR2023-01270 Page 248

cell a switches to target cell b without the flooding of the Abis interface of the prior art. Data packet transmission on the forward link from serving cell a to the MS and CQI on the reverse link between the MS and the serving cell a occurs until the CSD time out at which time all transmissions between serving cell a and the MS stop. Transmission of the data from target cell b to the MS should begin at the end of the CSD which is normally the time for target cell b to be set up as the new serving cell and to acquire the necessary radio resources. If the CSD is not sufficient to complete the switch over to target cell b, nevertheless the MS ceases to receive data packets from serving cell a and the aforementioned additional time delay may be necessary to complete switching.

A New Sequence Numbering format

In 1XTREME MAC layer, a sequence number is defined for the MuxPDU (Multiplex Sublayer Protocol Data Unit). This sequence number is used to synchronize buffer management and package retransmission during a fast cell site selection (FCSS). In the prior art 12 bits are defined for the sequence number. The length of the sequence number is coincidently the same as the Radio Link Protocol (RLP) ARQ sequence length. The use of 12 bits may be an over specification for the purpose of HARQ. If RLP is used for the data transmission, the RLP sequence number can also be used for this purpose.

Since the main purpose of sequence numbering is to synchronize the serving cell and the target during switching, the switching period should be fast and completed within a few frames duration (e.g. 2 frames or Xms). For a worst case (e.g. 4 HARQ channels and 4 transmissions), 6 bits of sequence number length is sufficient with the switching sequence of the invention. This length reduction reduces traffic overhead over the air. Hence, the sequence number length may be reduced from 12 bits to 6 bits in the 1XEV-DV specifications if the RLP sequence number is not used.

The following procedures are used by the cells and MS according to the present invention.

IPR2023-01270 Page 249

Forward Link Cell Switching and Cell Procedures

The cell defines and initializes the following data structures. The cell is considered active for a MS when the cell has the MAC Identifier (MAC_ID) assigned for the MS and is decoding the signal quality CQI feedback received from the MS. For example, target cell b in Figs. 2 and 3 is active in phase 3 and serving cell a is in transition in phase 2 and active in phase 1.

With reference to Fig. 4, the serving cell a performs the operations therein every Transmission Time Interval (TTI) ms as long as there are packets to transmit. The cell operation starts at initialization point 20 wherein N = number of H-ARQ channels, mob_seq_un = unified sequence number (initialized by BSC) , n = current H-ARQ channel being processed (initialized to 0) and int s[N] = one-bit H-ARQ channel sequence number (initialized to '0'). The cell operation proceeds to point 22 where a determination is made if the cell is active for the MS. If the answer is "no" at point 22, operation proceeds to point 24, where decoding the CQI and ACK/NAK sent on R-CCH by the MS occurs and operation proceeds back to point 22. If the cell is active at point 22, operation proceeds to point 26 wherein a determination is made if an ACK/NAK='1' was received from the previous transmission to the H-ARQ channel n, or if the maximum number of retransmissions has been exhausted. If the determination is "yes" at point 26, operation proceeds to point 28 where incrementing of the H-ARQ channel sequence number s(n) mod 2 and advance mob_seq_un occurs. If the determination is "no" at point 26, operation proceeds to point 30 where retransmission of the buffered frame associated with the current H-ARQ channel on the F-SHCH occurs. Operation proceeds from point 28 to point 32 wherein transmission of the encoded and modulated frame with the sequence number mob_seq_un occurs on F-SHCH. Operation proceeds from point 32 to point 34, from either of points 30 or 32 depending upon the previous determinations made at point 26, where transmission of the current H-ARQ sequence number s(n) on F-CCH occurs; decoding the ACK/NAK sent on the Reverse Control Channel from the MS occurs and incrementing of the H-ARQ channel n=n+1 mod N occurs.

Forward Link CSS MS Station Procedures

The MS runs the operations of Fig. 5 every TTI ms. The following data structures are defined at initialization point 50: n = current H-ARQ channel, int s[N] = one-bit H-ARQ channel sequence number (initialized to '1'); float b[N][Interleaver Size] = H-ARQ channel soft-symbol buffer (initialized to '0'I and d = delay measured in units of TTI ms, between transmission of a H-ARQ channel on the Forward Link and the associated acknowledgement on the Reverse Link. The operation proceeds from initialization at point 50 to point 52 where decoding of the H-ARQ channel n and the associated sequence numbers [n] received on the Forward Control Channel (F-CCH) from the active cell occurs. The operation proceeds from point 52 to point 54 where determination is made if the H-ARQ channel sequence number s(n) is the same as the previous transmission. If the answer is "yes" at point 54, operation proceeds to point 56 where the received soft-symbols are added with the soft-symbols stored in b(n). If the answer is "no" at point 54, operation proceeds to point 58 where the new soft-symbols are stored into b(n). Operation proceeds form point 56 to point 60 where decoding the frame occurs. Operation proceeds to point 62 where a determination is made if the cyclic redundancy code is OK. If the answer is "yes" at point 62, operation proceeds to point 64 where the decoded frame is passed up to the selection and distributed unit in the BSC and scheduling of an ACK/NAK = "1" occurs on the Reverse Control Channel (R-CCH)k*TTI ms frames later where k is a positive integer. If the answer is "no" at point 62, operation proceeds to point 66 where the decoded frame and scheduling an ACK/NAK='0' on the R-CCH k*TTI ms frames later occurs. Operation proceeds from points 64 and 66 to point 68 where any scheduled ACK/NAK is sent on the R-CCH; if the MS desires a cell switch, indication of the cell switching on the R-CCH for the target cell b occurs; if the MS indicates cell switching, the cells in the active set monitor of the R-CQICH transmissions for

the target cell Walsh cover; and setting the target cell b to active after CSD, which is Xms, occurs. Operation then returns to point 52.

While the invention has been described in terms of its preferred embodiments, it should be understood that numerous modifications may be made thereto. It is intended that all such modifications fall within the scope of the appended claims.

IPR2023-01270 Page 252

CLAIMS

What is claimed is:

1. In a system including a mobile station, cells in an active set including first serving and second target cells and a controller of the active cells, a method of switching forward link transmissions of data packets from the controller through the first serving cell to the mobile station to forward link transmission of data packets from the controller through the second target cell to the mobile station comprising:

determining at the mobile station that switching of the forward link transmission should occur from the first serving cell to the second target cell while the forward link transmission of the data packets through the first serving cell to the mobile station is occurring;

transmitting an indication to switch the forward link transmission of the data packets from the mobile station to the controller;

the controller, in response to the indication, switches the transmission of data packets from the first serving cell to the second target cell; and

the second target cell transmits the data packets to the mobile station.

2. A method in accordance with claim 1 wherein:

the first cell continues transmission of data packets on the forward link to the mobile station for a cell switch delay time period measured from the indication to switch until the completion of the switching.

3. A method in accordance with claim 2 wherein:

the mobile station transmits a quality indicator to only the first serving cell during the cell switch delay which is used by the first serving cell to control at least one of a power level of transmission or selection of modulation and coding type used by the forward link during the cell switch delay in transmitting data packets to the mobile station.

4. A method in accordance with claims 1-3 wherein:

the mobile station transmits acknowledgment information to the first serving cell during the cell switch delay; and

the first serving cell retransmits on the forward link during the cell switch delay packets which were negatively acknowledged.

5. A method in accordance with claim 4 wherein:

the acknowledgment information is either an acknowledgment or a negative acknowledgment that data packets of the forward link have been received by the mobile station.

6. A method in accordance with claims 1, 4 and 5 wherein:

the second cell transmits the data packets to the mobile station after expiration of a cell switch delay period measured from the indication to switch until the completion of the switching.

7. A method in accordance with claims 2-3 wherein:

the second target cell transmits the data packets to the mobile station after the expiration of the cell switch delay.

8. A method in accordance with claims 1, 2, 4-7 wherein:

the data packets are transmitted from the cells to the mobile station on a forward shared channel (F-SHCH); and

the indication to switch is transmitted from the mobile station to the group of active cells on the reverse control channel (R-CCH) and a quality indicator is sent on the reverse control channel to the first serving cell.

9. A method in accordance with claim 3 wherein:

the data packets are transmitted from the cells to the mobile station on a forward shared channel (F-SHCH);

the indication to switch is transmitted from the mobile station to the group of active cells on the reverse control channel (R-CCH) and the quality indicator is sent on the reverse control channel to the first serving cell.

10. A method in accordance with claim 8 wherein:

F-SHCH is mapped to a forward packet data channel (F-PDCH); and

R-CCH is mapped to a reverse acknowledgment channel (R-ACKCH) and a reverse channel quality indicator channel (R-CQICH).

11. A method in accordance with claim 2 wherein:

the cell switch delay is one of zero or an integer multiple of a time frame interval required to transmit a data packet on the forward link.

12. A method in accordance with claim 2 wherein:

the cell switch delay is determined or configured by the network dependent upon the serving and target cells in the active set being in a same base transceiver station or in different base transceiver stations.

13. A method in accordance with claim 1 wherein:

the indication to switch is a Walsh code cover of the second target cell.

14. A method in accordance with claims 6 and 7 wherein:

the second target cell starts transmission of data packets to the mobile station at a time including an additional time delay measured from an end of the cell switch delay period depending on a signaling delay or a time latency in the system.

15. A system comprising:

a mobile station, cells in an active set including first serving

IPR2023-01270 Page 255

and second target cells, and a controller of the active cells, and wherein

switching of forward link transmission of data packets from the controller through the first serving cell to the mobile station to forward link transmission of data packets from the controller through the second target cell to the mobile station occurs by determining at the mobile station that switching of forward link transmission should occur from the first serving cell to the second target cell while forward link transmission of the data packets through the first serving cell to the mobile station is occurring, transmitting an indication to switch the forward link transmission of the data packets from the mobile station to the controller, the controller in response to the indication switches the transmission of data packets from the first serving cell to the second target cell and the second target cell transmits the data packets to the mobile station.

16. A system in accordance with claim 15 wherein:

the first serving cell continues transmission of data packets on the forward link to the mobile station for a cell switch delay time period measured from the indication to switch until the completion of the switching.

17. A system in accordance with claim 16 wherein:

the mobile station transmits a quality indicator to only the first serving cell during the cell switch delay which is used by the first serving cell to control at least one of a power level of transmission or selection of modulation and coding type used by the forward link to the mobile station during the cell switch delay.

18. A method in accordance with claims 15-17 wherein:

the mobile terminal transmits acknowledgment information to the first serving cell during a cell switch delay; and

the first serving cell retransmits on the forward link during the cell switch delay packets which were negatively acknowledged.

IPR2023-01270 Page 256

19. A method in accordance with claim 16 wherein:

the acknowledgment information is either an acknowledgement or a negative acknowledgment that data packets of the forward link have been received by the mobile station.

20. A system in accordance with claims 15-19 wherein:

the second target cell transmits the data packets to the mobile station after expiration of a cell switch delay period measured from the indication to switch until the completion of the switching.

21. A system in accordance with claims 15-20 wherein:

the data packets are transmitted from the cells to the mobile station on a forward shared channel (F-SHCH); and

the indication to switch is transmitted from the mobile station to the group of active cells on the reverse control channel (R-CCH) and a quality indicator is sent on the reverse control channel to the first serving cell.

22. A system in accordance with claim 21 wherein:

F-SHCH is mapped to a forward packet data channel (F-PDCH); and

R-CCH is mapped to a reverse acknowledgment channel (R-ACKCH) and a reverse channel quality indicator channel (R-CQICH).

23. A system in accordance with claim 15 wherein:

the cell switch delay is one of zero or an integer multiple of a time frame interval required to transmit a data packet on the forward link.

IPR2023-01270 Page 257

24. A system in accordance with claim 15 wherein:

the cell switch delay is determined or configured by the network dependent upon the serving and target cells in the active set being in a same base transceiver station or in a different base transceiver station.

25. A system in accordance with claim 15 wherein:

the indication to switch is a Walsh code cover of the second target cell.

26. A system in accordance with claim 20 wherein:

the second target cell switches transmission of data packets to the mobile station at a time including an additional time delay measured from an end of the cell switch delay period depending on a signaling delay or a time latency in the system.

FIG. 1

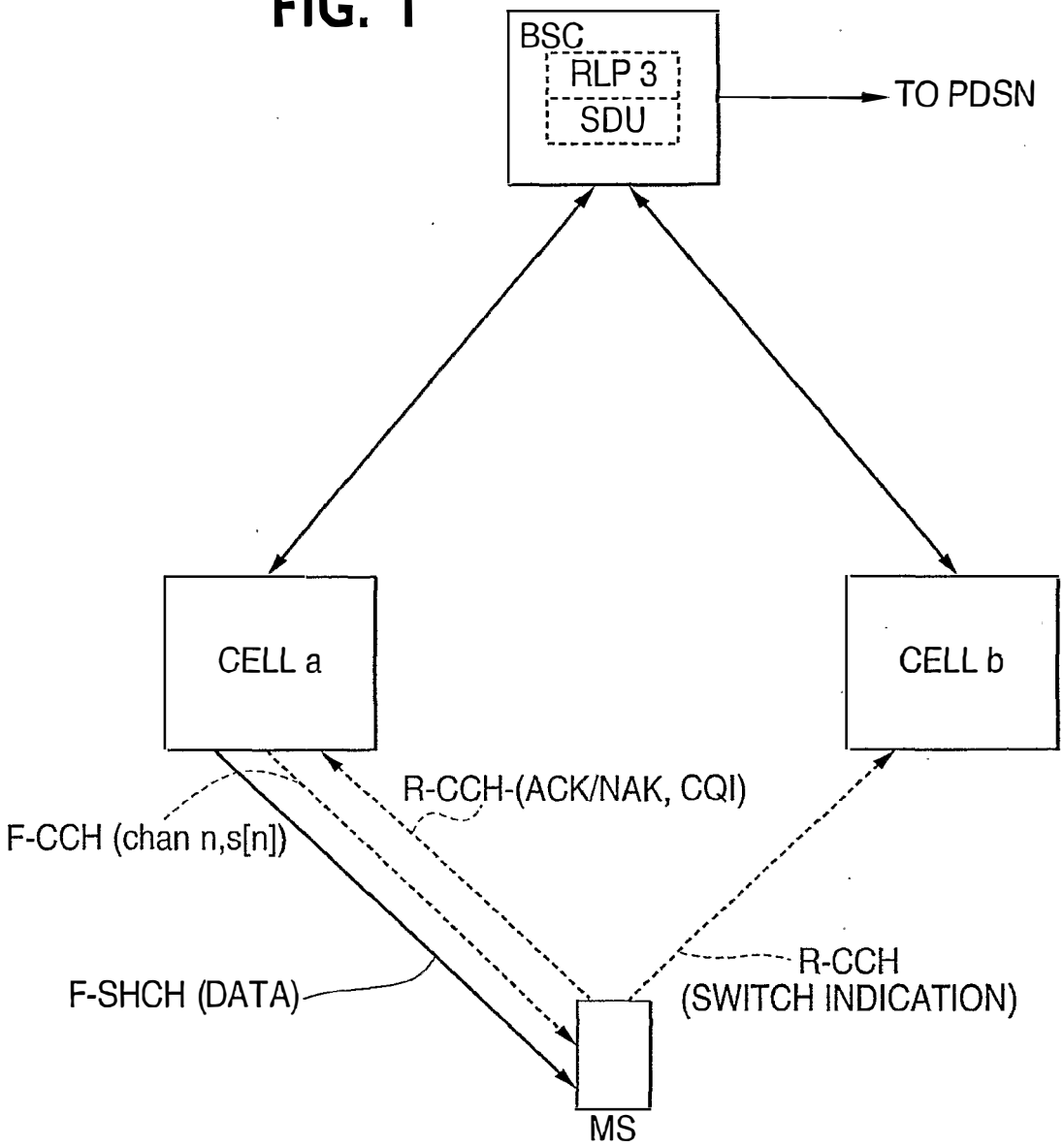

BSC
RLP 3
SDU
TO PDSN
CELL a
CELL b
R-CCH-(ACK/NAK, CQI)
F-CCH (chan n,s[n])
F-SHCH (DATA)
R-CCH
(SWITCH INDICATION)
MS

FIG. 2

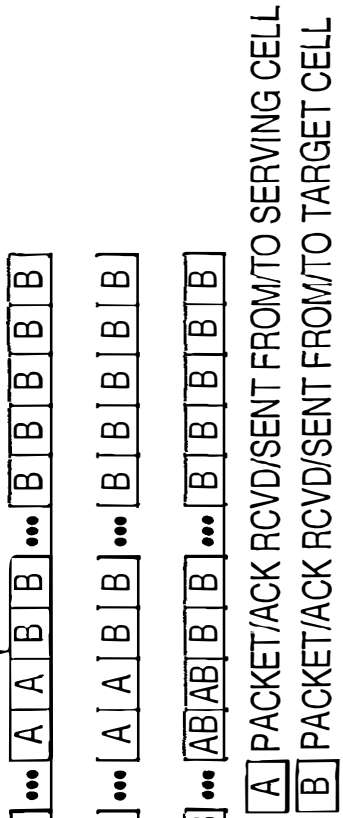

T1
T2=T1 + N
FORWARD DATA (F-PDCH)
REVERSE ACK (R-ACKCH)
REVERSE QUALITY (R-CQICH)
A PACKET/ACK RCVD/SENT FROM/TO SERVING CELL
B PACKET/ACK RCVD/SENT FROM/TO TARGET CELL

FIG. 3

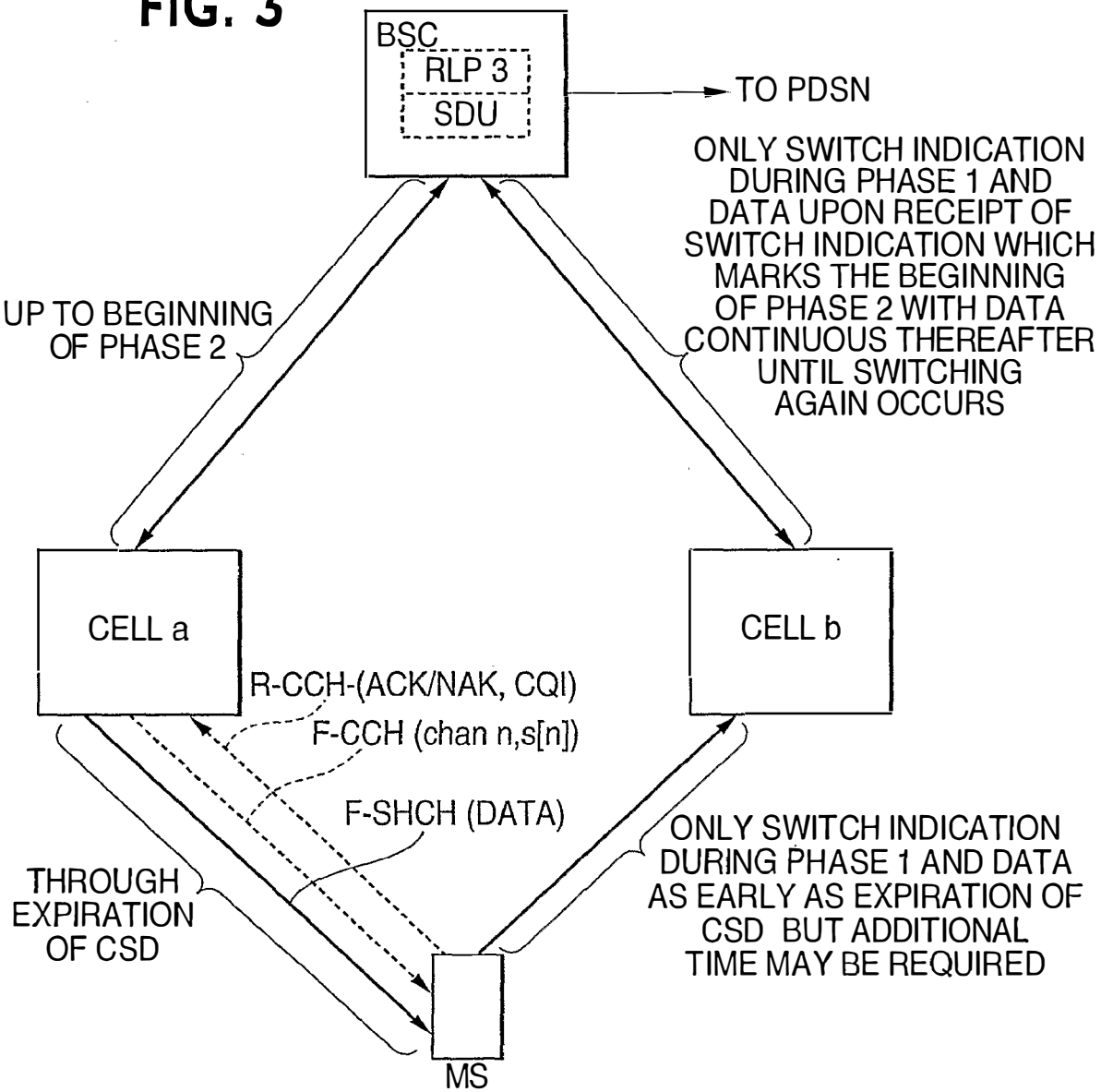

BSC
RLP 3
SDU
TO PDSN
ONLY SWITCH INDICATION DURING PHASE 1 AND DATA UPON RECEIPT OF SWITCH INDICATION WHICH MARKS THE BEGINNING OF PHASE 2 WITH DATA CONTINUOUS THEREAFTER UNTIL SWITCHING AGAIN OCCURS
UP TO BEGINNING OF PHASE 2
CELL a
CELL b
R-CCH-(ACK/NAK, CQI)
F-CCH (chan n,s[n])
F-SHCH (DATA)
THROUGH EXPIRATION OF CSD
ONLY SWITCH INDICATION DURING PHASE 1 AND DATA AS EARLY AS EXPIRATION OF CSD BUT ADDITIONAL TIME MAY BE REQUIRED
MS

FIG. 4

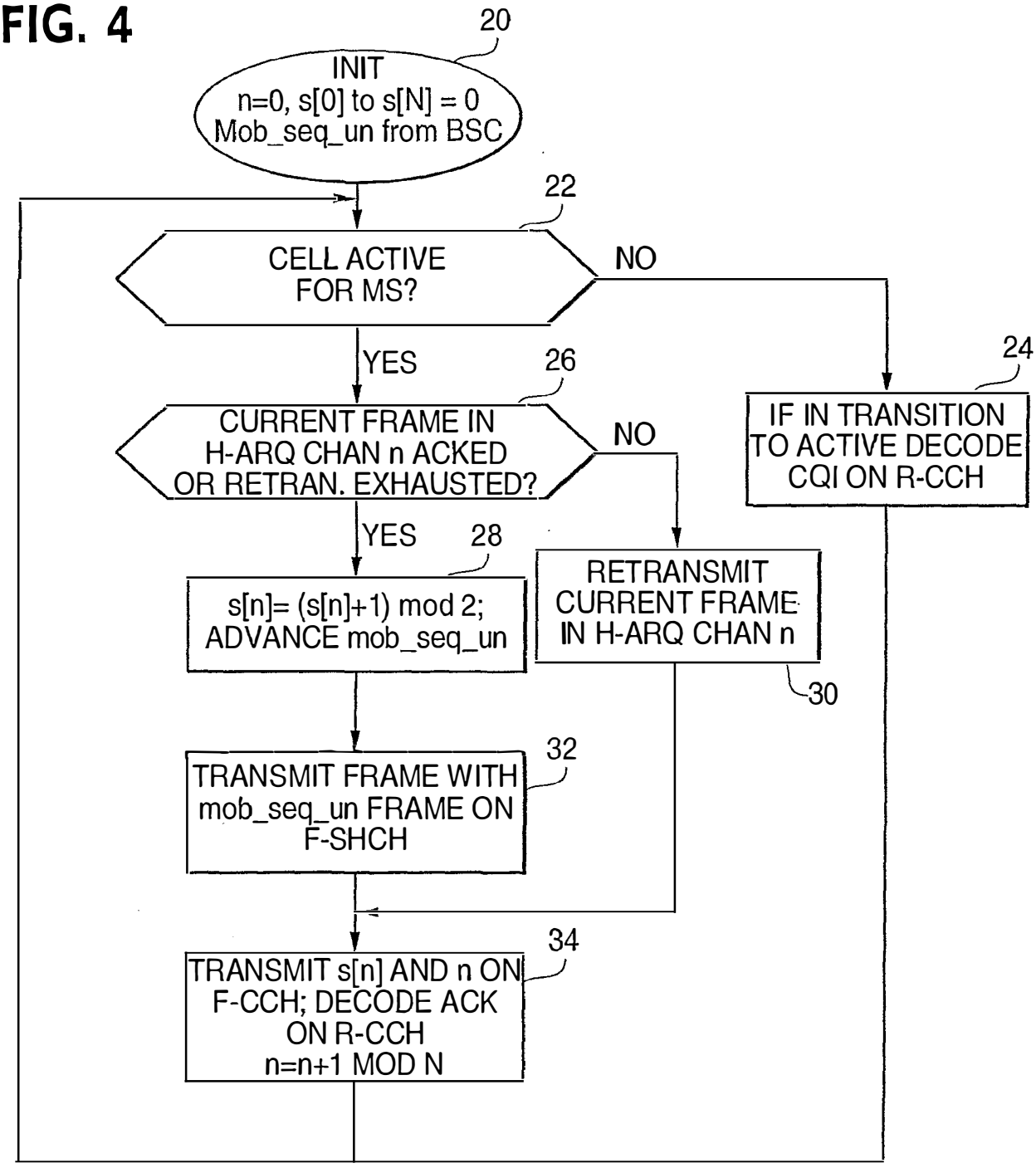
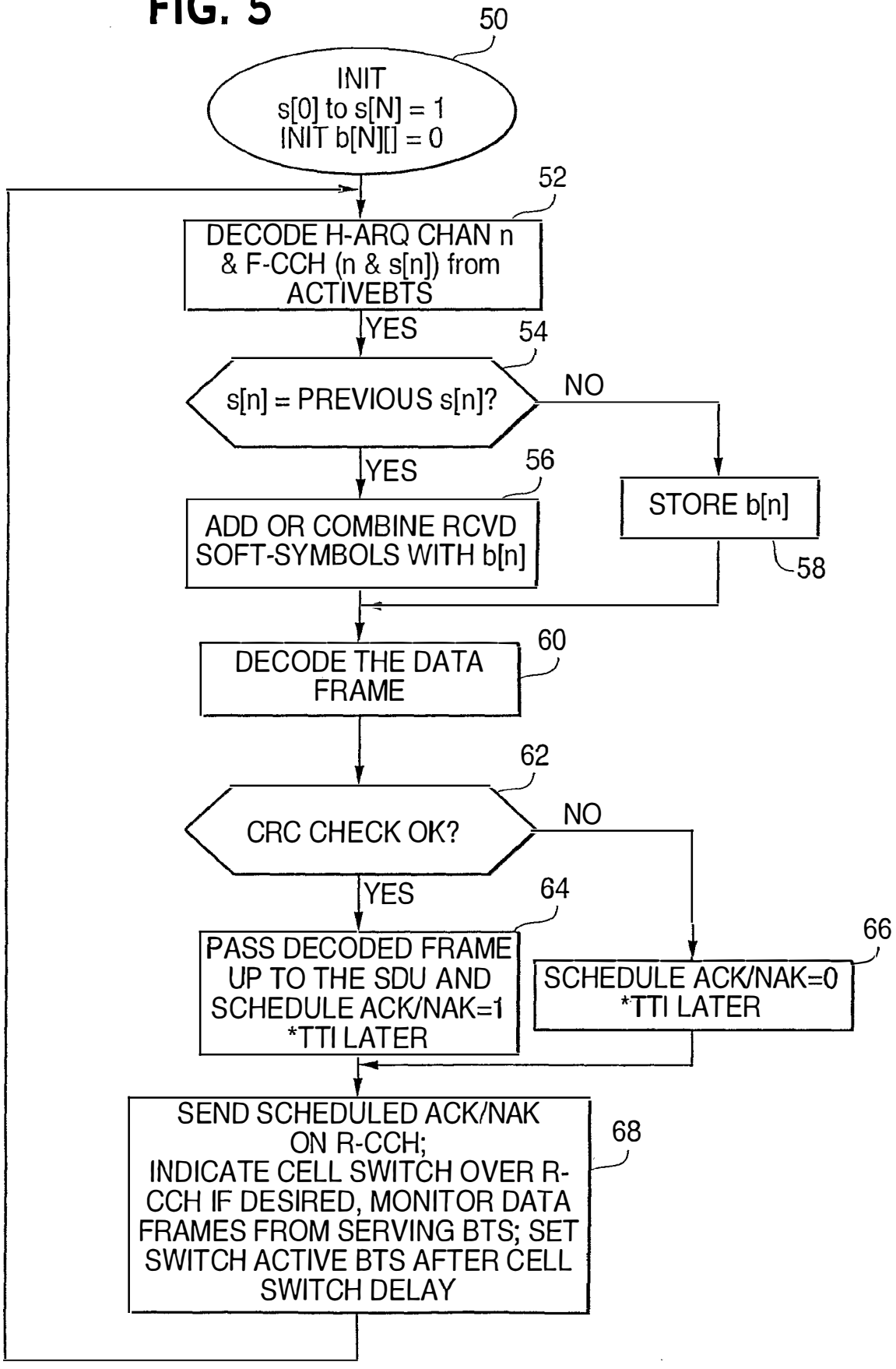

20
INIT
n=0, s[0] to s[N] = 0
Mob_seq_un from BSC
22
CELL ACTIVE FOR MS?
NO
YES
24
IF IN TRANSITION TO ACTIVE DECODE CQI ON R-CCH
26
CURRENT FRAME IN H-ARQ CHAN n ACKED OR RETRAN. EXHAUSTED?
NO
YES
28
s[n]= (s[n]+1) mod 2; ADVANCE mob_seq_un
RETRANSMIT CURRENT FRAME IN H-ARQ CHAN n
30
32
TRANSMIT FRAME WITH mob_seq_un FRAME ON F-SHCH
34
TRANSMIT s[n] AND n ON F-CCH; DECODE ACK ON R-CCH
n=n+1 MOD N

FIG. 5


50
INIT
s[0] to s[N] = 1
INIT b[N][] = 0
52
DECODE H-ARQ CHAN n & F-CCH (n & s[n]) from ACTIVEBTS
YES
54
s[n] = PREVIOUS s[n]?
NO
YES
56
ADD OR COMBINE RCVD SOFT-SYMBOLS WITH b[n]
STORE b[n]
58
DECODE THE DATA FRAME
60
62
CRC CHECK OK?
NO
YES
64
PASS DECODED FRAME UP TO THE SDU AND SCHEDULE ACK/NAK=1 *TTI LATER
66
SCHEDULE ACK/NAK=0 *TTI LATER
SEND SCHEDULED ACK/NAK ON R-CCH; INDICATE CELL SWITCH OVER R-CCH IF DESIRED, MONITOR DATA FRAMES FROM SERVING BTS; SET SWITCH ACTIVE BTS AFTER CELL SWITCH DELAY
68

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the PATENT APPLICATION of:	
	Zhang et al.
Application No.:	13/908,242
Confirmation No.:	5287
Filed:	June 3, 2013
For:	SUPPORTING ENHANCED UPLINK DURING SOFT HANDOVER
Group:	2473
Examiner:	Kwang Bin Yao

Our File:	SIG-2-0674US05
Date:	August 13, 2014

INFORMATION DISCLOSURE STATEMENT

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

Madam:

Further to Applicants' Duty of Disclosure pursuant to 37 C.F.R. §1.56, Applicants wish to bring to the Examiner's attention the material cited on the enclosed Form SB-08.

Copies of the newly cited documents are enclosed. Pursuant to 37 C.F.R. §1.98(a)(2)(ii), copies of the newly cited U.S. publications and/or patent documents have not been included.

This Application is a continuation of U.S. Patent Application No. 13/308,950, filed December 1, 2011, which issued June 4, 2013 as U.S. Patent No. 8,457,072, which

is a continuation of U.S. Patent Application No. 11/434,330, filed May 15, 2006, which issued March 6, 2012 as U.S. Patent No. 8,130,720, which is a continuation of U.S. Patent Application No. 10/962,720, filed October 12, 2004, which issued May 16, 2006 as U.S. Patent No. 7,046,648, which claims priority from Provisional Application No. 60/578,674, filed June 10, 2004, Provisional Application No. 60/520,692, filed November 17, 2003, Provisional Application No. 60/519,990, filed November 14, 2003, and Provisional Application No. 60/517,656, filed November 5, 2003.

Applicants would like to bring the following Applications to the Examiner's attention: U.S. Patent Application No. 13/236,133, filed September 19, 2011; U.S. Patent Application No. 10/925,426, filed August 25, 2004, which issued September 20, 2011 as U.S. Patent No. 8,023,463; Provisional Application No. 60/585,174, filed July 2, 2004; Provisional Application No. 60/520,207, filed November 14, 2003; Provisional Application No. 60/508,797, filed October 3, 2003; Provisional Application No. 60/507,554, filed October 1, 2003; and Provisional Application No. 60/497,747, filed August 25, 2003.

It is respectfully requested that the Examiner consider these documents and return an initialed copy of the Form SB-08 indicating consideration of the cited materials.

Respectfully submitted,

Zhang et al.

By /Abhik A. Huq/
Abhik A. Huq
Registration No. 40,656
(215) 568-6400

Volpe and Koenig, P.C.
United Plaza, Suite 1800
30 South 17th Street
Philadelphia, PA 19103

AAH/PCK
Enclosures (36)

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
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	13908242
Filing Date	2013-06-03
First Named Inventor	Zhang et al.
Art Unit	2464
Examiner Name	Ricky Quoc Ngo
Attorney Docket Number	SIG-2-0674US05

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					

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] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	99027740	WO	A1	1999-06-03	Ericsson Telefon AB LM	* Corresponds to KR 2001-0032521	☐

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

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]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	13908242
	Filing Date	2013-06-03
	First Named Inventor	Zhang et al.
	Art Unit	2464
	Examiner Name	Ricky Quoc Ngo
	Attorney Docket Number	SIG-2-0674US05

	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	13908242
	Filing Date	2013-06-03
	First Named Inventor	Zhang et al.
	Art Unit	2464
	Examiner Name	Ricky Quoc Ngo
	Attorney Docket Number	SIG-2-0674US05

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	/Abhik A. Huq/	Date (YYYY-MM-DD)	2014-09-10
Name/Print	Abhik A. Huq	Registration Number	40,656

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.

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : H04Q 7/38	A1	(11) International Publication Number: WO 99/27740
		(43) International Publication Date: 3 June 1999 (03.06.99)

(21) International Application Number: PCT/SE98/02131

(22) International Filing Date: 24 November 1998 (24.11.98)

(30) Priority Data:
08/979,866 26 November 1997 (26.11.97) US

(71) Applicant: TELEFONAKTIEBOLAGET LM ERICSSON (publ) [SE/SE]; S–126 25 Stockholm (SE).

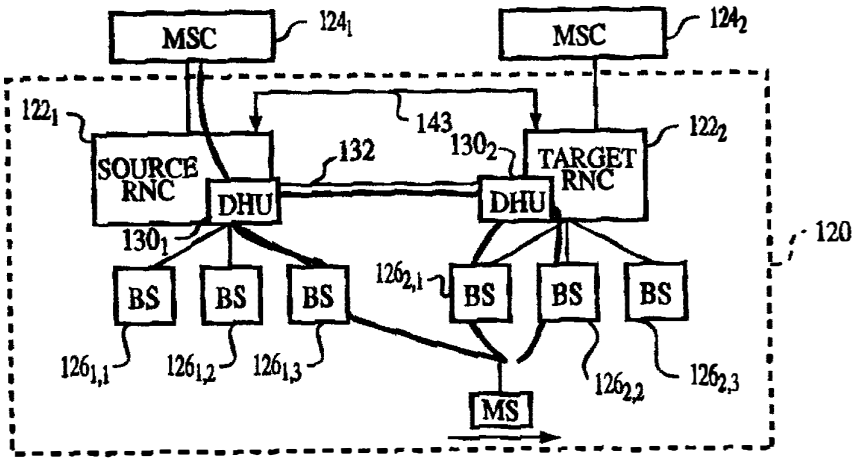
(72) Inventor: WALLENTIN, Pontus; Mässvägen 2, S–590 71 Ljungsbro (SE).

(74) Agent: ERICSSON RADIO SYSTEMS AB; Common Patent Dept., S–164 80 Stockholm (SE).

(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: MULTISTAGE DIVERSITY HANDLING FOR CDMA MOBILE TELECOMMUNICATIONS



(57) Abstract

In a soft handover cellular system, diversity handling operations are multistaged for a mobile connection which is controlled by an original or Source RNC (122_1) and which also utilizes a secondary or Target RNC (122_2). Non–Source RNCs each have a diversity handling units (DHU) which perform connection splitting and connection combining operations for all involved base stations (BS) owned by the non–Source RNC, so that only one transport connection need exist between the Source RNC and the Target RNC for the mobile connection. The Source RNC (122_1) has a diversity handover unit (130_1) which not only performs connection splitting and connection combining with respect to the involved base stations owned by the Source RNC, but also with respect to the one transport connection for each Target RNC involved in the mobile connection.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	**ES**	Spain	**LS**	Lesotho	**SI**	Slovenia
AM	Armenia	**FI**	Finland	**LT**	Lithuania	**SK**	Slovakia
AT	Austria	**FR**	France	**LU**	Luxembourg	**SN**	Senegal
AU	Australia	**GA**	Gabon	**LV**	Latvia	**SZ**	Swaziland
AZ	Azerbaijan	**GB**	United Kingdom	**MC**	Monaco	**TD**	Chad
BA	Bosnia and Herzegovina	**GE**	Georgia	**MD**	Republic of Moldova	**TG**	Togo
BB	Barbados	**GH**	Ghana	**MG**	Madagascar	**TJ**	Tajikistan
BE	Belgium	**GN**	Guinea	**MK**	The former Yugoslav Republic of Macedonia	**TM**	Turkmenistan
BF	Burkina Faso	**GR**	Greece			**TR**	Turkey
BG	Bulgaria	**HU**	Hungary	**ML**	Mali	**TT**	Trinidad and Tobago
BJ	Benin	**IE**	Ireland	**MN**	Mongolia	**UA**	Ukraine
BR	Brazil	**IL**	Israel	**MR**	Mauritania	**UG**	Uganda
BY	Belarus	**IS**	Iceland	**MW**	Malawi	**US**	United States of America
CA	Canada	**IT**	Italy	**MX**	Mexico	**UZ**	Uzbekistan
CF	Central African Republic	**JP**	Japan	**NE**	Niger	**VN**	Viet Nam
CG	Congo	**KE**	Kenya	**NL**	Netherlands	**YU**	Yugoslavia
CH	Switzerland	**KG**	Kyrgyzstan	**NO**	Norway	**ZW**	Zimbabwe
CI	Côte d'Ivoire	**KP**	Democratic People's Republic of Korea	**NZ**	New Zealand		
CM	Cameroon			**PL**	Poland		
CN	China	**KR**	Republic of Korea	**PT**	Portugal		
CU	Cuba	**KZ**	Kazakstan	**RO**	Romania		
CZ	Czech Republic	**LC**	Saint Lucia	**RU**	Russian Federation		
DE	Germany	**LI**	Liechtenstein	**SD**	Sudan		
DK	Denmark	**LK**	Sri Lanka	**SE**	Sweden		
EE	Estonia	**LR**	Liberia	**SG**	Singapore		

MULTISTAGE DIVERSITY HANDLING FOR CDMA MOBILE TELECOMMUNICATIONS

BACKGROUND

This patent application is related to United States Patent Application SN 08/980,013 (attorney docket: 2380-4) filed simultaneously, entitled "Diversity Handling Moveover for CDMA Mobile Telecommunications", which is incorporated herein by reference.

1. FIELD OF THE INVENTION

In mobile telecommunications, a mobile station such as mobile telephone communicates over radio channels with base stations. Typically a plurality of base stations are, in turn, ultimately connected to a mobile switching center. The mobile switching center is usually connected, e.g., via a gateway, to other telecommunication networks, such as the public switched telephone network.

In a code division multiple access (CDMA) mobile telecommunications system, the information transmitted between a base station and a particular mobile station is modulated by a mathematical code (such as spreading code) to distinguish it from information for other mobile stations which are utilizing the same radio frequency. Thus, in CDMA, the individual radio links are discriminated on the basis of codes. Various aspects of CDMA are set forth in Garg, Vijay K. et al., *Applications of CDMA in Wireless/Personal Communications*, Prentice Hall (1997).

In addition, in CDMA mobile communications, typically the same baseband signal with suitable spreading is sent from several base stations with overlapping coverage. The mobile terminal can thus receive and use signals from several base stations simultaneously. Moreover, since the radio environment changes rapidly, a mobile station likely has radio channels to several base stations at the same moment, e.g., so that the mobile station can select the best channel and, if necessary, use signals directed to the mobile from various base stations in order to keep radio interference low and capacity high. This utilization of radio channels from multiple base stations by a mobile station in a CDMA scheme is termed "soft handover" or "macro diversity."

Fig. 1 shows a radio access network (RAN) 20 which comprises radio network controllers (RNC) 22_1 and 22_2 respectively connected to mobile switching centers (MSC) 24_1 and 24_2. Radio network controller (RNC) 22_1 is connected to base stations (BS) $26_{1,1}$, $26_{1,2}$, and $26_{1,3}$; radio network controller (RNC) 22_2 is connected to base stations (BS) $26_{2,1}$, $26_{2,2}$, and $26_{2,3}$. At the moment shown in Fig. 1, and for reasons summarized above, mobile station MS is shown in Fig. 1 as having radio communication with two base stations, particularly base stations $26_{1,2}$, and $26_{1,3}$. The lines $28_{1,2}$ and $28_{1,3}$ each represent a communication path. Specifically, line $28_{1,2}$ depicts both the radio channel from mobile station MS to base station BS $26_{1,2}$ and the land line link channel from base station BS $26_{1,2}$ to radio network controller (RNC) 22_1; line $28_{1,3}$ depicts both the radio channel from mobile station MS to base station BS $26_{1,3}$ and the land line link channel from base station BS $26_{1,2}$ to radio network controller (RNC) 22_1. In the case of both lines $28_{1,2}$ and $28_{1,3}$, the land line link is connected to a diversity handover unit (DHU) 30_1 of radio network controller (RNC) 22_1.

Thus, as depicted with reference to Fig. 1, the mobile connection with mobile station MS potentially utilizes several "legs", each leg being represented by the

lines $28_{1,2}$ and $28_{1,3}$ in the case of mobile station MS of Fig. 1. As the overall connection between mobile station MS and any other party is viewed, the diversity handover unit (DHU) 30_1 serves essentially both to combine and split the different legs utilized by a mobile station. The splitting occurs in the sense that information directed toward the mobile station is directed along the plural parallel legs to differing base stations. Information received from a base station may actually be obtained through several of the legs (e.g., from several base stations), in which sense the diversity handover unit (DHU) 30_1 serves a combining function.

Fig. 1 illustrates the simple case in which the different legs of the connection, represented by lines $28_{1,2}$ and $28_{1,3}$, are for base stations BS all of which are connected to radio network controller (RNC) 22_1. However, should the mobile station MS roam sufficiently to pick up signals from another base station, e.g., into or proximate a cell handled by another base station, such as base station BS $26_{2,1}$, for example, a more complex situation occurs as shown in Fig. 1A.

In the situation depicted in Fig. 1A, the mobile connection involving mobile station MS employs base stations belonging to differing radio network controllers (RNC). Such situation involves a different type of handover -- an inter-RNC soft handover. Inter-RNC soft-handovers are made between two or several RNCs. In the particular situation shown in Fig. 1A, an inter-RNC soft handover is made between radio network controller (RNC) 22_1, which is also known as the "Source" RNC, and radio network controllers (RNC) 22_2, which is also known as the "Target" RNC. Radio network controller (RNC) 22_1 is the Source RNC since it has current control of the mobile radio connection. The Target RNC is an RNC, other than the Source RNC, that has, or has been decided to have, base stations utilized by the mobile radio connection.

To facilitate, e.g., inter-RNC soft-handovers, the radio network controllers (RNC) 22_1 and 22_2 are connected by an inter-RNC transport link 32. Inter-RNC

transport link 32 is utilized for the transport of control and data signals between Source RNC 22_1 and Target RNC 22_2, and can be either a direct link or a logical link as described, for example, in International Application Number PCT/US94/12419 (International Publication Number WO 95/15665).

Thus, in Fig. 1A, the mobile station MS communicates not only through the leg represented by line $28_{1,3}$, but now also by the leg represented by line $28_{2,1}$. The leg represented by line $28_{2,1}$ includes the radio link between mobile station MS and base station BS $26_{2,1}$, as well as the information pertinent to the mobile connection which is carried over inter-RNC transport link 32.

As mobile station MS continues to move, it may eventually occur that all of the base stations utilized by the mobile station are served by the Target RNC 22_2, as is pictured in Fig. 1B. In such case, inter-RNC transport link 32 must carry both legs of the mobile connection, represented by lines $28_{2,1}$ and $28_{2,2}$, respectively. Carrying multiple legs of the same mobile connection undesirably demands further resources from inter-RNC transport link 32. In Fig. 1B, diversity handover unit 30_1 handles all combining and splitting operations, even though no base station owned by Source RNC 22_1 is employed by the mobile connection with mobile station MS.

For the situation shown in Fig. 1B, resources of inter-RNC transport link 32 can be preserved if the diversity handling operations are moved to Target RNC 22_2. Utilization of inter-RNC transport link 32 would be reduced in that, for example, multiple packets destined in parallel for base stations BS 26_{12} and $26_{2,2}$ need not be carried on link 32, but rather a diversity handover unit at Target RNC $22_{2,2}$ could instead perform the splitting. A similar economy results in having a diversity handover unit at Target RNC $22_{2,2}$ combining the signals from mobile station MS as received via the base stations BS $26_{2,1}$ and $26_{2,2}$, and forwarding a resultant signal to Source RNC 22_1.

The movement of diversity handling operations (diversity handling "moveover") to a Target RNC, such as Target RNC 22_2 of Fig. 1B, is a complex endeavor, and can potentially result in an interruption of the established mobile connection. The prior art approach to moving diversity handling operations is shown in International Application Number PCT/US94/12419 (International Publication Number WO 95/15665). That approach, illustrated in Fig. 1C, involves a two step process. The first step of the process is routing the mobile connection, in a bypass mode, through a diversity handling unit (DHU) 30_2 in the Target RNC 22_2 upon first utilization by mobile station MS of the Target RNC (e.g., when a base station served by Target RNC is first invoked). In its bypass mode, diversity handling unit (DHU) 30_2 in the Target RNC 22_2 performs no combining or splitting operations. Rather, all combining and splitting operations remain the province of diversity handling unit (DHU) 30_1 in Source RNC 22.

Only later, when (and if) all base stations utilized by mobile station are owned by the Target RNC 22_2, is the second step of the above-described approach implemented. In the second step, the combining and splitting functions are moved from diversity handover unit (DHU) 30_1 of Source RNC 22_1 to diversity handover unit (DHU) 30_2 of Source RNC 22_2, and diversity handover unit (DHU) 30_1 is bypassed as shown in Fig. 1C. Thus, the control of the mobile connection is essentially transferred to Target RNC 22_2 in accordance with Interface Specification "TIA IS-634/PN-3539 MSC-BS Interface".

Thus, until the diversity handling operations (e.g., the connection combining and connection splitting operations) are moved to the Target RNC, the situation may exist (as in Fig. 1B, for example) in which two or more legs of a mobile connection require separate transport connections on the inter-RNC link. That is, frames and signaling from more than one base station owned by a Target RNC and involved in the same mobile connection are transported on the inter-RNC link to the

diversity handling unit (DHU) of the Source RNC. Duplication of frames with the same frame number, and hence of same content albeit perhaps different quality, from differing base stations and the signaling associate with those base stations thus increases traffic on the inter-RNC link. Moreover, since diversity handling may never occur, the increased traffic on the inter-RNC link may continue for the duration of the mobile connection.

What is needed therefore, and an object of the invention, is an efficient and economical technique for handling connection combining and connection splitting operations for a multiple-legged mobile connection.

SUMMARY OF THE INVENTION

Diversity handling operations are multistaged for a mobile connection which is controlled by an original or Source RNC and which also utilizes a secondary or Target RNC. Each non-Source RNCs has a diversity handling unit which performs connection splitting and connection combining operations for all involved base stations owned by the non-Source RNC, so that only one transport connection need exist between the Source RNC and the Target RNC for the mobile connection. The Source RNC has a diversity handling unit which not only performs connection splitting and connection combining with respect to the involved base stations owned by the Source RNC, but also with respect to the one transport connection for each Target RNC involved in the mobile connection.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other objects, features, and advantages of the invention will be apparent from the following more particular description of preferred embodiments as

illustrated in the accompanying drawings in which reference characters refer to the same parts throughout the various views. The drawings are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention.

Fig. 1, Fig. 1A, Fig. 1B, and Fig. 1C are each diagrammatic views showing prior art management of a mobile connection for a mobile station moving from base stations owned by a Source radio network controller to base stations controlled by a Target radio network controller.

Fig. 2 is a diagrammatic view of radio area network which utilizes multistage diversity handling according to a mode of the invention.

Fig. 3 is a diagrammatic view showing a relationship of Fig. 3A and Fig. 3B.

Fig. 3A is a schematic view showing a Source RNC and base stations managed thereby included in the radio area network of Fig. 2.

Fig. 3A is a schematic view showing a Target RNC and base stations managed thereby included in the radio area network of Fig. 2.

Fig. 4 is a schematic view of a sequence of operations according to an mode of the invention.

Fig. 5 is a diagrammatic view of a multistage frame splitting operation according to a mode of the invention.

Fig. 6 is a diagrammatic view of a multistage frame combining operation according to a mode of the invention.

Fig. 7 is a diagrammatic view of radio area network which utilizes multistage diversity handling according to a mode of the invention involving more than two stages.

Fig. 8, Fig. 8A, Fig. 8B, and Fig. 8C are diagrammatic view of frames according to an embodiment of the invention.

DETAILED DESCRIPTION OF THE DRAWINGS

In the following description, for purposes of explanation and not limitation, specific details are set forth such as particular architectures, interfaces, techniques, etc. in order to provide a thorough understanding of the present invention. However, it will be apparent to those skilled in the art that the present invention may be practiced in other embodiments that depart from these specific details. In other instances, detailed descriptions of well known devices, circuits, and methods are omitted so as not to obscure the description of the present invention with unnecessary detail.

Fig. 2 shows a radio network area 120 of the present invention which comprises a first set of base stations (BS) $126_{1,1}$, $126_{1,2}$, and $126_{1,3}$ connected by land lines to Source radio network controller (RNC) 122_1, and a second set of base stations (BS) $126_{2,2}$, $126_{2,2}$, and $126_{2,3}$ connected by land lines to a second radio network controller (RNC) 122_2 which serves as a Target radio network controller. Source RNC 122_1 is connected to mobile switching center 124_1 while Target RNC 122_2 is connected to mobile switching center 124_2. Source RNC 122_1 and Target RNC 122_2 are connected by inter-RNC transport link 132. Inter-RNC transport link 132 can be seen as a logical link, and may be physically switched via other nodes (e.g., other RNCs or MSCs). Source RNC 122_1 and Target RNC 122_2 are considered as control nodes of radio network area 120 in that, among other things, these RNCs control or manage the

sets of base stations respectively connected thereto.

As described in more detail herein, for a mobile connection controlled by an original or Source RNC and also utilizing a secondary or Target RNC, diversity handling operations are multistaged. That is, non-Source RNCs have diversity handling units which perform connection splitting and connection combining operations for all involved base stations owned by the non-Source RNC, so that only one transport connection need exist for the mobile connection through the inter-RNC link to the Source RNC. The Source RNC has a diversity handling unit which not only performs connection splitting and connection combining with respect to the involved base stations owned by the Source RNC, but also with respect to the one transport connection for each Target RNC involved in the mobile connection.

As an example, in a downlink scenario involving Source RNC 122_1 and Target RNC 122_2 of Fig. 2, for a mobile connection with mobile station MS, Source diversity handover unit (DHU) 130_1 [also known as a diversity trunk unit] receives frames from mobile switching center 124_1 and applies the frames to base station $126_{1,3}$ and via inter-RNC link 132 to Target RNC 122_2. In Target RNC 122_2, Target diversity handover unit (DHU) 130_2 obtains the frames and distributes a copy of each frame to each involved base station, i.e., base station (BS) $126_{2,1}$ and base station (BS) $126_{2,2}$.

In the uplink, Target diversity handover unit (DHU) 130_2 receives parallel frames for the mobile connection involving mobile station MS from both base station (BS) $126_{2,1}$ and base station (BS) $126_{2,2}$, selects the best frame of like-numbered frames, and applies the resultant (best) frame to Source diversity handling unit (DHU) 130_1 on inter-RNC link 132. At Source diversity handling unit (DHU) 130_1 the Source diversity handover unit (DHU) 130_1 choses between the resultant frame forwarded from Target RNC 122_2 and a similarly numbered frame obtained from its own base station, base station (BS) $126_{1,3}$. In this manner, transport of duplication

frames and signaling associated therewith on inter-RNC link 132 is eliminated, since transport need not occur with respect to both of base station (BS) $126_{2,1}$ and base station (BS) $126_{2,2}$.

Source RNC 122_1 is shown in more detail in Fig. 3A as comprising a switch 140_1. Switch 140_1, which is controlled by RNC control unit 142_1, has a plurality of ports, some of which are connected to diversity handover unit (DHU) 130_1 and others of which are connected to various interfaces. Diversity handover unit (DHU) 130_1 is connected to a timing unit 141_1. The RNC control unit 142_1 is connected to each element of RNC 122_1.

For reasons explained hereinafter, Source RNC 122_1 is connected to a signaling network represented by line 143. Source RNC 122_1 is connected to signaling network 143 via a signaling interface $143I_1$. Signaling interface $143I_1$ is connected to RNC control unit 142_1.

The interfaces connected to ports of switch 140_1 include MSC interface unit 144_1; RNC interface unit 146_1; and base station interface unit 148_1. MSC interface unit 144_1 is connected to mobile switching center 124_1. RNC interface unit 146_1 is connected to inter-RNC transport link 132. Base station interface unit 148_1 is connected to the first set of base stations (BS) served by Source RNC 122_1.

Diversity handover unit (DHU) 130_1 of Source RNC 122_1 primarily comprises DHU controller 160_1; frame splitter 162_1; a set of downlink buffers 164_{1-1} - 164_{1-n}; a frame selector 166_1; and a set of uplink buffers 168_{1-1} - 168_{1-n}. Both frame splitter 162_1 and frame selector 166_1 receive timing signals on line 170_1 from timing unit 141_1, and are also connected to DHU controller 160_1.

Frame splitter 162_1 receives (via switch 140_1) frames on line 172_1 from mobile switching center 124_1, while frame selector sends frames on line 174_1 to mobile switching center 124_1. Lines 172_1 and 174_1 are connected to particular ports of switch 140_1 which are internally connectable through switch 140_1 to mobile switching center 124_1.

Frame splitter 162_1 outputs frames received from mobile switching center 124_1 on line 172_1 to each of one of the buffers in set 164 which correspond to a base station currently involved in the mobile connection for the mobile station. Each of the buffers in set 164 is in turn connected to transmit the frames it receives to switch 140_1 over lines 176_{1-1} - 176_{1-n}. Lines 176_{1-1} - 176_{1-n} are connected to respective input ports of switch 140_1, which input ports are internally cross connectable (e.g., switchable) through switch 140_1 to the downlink land lines for the respective base stations BS participating in the mobile connection.

Frame selector 166_1 receives frames from various ones of the buffers in the set of up-link buffers 168_1 - 168_n. Base stations (BS) participating in a mobile connection send frames to their corresponding up-link buffers 168_1 - 168_n on corresponding ones of lines 178_1 - 178_n. Each of lines 178_{1-1} - 178_{1-n} is connected to corresponding ports of switch 140_1, with those ports being internally switchable internally through switch 140_1 to up-link land lines from the corresponding base stations (BS). Thus, when plural base stations are involved in a mobile connection, for plural frames representing the same up-linked information (e.g., frames having the same frame number) frame selector 166_1 picks the best frames for transmission (via switch 140_1) to mobile switching center 124_1.

As indicated above, DHU controller 160_1 of diversity handover unit (DHU) 130_1 is connected to frame splitter 162_1 and frame selector 166_1, for controlling operations thereof, as well as by line 180_1 to RNC control unit 142_1. RNC control unit

142_1 supervises operation of DHU controller 160_1 and coordinates operations of DHU controller 160_1 with other elements of Source RNC 122_1.

Fig. 3B shows Target RNC 122_2 inclusive of Target diversity handover unit (DHU) 130_2. Target RNC 122_2 of Fig. 3B has essentially the same structure as Source diversity handling unit (DHU) 130_1 of Fig. 3A, and likewise Target diversity handover unit (DHU) 130_2 of Fig. 3B has essentially the same structure as Source diversity handover unit (DHU) 130_1 of Fig. 3A. Therefore, the preceding discussion of Fig. 3A suffices for explanation of the elements and connections of Target RNC 122_2 and its Target diversity handover unit (DHU) 130_2, it being understood that elements of Target RNC 122_2 and Target diversity handover unit (DHU) 130_2 are similarly numerically referenced in Fig. 3B as in Fig. 3A but with differing subscripts (a subscript of "2" referring to Target RNC 122_2 and a subscript of "1" referring to Source diversity handling unit (DHU) 130_1).

Fig. 4 shows a sequence of operations according to an embodiment of the invention. Fig. 4 shows in three separate parallel vertical lines the operations conducted by each of Source RNC 122_1, Target RNC 122_2, and the base stations (BS) served by Target RNC 122_2 and involved in the mobile communication with mobile station MS.

Operation 4-1 of Fig. 4 shows RNC control unit 142_1 of Source RNC 122_1 determining that a new base station not owned by Source RNC 122_1 should be added to the mobile connection for mobile station MS. It will be assumed, in connection with an example illustrative scenario now described, that the mobile connection for mobile station MS thus far involves only base station (BS) $126_{1,3}$ and base station (BS) $126_{2,1}$. That is, the point in time for operation 4-1 for the illustrative example precedes the moment in time shown in Fig. 2, Fig. 3A, and Fig. 3A (e.g., that base station (BS) $126_{2,2}$ has not yet been added to the connection for mobile station MS. In fact, the determination made at operation 4-1 is that base station (BS) $126_{2,2}$ now needs to be added to the mobile connection for mobile station MS.

Reflecting the illustrative scenario, Fig. 3A shows Target diversity handover unit (DHU) 130_2 of Source RNC 122_1 handling legs of the mobile connection for mobile station MS with both base station (BS) $126_{1,3}$ and base station (BS) $126_{2,1}$. Line SS-1 of Fig. 3A shows that switch 140_1 is internally cross connected to send frames from MSC I/F unit 144_1 to frame splitter 162_1, from whence copies of the frames are forwarded to base station (BS) $126_{1,3}$ (as depicted by switch cross connection line SS-3) and to base station (BS) $126_{2,1}$ (as depicted by switch cross connection line SS-4 in switch 140_1 and cross connection lines TS-1 and TS-3 in switch 140_2 [see Fig. 3B]). The frame selector 166_1 of Source diversity handover unit (DHU) 130_1 receives frames from base station (BS) $126_{3,1}$ and base station (BS) $126_{2,1}$. Frames from base station (BS) $126_{3,1}$ are applied to frame selector 166_1 via cross connection line SS-5 and from base station (BS) $126_{2,1}$ via cross connection line SS-6 of switch 140_1 and cross connection lines TS-4 and TS-2 of switch 140_2 [see Fig. 3B]. Frame selector 166_1 of Source diversity handover unit (DHU) 130_1 selects the best of similarly numbered frames from the two legs of the connection, and applies the best frames to mobile switching center 124_1 via cross connection line SS-2 and MSC I/F unit 144_1 [see Fig. 3A].

Returning to operation 4-1, the determination to add base station (BS) $126_{2,2}$ to the mobile connection for mobile station MS is made by RNC control unit 141_1 of Source RNC 122_1 . The determination is based on measurements obtained by mobile station MS and transmitted to Source RNC 122_1

Once the determination to add a new base station BS not owned by another RNC is made at operation 4-1, Source RNC 122_1 checks whether any base station owned by that other RNC is already in use by the mobile connection for mobile station MS. If the mobile connection for mobile station MS does not thus far utilize a base station owned by that other RNC, Source RNC 122_1 allocates a connection on inter-RNC link 132, as depicted by operation 4-2. RNC control unit 142_1 allocates a port of switch 140_1 and a port of RNC interface unit 146_1 to be used by the new connection on inter-RNC link