AO 120 (Rev. 08/10)

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

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

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

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
6:22-cv-00138	2/8/2022	for the Western District of Texas

PLAINTIFF	DEFENDANT
WSOU Investments, LLC d/b/a Brazos Licensing and Development	ZTE Corporation

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	7,477,876	1/13/2009	WSOU Investments, LLC d/b/a Brazos Licensing and Develop
2			
3			
4			
5			

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

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

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

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

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

UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
10/002,746	11/02/2001	Amab Das	129250-002099/US

CONFIRMATION NO. 3832

151091
WSOU Investments, LLC
11150 Santa Monica Blvd., Suite 1400
Los Angeles, CA 90025

POA ACCEPTANCE LETTER

OC000000131508966

Date Mailed: 02/02/2022

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 02/01/2022.

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.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/tmwilliams/

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
10/002,746	11/02/2001	Amab Das	129250-002099/US

CONFIRMATION NO. 3832

32498
CAPITOL PATENT & TRADEMARK LAW FIRM, PLLC
P.O. BOX 1995
VIENNA, VA 22183

POWER OF ATTORNEY NOTICE

OC000000131508944

Date Mailed: 02/02/2022

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 02/01/2022.

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

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/tmwilliams/

PTO/AIA/80 (07-17)
Approved for use through 03/31/2021. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no person is 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:

[X] Practitioners associated with Customer Number: 151091

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 assignment 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:

OR

[X]

Firm or individual name Etheridge Law Group		
Address 2600 East Southlake Blvd., Suite 120-324		
City Southlake	State TX	Zip 76092
Country US		
Telephone (817) 470-7249	Email jim@etheridgelaw.com	

Assignee name and address: WSOU Investments, LLC
11150 Santa Monica Boulevard, Suite 1400
Los Angeles, CA 90025

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 Stuart Shanus	Date August 23, 2021
Name Stuart Shanus	Telephone 310-633-2327
Title President of WSOU Investments, LLC	

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 update (and by the USPTO to process) the file of a patent or reexamination proceeding. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 18 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.

Electronic Acknowledgement Receipt	
EFS ID:	44884852
Application Number:	10002746
International Application Number:	
Confirmation Number:	3832
Title of Invention:	VARIABLE RATE CHANNEL QUALITY FEEDBACK IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Amab Das
Customer Number:	32498
Filer:	Sean Dylan Burdick/Mita Encarnacion
Filer Authorized By:	Sean Dylan Burdick
Attorney Docket Number:	129250-002099/US
Receipt Date:	01-FEB-2022
Filing Date:	02-NOV-2001
Time Stamp:	00:34:27
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	Assignee showing of ownership per 37 CFR 3.73	Das_14-18_A-US-NP_aia0096.pdf	134416 a5781c22ff950d797b26ad23869ae34bce760f5e	no	3

Warnings:

Information:					
2	Power of Attorney	WSOU_Executed_POA_Etheridge_Correspondence.pdf	568072 a740c804b9168400043273 0d03925b2a06b4fcbe	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	702488	

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

New Applications Under 35 U.S.C. 111

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

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

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

New International Application Filed with the USPTO as a Receiving Office

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

PTO/AIA/96 (08-12)
Approved for use through 11/30/2020. 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: Arnab Das

Application No./Patent No.: 7,477,876 Filed/Issue Date: January 13, 2009

Titled: Variable Rate Channel Quality Feedback in a Wireless Communication System

WSOU INVESTMENTS LLC, a corporation

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

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

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

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

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

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

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

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

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

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

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

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

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

   1. From: Inventors To: Lucent Technologies, Inc.

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

      Reel 012354, Frame 0991, or for which a copy thereof is attached.

   2. From: Lucent Technologies, Inc. To: Alcatel-Lucent USA Inc.

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

      Reel 021918, Frame 0714, 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.

PTO/AIA/96 (08-12)
Approved for use through 11/30/2020. 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: Alcatel Lucent To: WSOU Investments, LLC

The document was recorded in the United States Patent and Trademark Office at
Reel 044000, Frame 0053, 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.

/Sean D. Burdick/	January 31, 2022
Signature	Date
Sean D. Burdick	51513
Printed or Typed Name	Title or Registration Number

[Page 2 of 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.

PETITION TO ACCEPT UNINTENTIONALLY DELAYED PAYMENT OF MAINTENANCE FEE IN AN EXPIRED PATENT (37 CFR 1.378(b))

Patent Number	Issue Date	Application Number	Filing Date	Docket Number (if applicable)
7477876	13-Jan-2009	10002746	02-Nov-2001	

CAUTION: Maintenance fee (and surcharge, if any) payment must correctly identify: (1) the patent number and (2) the application number of the actual U.S. application leading to issuance of that patent to ensure the fee(s) is/are associated with the correct patent. 37 CFR 1.366(c) and (d).

Applicants claims the following fee status:

◯ Small Entity

◯ Micro Entity

◉ Regular Undiscounted

Applicants selects the following :

◯ 3 1/2	◯ 7 1/2	◉ 11 1/2

PETITION FEE
The petition fee required by 37 CFR 1.17(m) (Fee Code 1558/2558) must be paid as a condition of accepting unintentionally delayed payment of the maintenance fee.

MAINTENANCE FEE (37 CFR 1.20(e)-(g))
The appropriate maintenance fee must be submitted with this petition.

STATEMENT

The delay in payment of the maintenance fee for this patent was unintentional.

Petitioner is reminded that a delay resulting from a deliberately chosen course of action or a change in circumstance is not an unintentional delay.

Petitioner is further reminded that a person seeking reinstatement of an expired patent should not make a statement that the delay in payment of the maintenance fee was unintentional unless the entire delay was unintentional, including the period from discovery that the maintenance fee was not timely paid until payment of the maintenance fee. For example, a statement that the delay in payment of the maintenance fee was unintentional would not be proper when the patentee becomes aware of an unintentional failure to timely pay the maintenance fee and then intentionally delays filing a petition for reinstatement of the patent under 37 CFR 1.378. See MPEP 2590.

NOTE: Where the petition under 37 CFR 1.378 is filed more than two years after the date the patent expired for nonpayment of the maintenance fee, the United States Patent and Trademark Office requires an additional explanation of the circumstances surrounding the delay that establishes the entire delay was unintentional. This requirement is in addition to the requirement to provide a statement that the entire delay was unintentional. See *Clarification of the Practice for Requiring Additional Information in Petitions Filed in Patent Applications and Patents Based on Unintentional Delay*, 85 FR 12222 (March 2, 2020). See MPEP 711.03(c)(II)(C)-(F) for additional guidance on the information required to establish that the entire delay was unintentional.

PETITIONER(S) REQUEST THAT THE DELAYED PAYMENT OF THE MAINTENANCE FEE BE ACCEPTED AND THE PATENT REINSTATED

THIS PORTION MUST BE COMPLETED BY THE SIGNATORY OR SIGNATORIES

37 CFR 1.378(c) states: "Any petition under this section must be signed in compliance with 37 CFR 1.33(b)."

I certify, in accordance with 37 CFR 1.4(d)(4) that I am

◉	An attorney or agent registered to practice before the Patent and Trademark Office who has been given power of attorney in this application.
○	An attorney or agent registered to practice before the Patent and Trademark Office
○	A sole patentee
○	A joint patentee; I certify that I am authorized to sign this submission on behalf of all the other patentees as evidenced by the power of attorney in the application
○	A joint patentee; all of whom are signing this e-petition
○	The assignee of record of the entire interest that qualifies as an authorized party under 37 CFR 1.33(b)

Attorney			
A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 10.18. Please see 37 CFR 1.4(d) for the form of the signature			
Signature	/Sean Burdick/		
Name	Sean Burdick	Registration Number	51513

Electronic Patent Application Fee Transmittal					
Application Number:	10002746				
Filing Date:	02-Nov-2001				
Title of Invention:	VARIABLE RATE CHANNEL QUALITY FEEDBACK IN A WIRELESS COMMUNICATION SYSTEM				
First Named Inventor/Applicant Name:	Amab Das				
Filer:	Sean Dylan Burdick/Kristina Pangan				
Attorney Docket Number:	129250-002099/US				
Filed as Large Entity					
Filing Fees for Utility under 35 USC 111(a)					
Description		**Fee Code**	**Quantity**	**Amount**	**Sub-Total in USD($)**
Basic Filing:					
MAINTENANCE FEE DUE AT 11.5 YEARS		1553	1	7700	7700
PET. DELAY PYMT MAINTAIN PATENT IN FORCE		1558	1	2100	2100
Pages:					
Claims:					
Miscellaneous-Filing:					
Petition:					
Patent-Appeals-and-Interference:					

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**9800**

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

In re Patent No. 7477876
Issue Date: January 13,2009
Application No. 10002746
Filed: November 2,2001
Attorney Docket No. 129250-002099/US

:
:DECISION GRANTING PETITION
:UNDER 37 CFR 1.378(b)
:

This is a decision on the electronic petition, filed April 14,2021 ,under 37 CFR 1.378(b) to accept the unintentionally delayed payment of the 11.5 year maintenance fee for the above-identified patent.

The petition is **GRANTED**.

The maintenance fee is accepted, and the above-identified patent reinstated as of April 14,2021 . This decision also constitutes notice that the fee has been accepted. An electronic copy of the petition and this decision has been created as an entry in the Image File Wrapper. Nevertheless, petitioner should print and retain an independent copy.

Telephone inquiries related to this electronic decision should be directed to the Electronic Business Center at 1-866-217-9197.

Electronic Acknowledgement Receipt	
EFS ID:	42458012
Application Number:	10002746
Patent Number:	7477876
Confirmation Number:	3832
Petition Issued Date:	April 14,2021
Title of Invention:	VARIABLE RATE CHANNEL QUALITY FEEDBACK IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Amab Das
Customer Number:	32498
Filer:	Sean Dylan Burdick/Kristina Pangan
Filer Authorized By:	Sean Dylan Burdick
Attorney Docket Number:	129250-002099/US
Receipt Date:	14-APR-2021
Filing Date:	02-NOV-2001
Time Stamp:	22:44:26
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	$9800
RAM confirmation Number	E20214DM44580269
Deposit Account	601970
Authorized User	Kristina Pangan
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Petition automatically granted by EFS	petition-request.pdf	38668 cb466730e71234ed26ae50038645811704c06a3e	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	32532 3a4f2270276075f5e64de1515dbc237a55a70bca	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	71200		

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 NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/002,746	01/13/2009	7477876	129250-002099/US	3832

32498 7590 12/22/2008

CAPITOL PATENT & TRADEMARK LAW FIRM, PLLC
P.O. BOX 1995
VIENNA, VA 22183

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

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

The Patent Term Adjustment is 1344 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Amab Das, Old Bridge, NJ;
Farooq Ullah Khan, Manalapan, NJ;

PART B - FEE(S) TRANSMITTAL

PTO/SB/21 DEC 08 2008 PATENT & TRADEMARK OFFICE

Complete and send this form, together with applicable fee(s), to: Mail Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

32498 7590 09/16/2008

CAPITOL PATENT & TRADEMARK LAW FIRM, PLLC
P.O. BOX 1995
VIENNA, VA 22183

12/08/2008 CCHAUD 00000095 122325 10002746

01 FC:1501 1510.00 DA
02 FC:1504 300.00 DA

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of [redacted] Transmission
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

Patty Giebler	(Depositor's name)
Patty Giebler	(Signature)
12-8-08	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/002,746	11/02/2001	Amab Das	129250-002099/US	3832

TITLE OF INVENTION: VARIABLE RATE CHANNEL QUALITY FEEDBACK IN A WIRELESS COMMUNICATION SYSTEM

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1440	$300	$0	$1740	12/16/2008

EXAMINER	ART UNIT	CLASS-SUBCLASS
NGUYEN, THUAN T	2618	455-067130

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. Use of a Customer Number is required.

2. For printing on the patent front page, list
(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 Gregory J. Murgia
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: **Alcatel-Lucent USA Inc.** (B) RESIDENCE: (CITY and STATE OR COUNTRY) **Murray Hill, NJ (US)**

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

4a. The following fee(s) are submitted:
☒ Issue Fee
☒ Publication Fee (No small entity discount permitted)
☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): (Please first reapply any previously paid issue fee shown above)
☐ A check is enclosed.
☐ Payment by credit card. Form PTO-2038 is attached.
☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number 12-2325 (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)
☐ a. Applicant claims SMALL ENTITY status. See 37 CFR 1.27. ☐ b. Applicant is no longer claiming SMALL ENTITY status. See 37 CFR 1.27(g)(2).

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

Authorized Signature Patty Giebler Date 12-8-08

Typed or printed name Patty Giebler Registration No. [redacted]

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.	10/002,746
Filing Date:	Nov. 2, 2001
Applicant:	Amab Das
Group Art Unit:	2618
Examiner:	Nguyen, Thuan T.
Title:	Variable Rate Channel Quality Feedback in a Wireless Communication System
Attorney Docket:	129250-002099/US

Customer Service Window
Randolph Building
401 Dulany Street
Alexandria, VA 22314
Mail Stop Issue Fee

October 7, 2008

COMMENTS ON THE EXAMINER'S STATEMENT OF REASONS FOR ALLOWANCE

Sir:

In reply to the Examiner's Statement of Reasons for Allowance, provided with the Notice of Allowance dated September 16, 2008 Applicants submit the following comments.

On pages 2-3 of the Notice Of Allowability under the heading "Reasons for Allowance", the Examiner presents statements regarding the rationales used to allow the claims.

Applicants agree that the indicated claims are allowable. However, Applicants wish to note the following. Notwithstanding the Examiner's comments, Applicants rely on the rationales set forth in their earlier responses as support for the allowance of the claims.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact the undersigned at the telephone number listed below.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 50-3777 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

CAPITOL PATENT & TRADEMARK LAW FIRM, PLLC.

By: /John E. Curtin/
John E. Curtin, Reg. No. 37,602
P.O. Box 1995
Vienna, Virginia 22183
(703) 266-3330

Electronic Acknowledgement Receipt	
EFS ID:	4076133
Application Number:	10002746
International Application Number:	
Confirmation Number:	3832
Title of Invention:	VARIABLE RATE CHANNEL QUALITY FEEDBACK IN A WIRELESS COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Amab Das
Customer Number:	32498
Filer:	John E. Curtin/Debra Bennett
Filer Authorized By:	John E. Curtin
Attorney Docket Number:	129250-002099/US
Receipt Date:	07-OCT-2008
Filing Date:	02-NOV-2001
Time Stamp:	20:47:38
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	Post Allowance Communication - Incoming	comments.pdf	58946 a5c29a6cc241b21f9fb5cf4da35d83bd96c01354	no	2

Warnings:
Information:

Total Files Size (in bytes):	58946

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

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

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

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

UNITED STATES PATENT AND TRADEMARK OFFICE

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United States Patent and Trademark Office
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P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

32498 7590 09/16/2008

CAPITOL PATENT & TRADEMARK LAW FIRM, PLLC
P.O. BOX 1995
VIENNA, VA 22183

EXAMINER	
NGUYEN, THUAN T	
ART UNIT	PAPER NUMBER
2618	

DATE MAILED: 09/16/2008

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/002,746	11/02/2001	Amab Das	129250-002099/US	3832

TITLE OF INVENTION: VARIABLE RATE CHANNEL QUALITY FEEDBACK IN A WIRELESS COMMUNICATION SYSTEM

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1440	$300	$0	$1740	12/16/2008

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

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

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

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

If the SMALL ENTITY is shown as NO:

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

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

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PTOL-85 (Rev. 08/07) Approved for use through 08/31/2010.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

32498 7590 09/16/2008

CAPITOL PATENT & TRADEMARK LAW FIRM, PLLC
P.O. BOX 1995
VIENNA, VA 22183

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/002,746	11/02/2001	Amab Das	129250-002099/US	3832

TITLE OF INVENTION: VARIABLE RATE CHANNEL QUALITY FEEDBACK IN A WIRELESS COMMUNICATION SYSTEM

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1440	$300	$0	$1740	12/16/2008

EXAMINER	ART UNIT	CLASS-SUBCLASS
NGUYEN, THUAN T	2618	455-067130

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) the names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____

2 _____

3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

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

4a. The following fee(s) are submitted:

❑ Issue Fee

❑ Publication Fee (No small entity discount permitted)

❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**

❑ A check is enclosed.

❑ Payment by credit card. Form PTO-2038 is attached.

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

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

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

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

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

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

This collection of information is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450.

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UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/002,746	11/02/2001	Amab Das	129250-002099/US	3832

32498 7590 09/16/2008

CAPITOL PATENT & TRADEMARK LAW FIRM, PLLC
P.O. BOX 1995
VIENNA, VA 22183

EXAMINER	
NGUYEN, THUAN T	
ART UNIT	PAPER NUMBER
2618	

DATE MAILED: 09/16/2008

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

The Patent Term Adjustment to date is 840 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 840 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

Notice of Allowability	Application No.	Applicant(s)	
	10/002,746	DAS ET AL.	
	Examiner	Art Unit	
	THUAN T. NGUYEN	2618	

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

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☐ This communication is responsive to _____.

2. ☒ The allowed claim(s) is/are *1 and 4-15*.

3. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☐ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

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

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

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☐ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

/TONY T. NGUYEN/
Primary Examiner
Art Unit: 2618

DETAILED ACTION

Response to Appeal Brief

1. By filing an appeal brief with arguments, applicant's request for reconsideration of the finality of the rejection of the last Office action is persuasive and, therefore, the finality of that action is withdrawn.

Allowable Subject Matter

2. Claims 1 and 4-15 have been allowed.

Reasons for Allowance

3. The following is an examiner's statement of reasons for allowance:

The prior art of record fails to teach or suggest a method for transmitting channel quality information in a wireless communication system comprising at least one base station and at least one mobile station, the method comprising: **varying a rate for reporting channel quality information from a mobile station to a base station as a function of the presence or absence of a reception of a data transmission at the mobile station**, wherein **the mobile station reports channel quality information at a first rate in the absence of a reception of a data transmission from the base station** and, **upon detection of a reception of a data transmission from the base station**, **the mobile station reports channel quality information at a second rate for a prescribed duration** as in claim 1; a method for adapting the rate of reporting channel quality information in a wireless communication system including at least one base station and at least one mobile station, the method comprising: **reporting channel quality information from the at least one mobile station to the at least one base station at a first**

rate in the absence of a reception of a data transmission at the at least one mobile station (as of claim 11); and a method for transmitting channel quality information in a wireless communication system including at least one base station and at least one mobile station, the method comprising: **varying a rate for reporting channel quality information from a mobile station to a base station as a function of the number of base stations with which the mobile station is communicating.**

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

4. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Balachandran; Krishna et al. (US 6108374 A) disclose a system and method for measuring channel quality information.

5. **Any response to this action should be mailed to:**

Commissioner of Patents and Trademarks
Washington, D.C. 20231

or faxed to the New Central Fax number:
(571) 273-8300, (for Technology Center 2600 only)

Hand deliveries must be made to Customer Service Window,
Randolph Building, 401 Dulany Street, Alexandria, VA 22314.

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tony Thuan Nguyen whose telephone number is (571) 272-7895. The examiner can normally be reached on Monday-Friday from 10:00 AM to 7:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Edward Urban, can be reached at (571) 272-7899.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Tony T. Nguyen/
Primary Examiner
Art Unit 2618

TTN
April 22, 2008

Notice of References Cited	Application/Control No. 10/002,746	Applicant(s)/Patent Under Reexamination DAS ET AL.	
	Examiner THUAN T. NGUYEN	Art Unit 2618	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-6,108,374	08-2000	Balachandran et al.	375/227
	B	US-			
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

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

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

EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L4	102736	"455"/$.ccls.	US-PGPUB; USPAT; EPO	OR	ON	2008/04/28 05:48
L5	95	L4 and "channel quality information".CLM.	US-PGPUB	OR	ON	2008/04/28 05:48
L6	327	L4 and "channel quality information"	US-PGPUB; USPAT; EPO	OR	ON	2008/04/28 05:48
L7	1	L6 and (vary$3 near8 rate).clm.	US-PGPUB	OR	ON	2008/04/28 05:48
S1	1	("5797089").PN.	US-PGPUB; USPAT; USOCR; EPO	OR	OFF	2003/09/21 19:47
S2	53950	"455"/$.ccls.	US-PGPUB; USPAT; EPO	OR	ON	2003/09/21 19:47
S3	25704	S2 and (wireless or mobile or cellular)	US-PGPUB; USPAT; EPO	OR	ON	2007/04/16 10:46
S4	1487	S3 and (channel near3 quality)	US-PGPUB; USPAT; EPO	OR	ON	2003/09/21 19:48
S5	1	S4 and (vary$3 near5 (feedback near3 rate))	US-PGPUB; USPAT; EPO	OR	ON	2003/09/21 19:49
S6	1	(channel near3 quality) and (vary $3 near5 (feedback near3 rate))	US-PGPUB; USPAT; EPO	OR	ON	2003/09/21 19:49
S7	13	(channel near3 quality) and (vary $3 near5 feedback)	US-PGPUB; USPAT; EPO	OR	ON	2007/04/16 10:46
S8	11	S7 and rate	US-PGPUB; USPAT; EPO	OR	ON	2003/09/21 19:49

S9	7	S8 and (wireless or mobile or cellular)	US-PGPUB; USPAT; EPO	OR	ON	2003/09/21 19:58
S10	3	S9 and "mobile station"	US-PGPUB; USPAT; EPO	OR	ON	2003/09/21 19:50
S11	1	S9 and "second rate"	US-PGPUB; USPAT; EPO	OR	ON	2007/04/16 10:47
S12	299	"variable rate" and (channel near3 quality)	US-PGPUB; USPAT; EPO	OR	ON	2003/09/21 19:59
S13	230	S12 and (wireless or mobile or cellular)	US-PGPUB; USPAT; EPO	OR	ON	2003/09/21 19:59
S14	7	S13 and "second rate"	US-PGPUB; USPAT; EPO	OR	ON	2003/09/21 20:24
S15	6	S14 and feedback	US-PGPUB; USPAT; EPO	OR	ON	2007/04/16 10:47
S16	2	S13 and ("mobile station" near8 report$3 near8 "channel quality")	US-PGPUB; USPAT; EPO	OR	ON	2003/09/21 20:24
S17	8	"mobile station" near8 report$3 near8 "channel quality"	US-PGPUB; USPAT; EPO	OR	ON	2003/09/21 20:26
S18	1	S17 and "second rate"	US-PGPUB; USPAT; EPO	OR	ON	2003/09/21 20:24
S19	2	S17 and "variable rate"	US-PGPUB; USPAT; EPO	OR	ON	2003/09/21 20:26
S20	1024	(channel near3 quality) and (vary $3 near5 rate)	US-PGPUB; USPAT; EPO	OR	ON	2007/04/16 11:16
S21	781	S20 and (wireless or mobile or cellular)	US-PGPUB; USPAT; EPO	OR	ON	2007/04/16 10:46

S22	278	S21 and ("second rate" or "different rate" or "higher rate")	US-PGPUB; USPAT; EPO	OR	ON	2007/04/16 11:19
S23	63	S22 and feedback	USPAT	OR	ON	2007/04/16 11:17
S24	38	S23 and "base station"	US-PGPUB; USPAT; EPO	OR	ON	2007/04/16 10:48
S25	8	S24 and "variable rate"	US-PGPUB; USPAT; EPO	OR	ON	2007/04/16 10:48
S26	90314	"455"/$.ccls.	US-PGPUB; USPAT; EPO	OR	ON	2007/04/16 11:16
S27	26	S26 and (report$3 near8 "channel quality") and (vary $3 near5 rate)	US-PGPUB; USPAT; EPO	OR	ON	2007/04/16 11:20
S28	5	S27 and feedback	USPAT	OR	ON	2007/04/16 11:17
S29	11	S27 and ("second rate" or "different rate" or "higher rate")	US-PGPUB; USPAT; EPO	OR	ON	2007/04/16 11:19
S30	8	S26 and (report$3 near8 "channel quality") and (vary $3 near5 rate)	USPAT	OR	ON	2007/04/16 11:21
S31	6	S30 and "signal strength"	US-PGPUB; USPAT; EPO	OR	ON	2007/04/16 11:21
S32	100331	"455"/$.ccls.	US-PGPUB; USPAT; EPO	OR	ON	2008/02/19 12:29
S33	300	S32 and "channel quality information"	US-PGPUB; USPAT; EPO	OR	ON	2008/02/19 12:29
S34	25	S33 and (vary$3 near8 rate)	US-PGPUB; USPAT; EPO	OR	ON	2008/02/19 12:30

S35	6	S33 and (vary$3 near8 rate)	USPAT	OR	ON	2008/02/19 12:30
S36	4	S35 and report$3	US-PGPUB; USPAT; EPO	OR	ON	2008/02/19 12:33

4/28/08 5:49:47 AM
C:\Documents and Settings\tnguyen19\My Documents\EAST\workspaces\10002746.wsp

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	10002746	DAS ET AL.
	Examiner	Art Unit
	THUAN T NGUYEN	2618

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

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

CLAIM		DATE								
Final	Original	04/24/2008								
1	1	=								
	2	-								
	3	-								
2	4	=								
3	5	=								
4	6	=								
5	7	=								
6	8	=								
7	9	=								
8	10	=								
9	11	=								
10	12	=								
11	13	=								
12	14	=								
13	15	=								

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	10002746	DAS ET AL.
	Examiner	Art Unit
	THUAN T NGUYEN	2618

ORIGINAL		INTERNATIONAL CLASSIFICATION	
CLASS	SUBCLASS	CLAIMED	NON-CLAIMED
455	67.13	H 0 4 B 17 / 02 (2006.01.01)	

CROSS REFERENCE(S)					
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)				
455	67.11	250.1	501		

NONE (Assistant Examiner) (Date)		Total Claims Allowed: 13	
/TONY T NGUYEN/ (Primary Examiner)	4/22/08 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	10002746	DAS ET AL.
	Examiner	Art Unit
	THUAN T NGUYEN	2618

SEARCHED			
Class	Subclass	Date	Examiner
455	436, 437, 502-503, 450, 442, 452.2, 358	4/22/08	TN
375	222, 225, 240	4/22/08	TN

SEARCH NOTES		
Search Notes	Date	Examiner
EAST SEARCHED	4/22/08	TN

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner
455	426, 437, 442, 503	4/22/08	TN
375	222, 225, 240	4/22/08	TN

Attorney Docket No. 129250-002099/US

IN THE U.S. PATENT AND TRADEMARK OFFICE

APPLICANT(S):	Arnab DAS et al.	CONF. NO.:	3832
APPL. NO.:	10/002,746	ART UNIT:	2618
FILED	November 2, 2001	EXAMINER:	Thuan T. NGUYEN
ENTITLED:	VARIABLE RATE CHANNEL QUALITY FEEDBACK IN A WIRELESS COMMUNICATION SYSTEM		

APPELLANTS' BRIEF ON APPEAL

MAIL STOP APPEAL BRIEF - PATENTS
Customer Service Window
Randolph Building
401 Dulany Street
Alexandria, VA 22314

February 13, 2008

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APPELLANTS' BRIEF ON APPEAL

I. REAL PARTY IN INTEREST:

The real party in interest in this appeal is Lucent Technologies Inc. Assignment of the application was submitted to the U.S. Patent and Trademark Office and recorded at Reel 012354, Frame 0991.

II. RELATED APPEALS AND INTERFERENCES:

There are no known appeals or interferences that will affect, be directly affected by, or have a bearing on the Board's decision in this Appeal.

III. STATUS OF CLAIMS:

Claims 1 and 4-15 are pending in the application, with claims 1, 11 and 13 being written in independent form. Claims 2 and 3 have been canceled.

Claims 1 and 4-15 remain finally rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. patent No. 6,067,458 to Chen ("Chen") in view of U.S. Patent No. 6,044,272 to Kobylinski ("Kobylinski"). Claims 1 and 4-15 are being appealed.

IV. STATUS OF AMENDMENTS:

An Amendment After Final ("AAF") was filed on November 28, 2007. As of this date the Appellants have not received an Advisory Action from the Examiner.

V. SUMMARY OF CLAIMED SUBJECT MATTER:

(i). Overview of the Subject Matter of the Independent Claims

The present invention is directed at varying the rate at which information about the quality of a channel, between a base station and mobile device, is sent from the mobile device to the base station. More specifically, independent claim 1 reads as follows (specification citations are in parenthesis):

1. A method for transmitting channel quality information in a wireless communication system comprising at least one base station and at least one mobile station, the method comprising:

varying a rate for reporting channel quality information from a mobile station to a base station as a function of the presence or absence of a reception of a data transmission at the mobile station (page 5, lines 6-16)**, wherein the mobile station reports channel quality information at a first rate in the absence of a reception of a data transmission from the base station** (page 5, lines 6-9; page 5, line 16 to page 6, line 5; and page 6, line 26 to page 7, line 16) **and, upon detection of a reception of a data transmission from the base station, the mobile station reports channel quality information at a second rate for a prescribed duration** (page 5, lines 11-13; page 5, line 16 to page 6, line 5; and page 6, line 26 to page 7, line 16)**.**

Independent claim 11 reads as follows:

11. A method for adapting the rate of reporting channel quality information in a wireless communication system including at least one base station and at least one mobile station (page 5, lines 6-16)**, the method comprising:**

reporting channel quality information from the at least one mobile station to the at least one base station at a first rate in the absence of a reception of a data transmission at the at least one mobile station (page 5, lines 6-9; page 5, line 16 to page 6, line 5; and page 6, line 26 to page 7, line 16)**; and**

in the presence of a reception of a data transmission at the at least one mobile station, adapting the rate for reporting channel quality information from the at least one mobile station to the at least one base station from the first rate to a second rate for a prescribed duration (page 5, lines 11-13; page 5, line 16 to page 6, line 5; and page 6, line 26 to page 7, line 16)**.**

Independent claim 13 reads as follows:

13. A method for transmitting channel quality information in a wireless communication system including at least one base station and at least one mobile station, the method comprising:

varying a rate for reporting channel quality information from a mobile station to a base station as a function of the number of base stations with which the mobile station is communicating (page 9, lines 1-22)**.**

In order to make the overview set forth above concise the disclosure that has been included, or referred to, above only represents a portion of the total disclosure set forth in the Specification that supports the independent claims.

(ii). The Remainder of the Specification Also Supports the Claims

The Appellants note that there may be additional disclosure in the Specification that also supports the independent and dependent claims. Further, by including the specification citations in parenthesis above the Appellants do not represent that this is the only evidence that supports the independent claims nor do Appellants necessarily represent that these citations alone can be used to fully interpret the claims of the present invention. Instead, the citations provide background support as an overview of the claimed subject matter.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL:

Appellants seek the Board's review and reversal of the rejection of claims 1 and 4-15 under 35 U.S.C. §103(a) based on Chen in combination with Kobylinski.

VII. ARGUMENTS:

A. The § 103 Rejections

Claims 1 and 4-15 stand rejected under 35 U.S.C. 103(a) as unpatentable over Chen in view of Kobylinski. The Appellants respectfully disagree.

(i) Independent claim 1

With regard to Chen, in the Final Office Action ("Action") the Examiner points to col. 6, lines 10-48, as teaching "varying rate information exchange between mobile station and base station" that uses an "idle time" rate of 1/8 of the full rate while a "higher rate is used when voice or data communicating between these two components," Action at 3. The Appellants contend that this interpretation is inconsistent with the teachings of Chen as would be understood by one of ordinary skill in the art.

The Appellants contend that, as reflected in Chen's FIGS. 1A-D, while the effective transmission rate decreases through FIGS. 1A-D, there is no suggestion that the actual transmission rate, i.e., the transmission rate during the active periods designated by the shaded blocks, varies in any way.

The Appellants further contend that no teaching or suggestion has been identified in Chen with regard to the transmission of "channel quality information" as recited in claim 1. Although the Appellants agree that Chen provides for higher effective transmission rates when transmitting data or voice when considered relative to the rates used for transmitting "silence," as taught by Chen, the additional information being transmitted is the content of the message, not additional or more frequent information regarding "channel quality information."

The Appellants note that the MPEP provides:

It is important for an examiner to properly communicate the basis for a rejection so that the issues can be identified early and the applicant can be given fair opportunity to reply. Furthermore, if an initially rejected application issues as a patent, the rationale behind an earlier rejection may be important

in interpreting the scope of the patent claims. Since issued patents are presumed valid and constitute a property right, the written record must be clear as to the basis for the grant. Since patent examiners cannot normally be compelled to testify in legal proceedings regarding their mental processes it is important that the written record clearly explain the rationale for decisions made during prosecution of the application. MPEP § 706.02(j) (internal citations omitted).

The Appellants respectfully contend that the Examiner's allegations regarding the particular type of information being transmitted by Chen does not fairly communicate the logical or factual basis upon which the allegation is based. The Appellants further contend that speculation alone does not constitute a valid basis for maintaining a rejection under 35 U.S.C. § 103(a). Accordingly, the Appellants maintain that this rejection should be withdrawn as not properly supported.

With respect to Kobylinski, the Appellants again contend that Kobylinski's disclosure, as understood by one of ordinary skill in the art, does not fairly teach or suggest the transmission of "channel quality information" at different rates. In particular, the Appellants note that Kobylinski's FIGS. 1A and 1B indicate that the mobile unit reports "channel quality information" including, for example, measured RSS values, measured BER values and DVCC via a SACCH (Slow Associated Control CHannel) word in response to either Measurement Order 1 or Measurement Order 2.

As reflected in Kobylinski's FIG. 2, the SACCH word 52 is present in each slot 50 of each frame 40. Accordingly, the Appellants contend that no teaching has yet been identified in Kobylinski that would suggest to one of ordinary skill in the art that "channel quality information" is being transmitted at different rates during idle periods when compared with data transmission periods. Indeed, the Appellants contend that, according to the teachings of Kobylinski, one of ordinary skill in the art would understand the mobile unit to be providing "channel quality information" at a substantially constant rate in response to either of the Measurement Orders generated by the base station.

The Appellants further note that claim 1 requires that the mobile station report "channel quality information at a first rate in the absence of a reception of a data transmission from the base station". The Appellants contend that according to Kobylinski, the mobile station only reports "channel quality information" in response to a command from the base station.

Accordingly, the Appellants contend that the proposed combination of Chen and Kobylinski is insufficient to teach or suggest each of the elements of claim 1.

(ii) Dependent claims 4 and 5

With respect to claims 4 and 5, the Appellants incorporate the discussion provided above with respect to claim 1 and the deficiencies of the proposed combination of Chen and Kobylinski. The Appellants maintain that no teaching or suggestion has yet been identified that would suggest that the increase in the effective transmission rate illustrated by Chen translates into an increased transmission rate of "channel quality information." Accordingly, in addition to their dependence from claim 1, the Appellants contend that claims 4 and 5 are separately allowable over the applied references.

(iii) Dependent claim 6

With respect to claim 6, the Appellants incorporate the discussion provided above with respect to claim 1 and the deficiencies of the proposed combination of Chen and Kobylinski. The Appellants maintain that no teaching or suggestion has yet been identified that would suggest that the increase in the effective transmission rate illustrated by Chen translates into any variation in the transmission rate of "channel quality information" as claimed or faster during transmission of data. Accordingly, in addition to its dependence from claim 1, the Appellants contend that claim 6 is separately allowable over the applied references.

(iv) Dependent claims 7-10

With respect to claims 7-10, the Appellants incorporate the discussion provided above with respect to claim 1 and the deficiencies of the proposed combination of Chen and Kobylinski. The Appellants maintain that no teaching or suggestion has yet been identified that would suggest that the increase in the effective transmission rate illustrated by Chen translates into an increased transmission rate of "channel quality information." Accordingly, the Appellants contend that these claims are allowable at least in light of their dependence from claim 1.

(v) Claims 11-15

With respect to claims 11 and 12 and 13-15, the Appellants incorporate the discussion provided above with respect to claim 1 and the deficiencies of the proposed combination of Chen and Kobylinski with regard to claims 1-10. The Appellants maintain that no teaching or suggestion has yet been identified that would suggest that the increase in the effective transmission rate illustrated by Chen translates into an increased transmission rate of "channel quality information" as recited in both claim 11 and claim 13. The Appellants contend, therefore, that these claims are allowable over the applied references for at least the reasons detailed above.

Conclusion:

Accordingly, Appellants respectfully request that the members of the Board reverse the decision of the Examiner, withdraw the rejections and allow claims 1 and 4-15.

The Commissioner is authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 50-3777 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

Capitol Patent & Trademark Law Firm, PLLC

By: /John E. Curtin/

John E. Curtin, Reg. No. 37,602

P.O. Box 1995
Vienna, VA 22183
(703)266-3330

VIII. CLAIMS APPENDIX

1. A method for transmitting channel quality information in a wireless communication system comprising at least one base station and at least one mobile station, the method comprising:

varying a rate for reporting channel quality information from a mobile station to a base station as a function of the presence or absence of a reception of a data transmission at the mobile station, wherein the mobile station reports channel quality information at a first rate in the absence of a reception of a data transmission from the base station and, upon detection of a reception of a data transmission from the base station, the mobile station reports channel quality information at a second rate for a prescribed duration.

2-3. (CANCELED)

4. The method according to claim 1, wherein, upon detection of a reception of a data transmission from the base station, the mobile station reports channel quality information at a plurality of rates over a prescribed time period after detection of the reception of a data transmission, wherein the plurality of rates are different than the first rate.

5. The method according to claim 4, wherein the prescribed time period includes a plurality of time intervals such that the channel quality information is reported at different ones of the plurality of rates during different ones of the plurality of time intervals.

6. The method according to claim 1, wherein the second rate is faster than the first rate.

7. The method according to claim 1, further comprising the step of estimating channel quality at the base station while the mobile station is reporting at the second rate, wherein estimated channel quality is used to derive a transmission format for a subsequent transmission.

8. The method according to claim 7, wherein the transmission format includes one or more parameters selected from the group consisting of modulation format, number of codes, and transmission rate.

9. The method according to claim 1, further comprising the step of estimating channel quality at the base station while the mobile station is reporting at the second rate, wherein estimated channel quality is used to calculate an amount of redundancy needed for a retransmission of a previous data transmission.

10. The method according to claim 1, wherein the channel quality information comprises a transmission rate calculated by the mobile station based on one or more channel conditions.

11. A method for adapting the rate of reporting channel quality information in a wireless communication system including at least one base station and at least one mobile station, the method comprising:

reporting channel quality information from the at least one mobile station to the at least one base station at a first rate in the absence of a reception of a data transmission at the at least one mobile station; and

in the presence of a reception of a data transmission at the at least one mobile station, adapting the rate for reporting channel quality information from the at least one mobile station to the at least one base station from the first rate to a second rate for a prescribed duration.

12. The method according to claim 11, wherein the second rate is faster than the first rate.

13. A method for transmitting channel quality information in a wireless communication system including at least one base station and at least one mobile station, the method comprising:

varying a rate for reporting channel quality information from a mobile station to a base station as a function of the number of base stations with which the mobile station is communicating.

14. The method according to claim 13, wherein the mobile station reports channel quality information at a first rate when the mobile station is communicating with one base station and wherein the mobile station reports channel quality information at a second rate when the mobile station is communicating with a plurality of base stations.

15. The method according to claim 14 wherein the second rate is faster than the first rate..

IX. EVIDENCE APPENDIX

None.

X. RELATED PROCEEDINGS APPENDIX

None.

Electronic Patent Application Fee Transmittal

Application Number:	10002746
Filing Date:	02-Nov-2001
Title of Invention:	Variable rate channel quality feedback in a wireless communication system
First Named Inventor/Applicant Name:	Amab Das
Filer:	John E. Curtin
Attorney Docket Number:	29250-002099/US
Filed as Large Entity	

Utility Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Notice of appeal	1401	1	510	510
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
			Total in USD ($)	**510**

Electronic Acknowledgement Receipt	
EFS ID:	2857651
Application Number:	10002746
International Application Number:	
Confirmation Number:	3832
Title of Invention:	Variable rate channel quality feedback in a wireless communication system
First Named Inventor/Applicant Name:	Amab Das
Customer Number:	32498
Filer:	John E. Curtin
Filer Authorized By:	
Attorney Docket Number:	29250-002099/US
Receipt Date:	13-FEB-2008
Filing Date:	02-NOV-2001
Time Stamp:	23:38:39
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$510
RAM confirmation Number	4216
Deposit Account	503777
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)	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes) /Message Digest	Multi Part /.zip	Pages (if appl.)
1	Appeal Brief Filed	AppealBrief.pdf	86264 81780234b3047cf6a4605731fca107f4c83e472f	no	13
Warnings:					
Information:					
2	Fee Worksheet (PTO-06)	fee-info.pdf	8158 cabe3e45521e9770c641dab0c1e7d9501fe04f31	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	94422		

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

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

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

MAIL STOP AF
EXAMINING GROUP 2618

PATENT
129250-002099/US

IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicant:	Arnab DAS et al.	Conf.:	3832
Appl. No.:	10/002,746	Group:	2618
Filed:	November 2, 2001	Examiner:	Thuan T. Nguyen
For:	VARIABLE RATE CHANNEL QUALITY FEEDBACK IN A WIRELESS COMMUNICATION SYSTEM		
Docket No.:	129250-002099/US		

NOTICE OF APPEAL FROM THE
PRIMARY EXAMINER TO THE BOARD OF APPEALS

Customer Service Window
Randolph Building
401 Dulany Street
Alexandria, VA 22314
Mail Stop AF

December 13, 2007

Sir:

Applicants hereby appeal to the Board of Appeals from the decision dated September 13, 2007 of the Supervisory Patent Examiner's final rejection of claims 1, and 4-15.

☐ The enclosed document is being transmitted via the Certificate of Mailing provisions of 37 C.F.R. § 1.8.

☐ The enclosed document is concurrently filed with a Pre-Appeal Brief Request for Review.

Applicants hereby petition for an extension of _____ (_____) **month(s)** pursuant to 37 C.F.R. §§ 1.17 and 1.136(a).

The fee has been calculated as shown below:

☐ NO extensions of time have been previously obtained for responding to the Final Rejection. Thus a fee of $.00 is required for the full period of the above-requested

extension of time.

☐ An extension of _____(_____) **month(s)** for responding to the Final Rejection was previously requested and paid for on . Thus a fee of $ is required.

☐ Applicant claims small entity status. See 37 C.F.R. § 1.27.

The Government fee for filing a Notice of Appeal to the Board of Appeals is calculated as follows:

☒ Large entity - $510.00

☐ Small Entity - $250.00

Therefore, the TOTAL FEE due for the filing of this Notice of Appeal is $510.

Payment of the above TOTAL FEE is being made in the following manner:

☐ Check in the amount of $510.00 is enclosed.

☒ Please charge Deposit Account No. 50-3777 in the amount of $510.00. A triplicate copy of this sheet is attached.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 50-3777 for any additional fees required under 37 C.F.R. §§1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

CAPITOL PATENT & TRADEMARK LAW FIRM, PLLC.

By ; /John E. Curtin/
John E. Curtin, Reg. No. 37,602

P.O. Box 1995
Vienna, Virginia 22183
(703) 266-3330

Electronic Patent Application Fee Transmittal

Application Number:	10002746
Filing Date:	02-Nov-2001
Title of Invention:	Variable rate channel quality feedback in a wireless communication system
First Named Inventor/Applicant Name:	Amab Das
Filer:	John E. Curtin
Attorney Docket Number:	29250-002099/US
Filed as Large Entity	

Utility Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Notice of appeal	1401	1	510	510
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
			Total in USD ($)	**510**

Electronic Acknowledgement Receipt	
EFS ID:	2590093
Application Number:	10002746
International Application Number:	
Confirmation Number:	3832
Title of Invention:	Variable rate channel quality feedback in a wireless communication system
First Named Inventor/Applicant Name:	Amab Das
Customer Number:	32498
Filer:	John E. Curtin
Filer Authorized By:	
Attorney Docket Number:	29250-002099/US
Receipt Date:	13-DEC-2007
Filing Date:	02-NOV-2001
Time Stamp:	23:10:15
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$510
RAM confirmation Number	4337
Deposit Account	503777
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 1.17 (Patent application and reexamination processing fees)	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes) /Message Digest	Multi Part /.zip	Pages (if appl.)
1	Notice of Appeal Filed	NoticeofAppeal.pdf	19980 bff8ee47e0bc7371a4c86fed18a231f60de25057	no	2
Warnings:					
Information:					
2	Fee Worksheet (PTO-06)	fee-info.pdf	8158 a33bc6d3fdb7b5681dceac04043e124e1935b5a6	no	2
Warnings:					
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		Total Files Size (in bytes):	28138		

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

New International Application Filed with the USPTO as a Receiving Office
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M/S AF
Attorney Docket No. 129250-002099/US

IN THE U.S. PATENT AND TRADEMARK OFFICE

APPLICANT(S):	Arnab DAS et al.	CONF. NO.:	3832
APPL. NO.:	10/002,746	ART UNIT:	2618
FILED	November 2, 2001	EXAMINER:	Thuan T. NGUYEN
ENTITLED:	VARIABLE RATE CHANNEL QUALITY FEEDBACK IN A WIRELESS COMMUNICATION SYSTEM		

RESPONSE UNDER 37 C.F.R. § 1.116

November 28, 2007

M/S AF
Commissioner for Patents
Customer Service Window
Randolph Building
401 Dulany Street
Alexandria, VA 22314

Sir:

In response to the FINAL Office Action dated September 13, 2007, ("Action") for the above-identified patent application, entry and consideration of the amendments to the claims and remarks provided below is respectfully requested. The Applicants respectfully submit that entry of the present amendments would place the claims in better form for appeal and should, therefore, be entered. The sections included in this response are as follows:

Amendments to the Claims begin on **page 2** of this paper; and
a **Remarks** section begins on **page 7** of this paper.

AMENDMENTS TO THE CLAIMS

The following is a complete, marked up listing of revised claims with a status identifier in parentheses, underlined text indicating insertions, and strikethrough and/or double-bracketed text indicating deletions.

LISTING OF CLAIMS

1. (PREVIOUSLY PRESENTED) A method for transmitting channel quality information in a wireless communication system comprising at least one base station and at least one mobile station, the method comprising:

varying a rate for reporting channel quality information from a mobile station to a base station as a function of the presence or absence of a reception of a data transmission at the mobile station, wherein the mobile station reports channel quality information at a first rate in the absence of a reception of a data transmission from the base station and, upon detection of a reception of a data transmission from the base station, the mobile station reports channel quality information at a second rate for a prescribed duration.

2-3. (CANCELED)

4. (PREVIOUSLY PRESENTED) The method according to claim 1, wherein, upon detection of a reception of a data transmission from the base station, the mobile station reports channel quality information at a plurality of rates over a prescribed time period after detection of the reception of a data transmission, wherein the plurality of rates are different than the first rate.

5. (PREVIOUSLY PRESENTED) The method according to claim 4, wherein the prescribed time period includes a plurality of time intervals such that the channel quality information is reported at different ones of the plurality of rates during different ones of the plurality of time intervals.

6. (PREVIOUSLY PRESENTED) The method according to claim 1, wherein the second rate is faster than the first rate.

7. (PREVIOUSLY PRESENTED) The method according to claim 1, further comprising the step of estimating channel quality at the base station while the mobile station is reporting at the second rate, wherein estimated channel quality is used to derive a transmission format for a subsequent transmission.

8. (ORIGINAL) The method according to claim 7, wherein the transmission format includes one or more parameters selected from the group consisting of modulation format, number of codes, and transmission rate.

9. (PREVIOUSLY PRESENTED) The method according to claim 1, further comprising the step of estimating channel quality at the base station while the mobile station is reporting at the second rate, wherein estimated channel quality is used to calculate an amount of redundancy needed for a retransmission of a previous data transmission.

10. (ORIGINAL) The method according to claim 1, wherein the channel quality information comprises a transmission rate calculated by the mobile station based on one or more channel conditions.

11. (PREVIOUSLY PRESENTED) A method for adapting the rate of reporting channel quality information in a wireless communication system including at least one base station and at least one mobile station, the method comprising:

reporting channel quality information from the at least one mobile station to the at least one base station at a first rate in the absence of a reception of a data transmission at the at least one mobile station; and

in the presence of a reception of a data transmission at the at least one mobile station, adapting the rate for reporting channel quality information from the at least one mobile station to the at least one base station from the first rate to a second rate for a prescribed duration.

12. (ORIGINAL) The method according to claim 11, wherein the second rate is faster than the first rate.

13. (CURRENTLY AMENDED) A method for transmitting channel quality information in a wireless communication system including at least one base station and at least one mobile station, the method comprising:

varying a rate for reporting channel quality information from a mobile station to a base station as a function of the number of base stations [[that]] with which the mobile station is communicating[[with]].

14. (ORIGINAL) The method according to claim 13, wherein the mobile station reports channel quality information at a first rate when the mobile station is communicating with one base station and wherein the mobile station reports channel quality information at a second rate when the mobile station is communicating with a plurality of base stations.

15. (ORIGINAL) The method according to claim 14 wherein the second rate is faster than the first rate.

* * * * *

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REMARKS

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

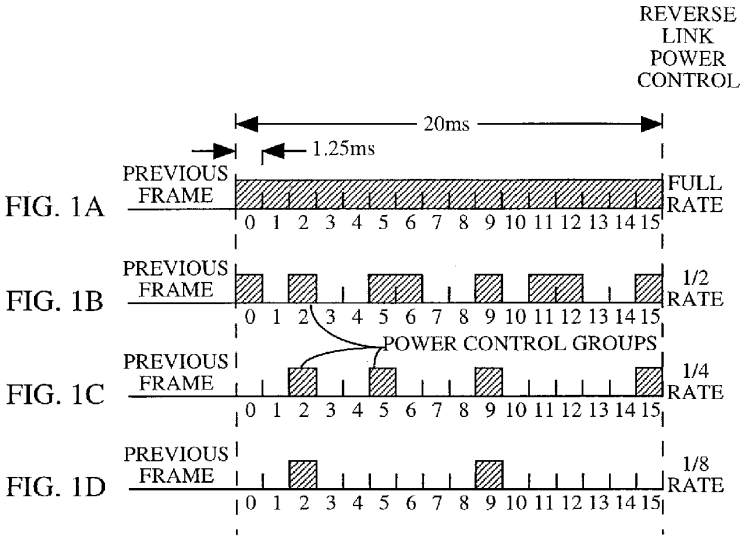
No claims having been canceled or added by this response, the Applicants respectfully submit that claims 1 and 4-15 remain properly under consideration in this application. The above Listing of Claims shows the amended claims in marked-up form in accordance with 37 C.F.R. § 1.121.

Rejections under 35 U.S.C. § 103

Claims 1 and 4-15 stand rejected under 35 U.S.C. 103(a) as unpatentable over Chen (U.S. Patent No. 6,067,458) ("Chen") in view of in view of Kobylinski et al. (U.S. Patent 6,044,272) ("Kobylinski"). The Applicants traverse this rejection.

With regard to Chen, the Examiner points to col. 6, lines 10-48, as teaching "varying rate information exchange between mobile station and base station" that uses an "idle time" rate of 1/8 of the full rate while a "higher rate is used when voice or data communicating between these two components," Action at 3. The Applicants contend that this interpretation is inconsistent with the teachings of Chen as would be understood by one of ordinary skill in the art.

The Applicants contend that, as reflected in Chen's FIGS. 1A-D (reproduced below), while the effective transmission rate decreases through FIGS. 1A-D, there is no suggestion that the actual transmission rate, *i.e.*, the transmission rate during the active periods designated by the shaded blocks, varies in any way.



The Applicants further contend that no teaching or suggestion has been identified in Chen with regard to the transmission of "channel quality information" as recited in claim 1. Although the Applicants agree that Chen provides for higher effective transmission rates when transmitting data or voice when considered relative to the rates used for transmitting "silence," as taught by Chen, the additional information being transmitted is the content of the message, not additional or more frequent information regarding the "channel quality information."

The Applicants note that the MPEP provides:

> It is important for an examiner to properly communicate the basis for a rejection so that the issues can be identified early and the applicant can be given fair opportunity to reply. Furthermore, if an initially rejected application issues as a patent, the rationale behind an earlier rejection may be important in interpreting the scope of the patent claims. Since issued patents are presumed valid and constitute a property right, the written record must be clear as to the basis for the grant. Since patent examiners cannot normally be compelled to testify in legal proceedings regarding their mental processes it is important that the written record clearly explain the rationale for decisions made during prosecution of the application.

MPEP § 706.02(j) (internal citations omitted). The Applicants respectfully contend that the Examiner's allegations regarding the particular type of information being transmitted by Chen does not fairly communicate the logical or factual basis upon which the allegation is based. The Applicants further contend that speculation alone does not constitute a valid basis for maintaining a rejection under 35 U.S.C. § 103(a).

Accordingly, should the Examiner wish to maintain the present rejection based on the teachings of Chen, the Applicants request that the next communication identify, with specificity, the portion or portions of Chen that are alleged to teach the communication of "channel quality information" at varying rates so that the Applicants may have a full and fair opportunity to understand and address the Examiner's reasoning. If no such teachings are identified, the Applicants maintain that this rejection should be withdrawn as not properly supported.

With respect to Kobylinski, the Applicants again contend that the disclosure, as understood by one of ordinary skill in the art, does not fairly teach or suggest the transmission of "channel quality information" at different rates. In particular, the Applicants note that Kobylinski's FIGS. 1A and 1B (reproduced below) indicate that the mobile unit reports "channel quality information" including, for example, measured RSS values, measured BER values and DVCC via the SACCH (Slow Associated Control CHannel) word in response to either Measurement Order 1 or Measurement Order 2.

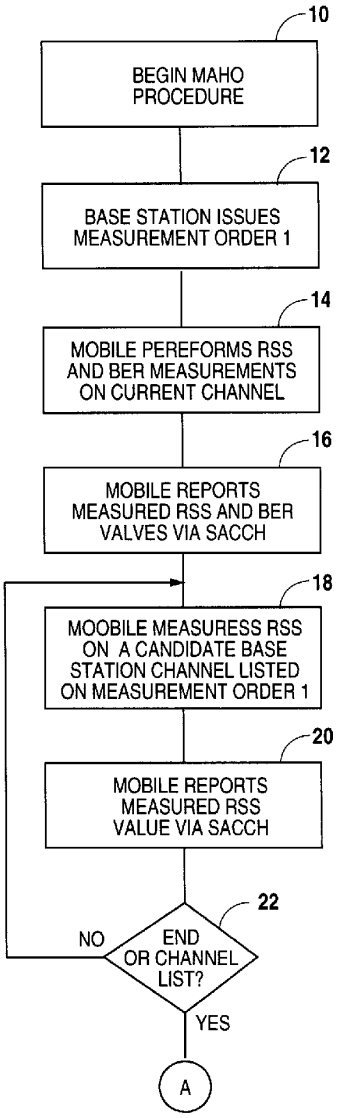


Fig.1A

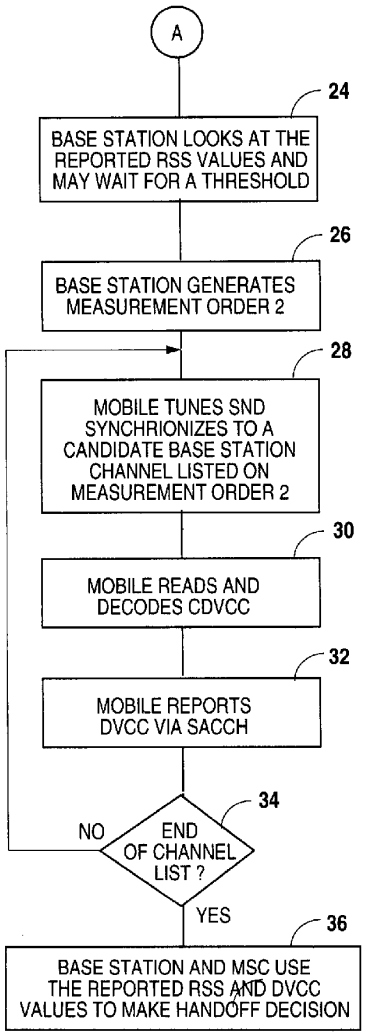


Fig. 1B

As reflected in Kobylinski's FIG. 2 (reproduced below), the SACCH word 52 is present in each slot 50 of each frame 40. Accordingly, the Applicants contend that no teaching

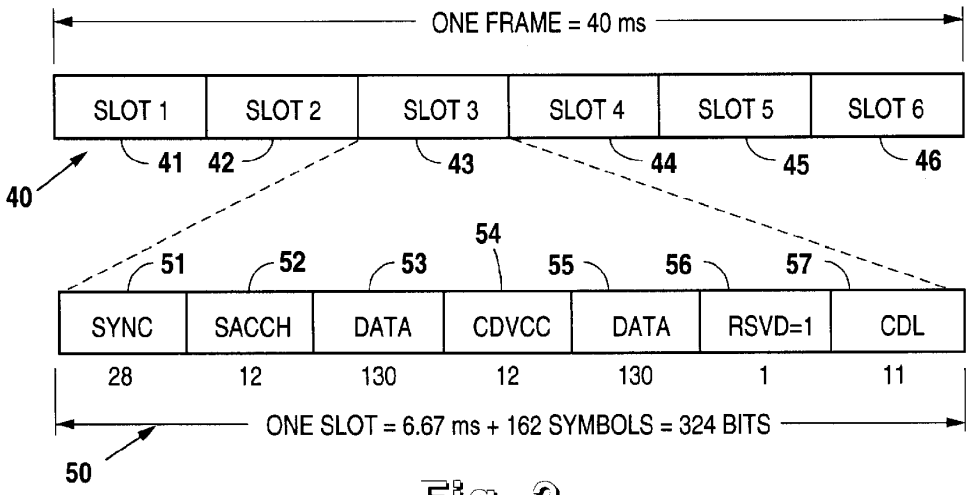


Fig. 2

has yet been identified in Kobylinski that would suggest to one of ordinary skill in the art that "channel quality information" is being transmitted at different rates during idle periods when compared with data transmission periods. Indeed, the Applicants contend that, in accord with the teachings of Kobylinski, one of ordinary skill in the art would understand the mobile unit to be providing "channel quality information" at a substantially constant rate in response to either of the measurement orders generated by the base station.

The Applicants further note that claim 1 requires that the mobile station report "channel quality information at a first rate ***in the absence of a reception of a data transmission from the base station***" (emphasis added). The Applicants contend that according to Kobylinski, the mobile station only reports "channel quality information" in

response to a command from the base station. Accordingly, the Applicants contend that the proposed combination of Chen and Kobylinski is insufficient to teach or suggest each of the elements of the recited method.

Accordingly, should the Examiner wish to maintain the present rejection based on the teachings of Kobylinski, the Applicants request that the next communication identify, with specificity, the portion or portions of Kobylinski that are alleged to teach the communication of "channel quality information" and/or the transmission of such information in the absence of a "Measurement Order" from the base station so that the Applicants may have a full and fair opportunity to understand and address the Examiner's reasoning. If no such teachings are identified, the Applicants maintain that this rejection should be withdrawn as not properly supported.

With respect to claims 4 and 5, the Applicants incorporate the discussion provided above with regard to the deficiencies of the proposed combination of Chen and Kobylinski. The Applicants maintain that no teaching or suggestion has yet been identified that would suggest that the increase in the effective transmission rate illustrated by Chen translates into an increased transmission rate of "channel quality information." Accordingly, in addition to their dependence from claim 1, the Applicants contend that claims 4 and 5 are separately allowable over the applied references.

With respect to claim 6, the Applicants incorporate the discussion provided above with regard to the deficiencies of the proposed combination of Chen and Kobylinski. The

Applicants maintain that no teaching or suggestion has yet been identified that would suggest that the increase in the effective transmission rate illustrated by Chen translates into any variation in the transmission rate of "channel quality information" as claimed or faster during transmission of data. Accordingly, in addition to its dependence from claim 1, the Applicants contend that claim 6 is separately allowable over the applied references.

With respect to claims 7-10, the Applicants incorporate the discussion provided above with regard to the deficiencies of the proposed combination of Chen and Kobylinski. The Applicants maintain that no teaching or suggestion has yet been identified that would suggest that the increase in the effective transmission rate illustrated by Chen translates into an increased transmission rate of "channel quality information." Accordingly, the Applicants contend that these claims are allowable at least in light of their dependence from claim 1.

With respect to claims 11 and 12 and 13-15, the Applicants incorporate the discussion provided above with regard to the deficiencies of the proposed combination of Chen and Kobylinski with regard to claims 1-10. The Applicants maintain that no teaching or suggestion has yet been identified that would suggest that the increase in the effective transmission rate illustrated by Chen translates into an increased transmission rate of "channel quality information" as recited in both claim 11 and claim 13. The

Applicants contend, therefore, that these claims are allowable over the applied references for at least the reasons detailed above.

The Applicants request that the pending rejections be reconsidered and withdrawn accordingly.

CONCLUSION

In view of the above remarks and amendments, the Applicants respectfully submit that each of the pending objections and rejections have been addressed and overcome, leaving the present application in condition for allowance. A Notice to that effect is respectfully requested.

If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to contact the undersigned.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies to charge any underpayment or non-payment of any fees required under 37 C.F.R. §§ 1.16 or 1.17, or credit any overpayment of such fees, to Deposit Account No. 503777, including, in particular, extension of time fees.

Respectfully submitted,

CAPITOL PATENT & TRADEMARK LAW FIRM, PLLC

By /Gregory P. Brummett/ (Reg. No. 41,646) for
John E. Curtin, Reg. No. 37,602

P.O. Box 1995
Vienna, VA 22183

PTO/SB/21 (11-07)
Approved for use through 11/30/2007. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Total Number of Pages in This Submission	17

Application Number	10/002,746
Filing Date	2 NOVEMBER 2007
First Named Inventor	Arnab DAS
Art Unit	2618
Examiner Name	Thaun T. NGUYEN
Attorney Docket Number	129250-002099/US

ENCLOSURES *(Check all that apply)*

- ☐ Fee Transmittal Form
  - ☐ Fee Attached
- ☑ Amendment/Reply
  - ☑ After Final
  - ☐ Affidavits/declaration(s)
- ☐ Extension of Time Request
- ☐ Express Abandonment Request
- ☐ Information Disclosure Statement
- ☐ Certified Copy of Priority Document(s)
- ☐ Reply to Missing Parts/ Incomplete Application
  - ☐ Reply to Missing Parts under 37 CFR 1.52 or 1.53
- ☐ Drawing(s)
- ☐ Licensing-related Papers
- ☐ Petition
- ☐ Petition to Convert to a Provisional Application
- ☐ Power of Attorney, Revocation Change of Correspondence Address
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- ☐ Appeal Communication to TC **(Appeal Notice, Brief, Reply Brief)**
- ☐ Proprietary Information
- ☐ Status Letter
- ☐ Other Enclosure(s) (please Identify below):

Remarks

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	CAPITOL PATENT & TRADEMARK LAW FIRM PLLC		
Signature	/GREGORY P. BRUMMETT/		
Printed name	GREGORY P. BRUMMETT		
Date	28 NOVEMBER 2007	Reg. No.	41,646

CERTIFICATE OF TRANSMISSION/MAILING

I hereby certify that this correspondence is being facsimile transmitted to the USPTO or deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450 on the date shown below:

Signature			
Typed or printed name		Date	

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Electronic Acknowledgement Receipt	
EFS ID:	2517111
Application Number:	10002746
International Application Number:	
Confirmation Number:	3832
Title of Invention:	Variable rate channel quality feedback in a wireless communication system
First Named Inventor/Applicant Name:	Amab Das
Customer Number:	32498
Filer:	Gregory Paul Brummett
Filer Authorized By:	
Attorney Docket Number:	29250-002099/US
Receipt Date:	28-NOV-2007
Filing Date:	02-NOV-2001
Time Stamp:	10:58:13
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	Amendment After Final	2007-11-28_Response.pdf	345990 c469ffcd77ac030189f68fc7ebd0e6ad0fa3d542	no	16
Warnings:					
Information:					

2	Miscellaneous Incoming Letter	2007-11-28_SB21.pdf	57289 5627379ac7ce71e8c72c702d3853d65eed4dc287	no	1
Warnings:					
Information:					
			Total Files Size (in bytes):	403279	

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PTO/SB/06 (07-06)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number	Filing Date	☐ To be Mailed
10/002,746	11/02/2001	

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)	SMALL ENTITY ☐		OR	OTHER THAN SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	

APPLICATION AS AMENDED – PART II

		(Column 1)		(Column 2)	(Column 3)	SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
	11/28/2007	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
AMENDMENT	Total (37 CFR 1.16(i))	* 13	Minus	** 20	= 0	X $ =		OR	X $50=	0
	Independent (37 CFR 1.16(h))	* 3	Minus	***3	= 0	X $ =		OR	X $210=	0
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	0

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

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

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

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

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

Legal Instrument Examiner:
MARCIA J. GORDON

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/002,746	11/02/2001	Amab Das	29250-002099/US	3832

32498 7590 09/13/2007

CAPITOL PATENT & TRADEMARK LAW FIRM, PLLC
ATTN: JOHN CURTIN
P.O. BOX 1995
VIENNA, VA 22183

EXAMINER	
NGUYEN, THUAN T	
ART UNIT	**PAPER NUMBER**
2618	

MAIL DATE	DELIVERY MODE
09/13/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/002,746	DAS ET AL.	
	Examiner	Art Unit	
	THUAN T. NGUYEN	2618	

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

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1 and 4-15* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1, 4-15* is/are rejected.

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

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

Application Papers

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

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

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

Priority under 35 U.S.C. § 119

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

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Applicant's arguments filed on 6/13/2007 have been fully considered but they are not persuasive.

Applicant basically argues that Chen and Kobylinski does not teach the feature of "report channel quality from mobile stations to base stations at a first rate in the absence of a reception of data transmission from the base station, and then, upon detection of a reception of data transmission from the base station, the mobile station reports channel quality information at a second rate for a predetermined duration"; the examiner respectfully disagrees and previously pointed out that Kobylinski teaches the same technique of report channel quality from mobile stations to base stations at a first rate in the absence of a reception of data transmission from the base station, and then, upon detection of a reception of data transmission from the base station, the mobile station reports channel quality information at a second rate for a predetermined duration (refer to col. 4/line 38 to col. 5/line 11, as at first the mobile reports the channel quality in SACCH during its idle time slot, meaning no communication or no transmission data; and then at later time, as the base station receives data, the base station instructs the mobile to tune to a different channel the DVCC for further reports and communication—the second measurement order).

Therefore, the examiner believes the technique of simply "varying a rate for reporting channel quality information from a mobile station to a base station" is not novel in the art as disclosed by Kobylinski's prior art.

Remark

2. Claims 2-3 have been previously cancelled in the amendment dated 2/2/04, and claims 1 and 4-15 are pending for reconsideration.

Claim Rejections - 35 USC § 103

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

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

4. Claims 1, and 4-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen (U.S. Patent No. 6,067,458) in view of Kobylinski et al. (U.S. Patent 6,044,272).

Regarding claim 1, Chen discloses a method for transmitting channel quality information in a wireless communication system with at least a base station and at least a mobile station (Fig. 2), the method comprising varying a rate for reporting channel quality information from a mobile station to a base station as a function of the presence or absence of a reception of a transmission at the mobile station (see col. 6/lines 10-48 for varying rate information exchange between mobile station and base station, in idle time or absence of a reception of a data transmission at the mobile station, rate is communicated at the eighth rate, and higher rate is used when voice or data communicating between these two components; and col. 13/lines 48-65 as mobile station communicates to base station & col. 14/lines 32-42 for channel quality monitoring and control).

Applicants argue that Chen has different approach in report channel quality; however, in the same field of signal strength detection and reporting channel quality in wireless systems,

Kobylinski teaches the same technique of report channel quality from mobile stations to base stations at a first rate in the absence of a reception of data transmission from the base station, and then, upon detection of a reception of data transmission from the base station, the mobile station reports channel quality information at a second rate for a predetermined duration (refer to col. 4/line 38 to col. 5/line 11, as at first the mobile reports the channel quality in SACCH during its idle time slot, meaning no communication or no transmission data; and then at later time, as the base station receives data, the base station instructs the mobile to tune to a different channel the DVCC for further reports and communication—the second measurement order). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Chen's system with Kobylinski's teaching technique of having channel reports from mobile station at one channel rate, and then, at a later time, tuning to a different channel rate as required.

(Claims 2 and 3 were canceled).

As for claim 4, in view of claim 1, Chen discloses a plurality of rates over a prescribed time period after the detection of reception of a data transmission, particularly, ranging from a first rate set for transmitting speech data up to a second rate set of 64 kbps for exchanging voice and other data (col. 6/lines 29-48 & col. 13/lines 48-51).

As for claim 5, in view of claim 4, Chen discloses a plurality of rates can be transmitted or reported at different ones of the plurality of rates on a reverse link from the mobile station to the base station during different ones of the plurality of time intervals (Figs. 1A- F shows an example within one time interval of 20ms, and col. 2/line 53 to col. 3/line 3).

As for claim 6, in view of claim 1, Chen further discloses that the second rate is faster than the first rate, i.e., the second rate either at the first rate set or at the second rate set is faster than the first rate at idle time (or at the eighth rate, see col. 6/lines 18-48).

As for claim 7, in view of claim 1, Chen further discloses that the base station determines the channel quality collected from the mobile station for deriving a transmission format for a next transmission (col. 13/line 55 to col. 14/line 20).

As for claim 8, in further view of claim 7, Chen further includes within the transmission format one or more parameters selected from the group consisting of modulation format, number of codes, and transmission rate (col. 12/line 22 to col. 13/line 40).

As for claim 9, in view of claim 6, Chen further addresses the calculation an amount of redundancy needed for a retransmission of a previous transmission by using a routine 300 in recalculating the necessary step whether to use the previous transmission or not (Fig. 7, and col. 11/lines 40-63 & col. 13/lines 20-33 for recalled or previously stored power transmission control setting).

As for claim 10, in view of claim 1, Chen further discloses wherein the channel quality information comprises a transmission rate calculated by the mobile station based on one or more channel conditions (col. 12/line 63 to col. 13/line 47 for more additional conditions can be collected by the base stations).

As for claims 11-12, these claims for same limitations are rejected for the reasons given in the scope of claims 1-10 as already disclosed above.

As for claims 13-15, Kobylinski further shows the step of varying a rate for reporting channel quality information from a mobile station to a base station as a function of the number of

base stations that the mobile station is communicating with (refer to col. 4/line 64 to col. 5/line 11) as relevant and distinguished base stations can be determined for better handoff, in this scenario); for claim 14, refer to col. 4/line 38 to col. 5/line 11, as at first the mobile reports the channel quality in SACCH during its idle time slot, meaning no communication or no transmission data (with its current base station); and then at later time, as the base station receives data, the base station instructs the mobile to tune to a different channel the DVCC for further reports and communication—the second measurement order for the process of communication to other candidate base stations based on the received signal strength values; (for claim 15) and the rate for second channel is faster than the rate for the first channel, since the first channel is SACCH or Slow associated control channel.

Conclusion

5. THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

6. **Any response to this action should be mailed to:**
Commissioner of Patents and Trademarks
Washington, D.C. 20231

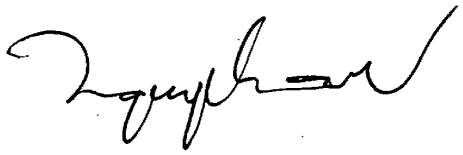
or faxed to the New Central Fax number:
(571) 273-8300, (for Technology Center 2600 only)

Hand deliveries must be made to Customer Service Window,
Randolph Building, 401 Dulany Street, Alexandria, VA 22314.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tony Thuan Nguyen whose telephone number is (571) 272-7895. The examiner can normally be reached on Monday-Friday from 9:30 AM to 7:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Edward Urban, can be reached at (571) 272-7899.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Tony T. Nguyen
Primary Examiner
Art Unit 2618

TTN
August 24, 2007

Index of Claims

Application/Control No.	Applicant(s)/Patent under Reexamination
10/002,746	DAS ET AL.
Examiner	**Art Unit**
THUAN T. NGUYEN	2618

√	Rejected	–	(Through numeral) Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

Claim Final	Claim Original	Date 4/11/07	Date 8/24/07	Date	Date	Date	Date	Date	Date	Date
	1	√	√							
	~~2~~									
	~~3~~									
	4	√	√							
	5									
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	7									
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	16									
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	19									
	20									
	21									
	22									
	23									
	24									
	25									

Claim Final	Claim Original	Date

Claim Final	Claim Original	Date

Search Notes

Application No.	Applicant(s)	
10/002,746	DAS ET AL.	
Examiner	**Art Unit**	
THUAN T. NGUYEN	2618	

SEARCHED			
Class	Subclass	Date	Examiner
455	437 438	4/10/07	[illegible]
	502		
	503		
	438		
	432		
	450		
	442		
370	331	4/11/07	[illegible]
	392		
455	452.2		
	358		
375	225		
	222		
	240		

updated above 8/23/07 [illegible]

INTERFERENCE SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	DATE	EXMR
East searching	4/10/07 4/11/07	[illegible] [illegible]
East updated	8/23/07	[illegible]

UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
10/002,746	11/02/2001	Amab Das	29250-002099/US

CONFIRMATION NO. 3832

32498
CAPITOL PATENT & TRADEMARK LAW FIRM, PLLC
ATTN: JOHN CURTIN
P.O. BOX 1995
VIENNA, VA 22183

OC000000024526858

Date Mailed: 06/25/2007

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 06/13/2007.

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.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
10/002,746	11/02/2001	Amab Das	29250-002099/US

CONFIRMATION NO. 3832

HARNESS, DICKEY & PIERCE, P.L.C.
P.O. BOX 8910
RESTON, VA 20195

OC000000024526772

Date Mailed: 06/25/2007

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 06/13/2007.

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

Office of Initial Patent Examination (571) 272-4000, or 1-800-PTO-9199
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APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
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OC000000024526858

32498
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ATTN: JOHN CURTIN
P.O. BOX 1995
VIENNA, VA 22183

Date Mailed: 06/25/2007

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P. Zimmerma

Office of Initial Patent Examination (571) 272-4000, or 1-800-PTO-9199
ATTORNEY/APPLICANT COPY

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Alexandria, Virginia 22313-1450
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APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
10/002,746	11/02/2001	Amab Das	29250-002099/US

CONFIRMATION NO. 3832

HARNESS, DICKEY & PIERCE, P.L.C.
P.O. BOX 8910
RESTON, VA 20195

OC000000024526772

Date Mailed: 06/25/2007

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 06/13/2007.

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

P. Zimmerman

Office of Initial Patent Examination (571) 272-4000, or 1-800-PTO-9199
FORMER ATTORNEY/AGENT COPY

OIPE IAP97
JUN 13 2007
PATENT & TRADEMARK OFFICE

Please type a plus sign (+) inside this box. —

HDP/SB/21 based on PTO/SB/21 (08-00)

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application Number	**10/002,746**
Filing Date	November 2, 2001
Inventor(s)	Arnab DAS et al.
Group Art Unit	2618
Examiner Name	Thuan T. Nguyen
Attorney Docket Number	129250-002099/US

ENCLOSURES *(check all that apply)*

☐ Fee Transmittal Form	☐ Assignment Papers *(for an Application)*	☐ After Allowance Communication to Group
☐ Fee Attached	☐ Letter to the Official Draftsperson and ____ Sheets of Formal Drawing(s)	☐ LETTER SUBMITTING APPEAL BRIEF AND APPEAL BRIEF (w/clean version of pending claims)
☒ Amendment	☐ Licensing-related Papers	☐ Appeal Communication to Group *(Notice of Appeal, Brief, Reply Brief)*
☐ After Final	☐ Petition	☐ Proprietary Information
☐ Affidavits/declaration(s)	☐ Petition to Convert to a Provisional Application	☐ Status Letter
☐ Extension of Time Request (contained in Notice of Appeal)	☒ Power of Attorney, Revocation Change of Correspondence Address	☐ Other Enclosure(s) *(please identify below)*:
☐ Express Abandonment Request	☐ Terminal Disclaimer	
☐ Information Disclosure Statement	☐ Request for Refund	
☐ Certified Copy of Priority Document(s)	☐ CD, Number of CD(s) ____	
☐ Response to Missing Parts/ Incomplete Application	Remarks	
☐ Response to Missing Parts under 37 CFR 1.52 or 1.53		

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm *or* Individual name	**CAPITOL PATENT & TRADEMARK LAW FIRM, PLLC**	Attorney Name John E. Curtin	Reg. No. 37,602
Signature			
Date	June 13, 2007		

OIPE IAP97
JUN 13 2007
PATENT & TRADEMARK OFFICE

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Arnab DAS et al.

Application No.: 10/002,746

Group No.: 2618

Filed: November 2, 2001

Examiner: Thuan T. Nguyen

For: VARIABLE RATE CHANNEL QUALITY FEEDBACK IN A WIRELESS COMMUNICATION SYSTEM

Attorney Docket No.: 129250-002099/US

Customer Service Window
Randolph Building
401 Dulany Street
Alexandria, VA 22314
Mail Stop Amendment

June 13, 2007

Response

Sir:

In response to the Office Action dated April 20, 2007 ("Office Action"), the Applicants respond as follows. A claim listing begins on page 2 of this paper. Remarks begin on page 6 of this paper.

	Claims remaining		Highest number previously paid for		Present extra
Total	**13**	-	**15**	=	**0**
Independent	**3**	-	**3**	=	**0**

IN THE CLAIMS

The following is a complete listing of revised claims with a status identifier in parenthesis.

LISTING OF CLAIMS

1. (Previously Presented) A method for transmitting channel quality information in a wireless communication system comprising at least one base station and at least one mobile station, the method comprising:

varying a rate for reporting channel quality information from a mobile station to a base station as a function of the presence or absence of a reception of a data transmission at the mobile station, wherein the mobile station reports channel quality information at a first rate in the absence of a reception of a data transmission from the base station and, upon detection of a reception of a data transmission from the base station, the mobile station reports channel quality information at a second rate for a prescribed duration.

2. (Cancelled)

3. (Cancelled)

4. (Previously Presented) The method according to claim 1, wherein, upon detection of a reception of a data transmission from the base station, the mobile station reports channel quality information at a plurality of rates over a prescribed time period after detection of the reception of a data transmission, wherein the plurality of rates are different than the first rate.

5. (Previously Presented) The method according to claim 4, wherein the prescribed time period includes a plurality of time intervals such that the channel quality information is reported at different ones of the plurality of rates during different ones of the plurality of time intervals.

6. (Previously Presented) The method according to claim 1, wherein the second rate is faster than the first rate.

7. (Previously Presented) The method according to claim 1, further comprising the step of estimating channel quality at the base station while the mobile station is reporting at the second rate, wherein estimated channel quality is used to derive a transmission format for a subsequent transmission.

8. (Original) The method according to claim 7, wherein the transmission format includes one or more parameters selected from the group consisting of modulation format, number of codes, and transmission rate.

9. (Previously Presented) The method according to claim 1, further comprising the step of estimating channel quality at the base station while the mobile station is reporting at the second rate, wherein estimated channel quality is used to calculate an amount of redundancy needed for a retransmission of a previous data transmission.

10. (Original) The method according to claim 1, wherein the channel quality information comprises a transmission rate calculated by the mobile station based on one or more channel conditions.

11. (Previously Presented) A method for adapting the rate of reporting channel quality information in a wireless communication system including at least one base station and at least one mobile station, the method comprising:

reporting channel quality information from the at least one mobile station to the at least one base station at a first rate in the absence of a reception of a data transmission at the at least one mobile station; and

in the presence of a reception of a data transmission at the at least one mobile station, adapting the rate for reporting channel quality information from the at least one mobile station to the at least one base station from the first rate to a second rate for a prescribed duration.

12. (Original) The method according to claim 11, wherein the second rate is faster than the first rate.

13. (Original) A method for transmitting channel quality information in a wireless communication system including at least one base station and at least one mobile station, the method comprising:

varying a rate for reporting channel quality information from a mobile station to a base station as a function of the number of base stations that the mobile station is communicating with.

14. (Original) The method according to claim 13, wherein the mobile station reports channel quality information at a first rate when the mobile station is communicating with one base station and wherein the mobile station reports channel quality information at a second rate when the mobile station is communicating with a plurality of base stations.

15. (Original) The method according to claim 14 wherein the second rate is faster than the first rate.

REMARKS

A. The Section 103(a) Rejections

Claims 1 and 4-15 were rejected under 35 U.S.C. §103(a) based on the combination of U.S. Patent No. 6,067,458 to Chen ("Chen") and U.S. Patent No. 6,044,272 to Kobylinski et al ("Kobylinski"). Applicants respectfully disagree and traverse these rejections for at least the reasons set forth below.

(i.) Claims 1 and 4-12

Each of claims 1 and 4-12 include the feature of a mobile station that reports channel quality information at a first rate, in the absence of a reception of a data transmission from a base station, and, upon detection of a reception of a data transmission from the base station, at a second rate for a prescribed duration.

The Examiner acknowledges that Chen fails to disclose or suggest the reporting features in claims 1 and 4-12. To make up for this deficiency the Examiner now relies upon Kobylinski. However, as the Examiner acknowledges in the Office Action it is only after a base station receives data, not a mobile, that the mobile is instructed to change its reporting rate. Further, as the Applicants have explained in detail before (see Applicants' appeal brief dated February 28, 2005), the claims are directed at a mobile changing its reporting rate after receiving data transmissions from a base station, not instructions.

Because the combination of Chen and Kobylinski fail to disclose or suggest the features of claims 1 and 4-12 this combination of references does not render these claims obvious under §103(a).

(ii.) Claims 13-15

Each of claims 13-15 include the feature of a method that allows a mobile to vary the rate at which it reports channel quality information to a base station. More specifically, the rate is varied as a function of the number of base stations that the mobile station is communicating with. The Examiner acknowledges that Chen does not disclose or suggest such reporting and relies upon Kobylinski to make up for this deficiency.

However, Kobylinski appears to be unrelated to claims 13-15. More particularly, the excerpts from Kobylinski cited by the Examiner in the Office Action as disclosing the variation of a reporting rate as a function of the number of base stations that a mobile station is communicating with (i.e., column 4, line 64 to column 5, line 11) do not appear to be related to the variation of a reporting rate. Instead, these excerpts appear to be related to the selection of one or more base stations by a mobile ("then utilize the reported received signal strength measurements and DVCC values to distinguish and identify plausible (and the optimal) base stations for handoff....").

Because the combination of Chen and Kobylinski fail to disclose or suggest the features of claims 13-15 this combination of references does not render these claims obvious under §103(a).

Accordingly, Applicants respectfully request withdrawal of the rejections and allowance of claims 1 and 4-15.

Should there be any outstanding matters that need to be resolved in the present application the Examiner is respectfully requested to contact John E. Curtin at the telephone number listed below.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 50-3777 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

CAPITOL PATENT & TRADEMARK LAW FIRM, PLLC.

By_____

John E. Curtin, Reg. No. 37,602
P.O. Box 1995
Vienna, Virginia 22183
(703) 266-3330

OIPE IAP97
JUN 13 2007
PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent Application

Applicants: Arnab DAS et al.

Application No.: 10/002,746

Group No.: 2618

Filed: November 2, 2001

Examiner: Thuan T. Nguyen

For: VARIABLE RATE CHANNEL QUALITY FEEDBACK IN A WIRELESS COMMUNICATION SYSTEM

Attorney Docket No.: 129250-002099/US

CHANGE OF ADDRESS

Customer Service Window
Randolph Building
401 Dulany Street
Alexandria, VA 22314
Mail Stop Amendment

Please change the Customer No. to **32498** and the correspondence address of the attorneys of record in the above-identified application to:

The new correspondence address is:

CAPITOL PATENT & TRADEMARK LAW FIRM, PLLC.
P.O. Box 1995
Vienna, VA 22183

The undersigned is empowered to sign this Change of Address on behalf of the Assignee.

Respectfully submitted,

CAPITOL PATENT & TRADEMARK LAW FIRM, PLLC.

By _____

John E. Curtin, Reg. No. 37,602
P.O. Box 1995
Vienna, Va. 22183
(703) 266-3330



PATENT
ATTORNEY DOCKET NO. 129250-002099/US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants:	Arnab DAS et al.	Group No.:	2618
Application No.:	10/002,746	Examiner:	Thuan T. Nguyen
Filed:	November 2, 2001		

For: VARIABLE RATE CHANNEL QUALITY FEEDBACK IN A WIRELESS COMMUNICATION SYSTEM

REVOCATION OF POWER OF ATTORNEY, SUBSTITUTE POWER OF ATTORNEY, AND CHANGE IN CORRESPONDENCE ADDRESS

U.S. Patent and Trademark Office
Customer Window
401 Delaney Street
Alexandria,, VA 22314

Dear Sir:

The Assignee of the above-identified patent application, Lucent Technologies, Inc. having a business office at 600 Mountain Avenue, P.O. Box 636, Murray Hill, NJ 07974-0636, as evidenced by the recordation at Reel 012354 and Frame 0991, hereby revokes any and all previous powers of attorney for the above-identified patent application or issued patent, and hereby appoints the CAPITOL PATENT & TRADEMARK LAW FIRM, PLLC and Lucent Technologies as the attorneys of the Assignee to receive all correspondence relating to the above-identified application or patent and to transact all business in the United States Patent and Trademark Office connected therewith, with full power of substitution and revocation, and the Assignee ratifies any act done by the Assignee's attorneys in respect of this patent. The new correspondence address is:

CAPITOL PATENT & TRADEMARK LAW FIRM, PLLC
P.O. Box 1995
Vienna, VA 22183
Customer Number 32498

The undersigned (whose title is supplied below) is empowered to sign this Revocation and Substitute Power of Attorney on behalf of the Assignee.

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

6/13/07
Date

Eugene J. Rosenthal
Corporate Counsel

PTO/SB/06 (07-06)
Approved for use through 1/31/2007. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number	Filing Date	☐ To be Mailed
10/002,746	11/02/2001	

APPLICATION AS FILED – PART I

	(Column 1)	(Column 2)	SMALL ENTITY ☐		OR	OTHER THAN SMALL ENTITY	
FOR	NUMBER FILED	NUMBER EXTRA	RATE ($)	FEE ($)		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*	X $ =		OR	X $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	X $ =			X $ =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	

APPLICATION AS AMENDED – PART II

		(Column 1)		(Column 2)	(Column 3)	SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
	06/13/2007	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)		RATE ($)	ADDITIONAL FEE ($)
AMENDMENT	Total (37 CFR 1.16(i))	* 13	Minus	** 20	= 0	X $ =		OR	X $50=	0
	Independent (37 CFR 1.16(h))	* 3	Minus	***3	= 0	X $ =		OR	X $200=	0
	☐ Application Size Fee (37 CFR 1.16(s))									
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	0

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

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

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

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

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

Legal Instrument Examiner:
Patsy Zimmerman

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/002,746	11/02/2001	Amab Das	29250-002099/US	3832

7590 04/20/2007

HARNESS, DICKEY & PIERCE, P.L.C.
P.O. BOX 8910
RESTON, VA 20195

EXAMINER	
NGUYEN, THUAN T	
ART UNIT	PAPER NUMBER
2618	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	04/20/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/002,746	DAS ET AL.	
	Examiner	Art Unit	
	THUAN T. NGUYEN	2618	

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

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1 and 4-15* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1, 4-15* is/are rejected.

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

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

Application Papers

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

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

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

Priority under 35 U.S.C. § 119

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

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to After Final Appeal Brief

1. Applicant's request for reconsideration of the finality of the rejection of the last Office action is persuasive and, therefore, the finality of that action is withdrawn.

Remark

2. Claims 2-3 were canceled in the amendment dated 2/2/04, and claims 1 and 4-15 are pending for reconsideration.

3. Applicant's arguments with respect to claims 1, and 4-15 have been considered but are moot in view of the new ground(s) of rejection.

Claim Rejections - 35 USC § 103

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

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

5. Claims 1, and 4-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chen (U.S. Patent No. 6,067,458) in view of Kobylinski et al. (U.S. Patent 6,044,272).

Regarding claim 1, Chen discloses a method for transmitting channel quality information in a wireless communication system with at least a base station and at least a mobile station (Fig. 2), the method comprising varying a rate for reporting channel quality information from a mobile station to a base station as a function of the presence or absence of a reception of a transmission

at the mobile station (see col. 6/lines 10-48 for varying rate information exchange between mobile station and base station, in idle time or absence of a reception of a data transmission at the mobile station, rate is communicated at the eighth rate, and higher rate is used when voice or data communicating between these two components; and col. 13/lines 48-65 as mobile station communicates to base station & col. 14/lines 32-42 for channel quality monitoring and control).

Applicants argue that Chen has different approach in report channel quality; however, in the same field of signal strength detection and reporting channel quality in wireless systems, Kobylinski teaches the same technique of report channel quality from mobile stations to base stations at a first rate in the absence of a reception of data transmission from the base station, and then, upon detection of a reception of data transmission from the base station, the mobile station reports channel quality information at a second rate for a predetermined duration (refer to col. 4/line 38 to col. 5/line 11, as at first the mobile reports the channel quality in SACCH during its idle time slot, meaning no communication or no transmission data; and then at later time, as the base station receives data, the base station instructs the mobile to tune to a different channel the DVCC for further reports and communication—the second measurement order). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify Chen's system with Kobylinski's teaching technique of having channel reports from mobile station at one channel rate, and then, at a later time, tuning to a different channel rate as required.

(Claims 2 and 3 were canceled).

As for claim 4, in view of claim 1, Chen discloses a plurality of rates over a prescribed time period after the detection of reception of a data transmission, particularly, ranging from a

first rate set for transmitting speech data up to a second rate set of 64 kbps for exchanging voice and other data (col. 6/lines 29-48 & col. 13/lines 48-51).

As for claim 5, in view of claim 4, Chen discloses a plurality of rates can be transmitted or reported at different ones of the plurality of rates on a reverse link from the mobile station to the base station during different ones of the plurality of time intervals (Figs. 1A- F shows an example within one time interval of 20ms, and col. 2/line 53 to col. 3/line 3).

As for claim 6, in view of claim 1, Chen further discloses that the second rate is faster than the first rate, i.e., the second rate either at the first rate set or at the second rate set is faster than the first rate at idle time (or at the eighth rate, see col. 6/lines 18-48).

As for claim 7, in view of claim 1, Chen further discloses that the base station determines the channel quality collected from the mobile station for deriving a transmission format for a next transmission (col. 13/line 55 to col. 14/line 20).

As for claim 8, in further view of claim 7, Chen further includes within the transmission format one or more parameters selected from the group consisting of modulation format, number of codes, and transmission rate (col. 12/line 22 to col. 13/line 40).

As for claim 9, in view of claim 6, Chen further addresses the calculation an amount of redundancy needed for a retransmission of a previous transmission by using a routine 300 in recalculating the necessary step whether to use the previous transmission or not (Fig. 7, and col. 11/lines 40-63 & col. 13/lines 20-33 for recalled or previously stored power transmission control setting).

As for claim 10, in view of claim 1, Chen further discloses wherein the channel quality information comprises a transmission rate calculated by the mobile station based on one or more

channel conditions (col. 12/line 63 to col. 13/line 47 for more additional conditions can be collected by the base stations).

As for claims 11-12, these claims for same limitations are rejected for the reasons given in the scope of claims 1-10 as already disclosed above.

As for claims 13-15, Kobylinski further shows the step of varying a rate for reporting channel quality information from a mobile station to a base station as a function of the number of base stations that the mobile station is communicating with (refer to col. 4/line 64 to col. 5/line 11) as relevant and distinguished base stations can be determined for better handoff, in this scenario); for claim 14, refer to col. 4/line 38 to col. 5/line 11, as at first the mobile reports the channel quality in SACCH during its idle time slot, meaning no communication or no transmission data (with its current base station); and then at later time, as the base station receives data, the base station instructs the mobile to tune to a different channel the DVCC for further reports and communication—the second measurement order for the process of communication to other candidate base stations based on the received signal strength values; (for claim 15) and the rate for second channel is faster than the rate for the first channel, since the first channel is SACCH or Slow associated control channel.

Conclusion

6. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Chen, ManJunath et al., Bhaskar et al., and Persson et al. (PTO-892 attached) disclose systems realted to report channel quality and RSSI.

7. **Any response to this action should be mailed to:**
Commissioner of Patents and Trademarks
Washington, D.C. 20231

or faxed to the New Central Fax number:
(571) 273-8300, (for Technology Center 2600 only)

Hand deliveries must be made to Customer Service Window,
Randolph Building, 401 Dulany Street, Alexandria, VA 22314.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tony Thuan Nguyen whose telephone number is (571) 272-7895. The examiner can normally be reached on Monday-Friday from 9:30 AM to 7:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Edward Urban, can be reached at (571) 272-7899.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Tony T. Nguyen
Primary Examiner
Art Unit 2618

TTN
April 11, 2007

Notice of References Cited

Application/Control No.	Applicant(s)/Patent Under Reexamination	
10/002,746	DAS ET AL.	
Examiner	Art Unit	Page 1 of 1
THUAN T. NGUYEN	2618	

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-6,044,272	03-2000	Kobylinski et al.	455/437
*	B	US-6,760,576 B2	07-2004	Chen, Tao	455/266
*	C	US-6,324,503 B1	11-2001	Manjunath et al.	704/226
*	D	US-6,154,499	11-2000	Bhaskar et al.	375/259
*	E	US-5,778,316	07-1998	Persson et al.	455/434
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

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

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

Index of Claims

Application/Control No.	Applicant(s)/Patent under Reexamination
10/002,746	DAS ET AL.
Examiner	**Art Unit**
THUAN T. NGUYEN	2618

√	Rejected	–	(Through numeral) Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

Claim		Date
Final	Original	4/11/07
	1	✓
	~~2~~ 3	
	~~3~~	
	4	✓
	5	—
	6	—
	7	—
	8	—
	9	—
	10	—
	11	—
	12	—
	13	—
	14	—
	15	✓
	16	
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	22	
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Claim		Date
Final	Original	

Claim		Date
Final	Original	

Search Notes

Application No.	Applicant(s)	
10/002,746	DAS ET AL.	
Examiner	**Art Unit**	
THUAN T. NGUYEN	2618	

SEARCHED			
Class	Subclass	Date	Examiner
455	437 438	4/10/07	DTB
	502		
	503		
	438		
	432		
	450		
↓	442	↓	↓
370	331	4/11/07	DTB
↓	392		
455	452.2		
↓	358		
375	225		
↓	222		
↓	240	↓	↓

INTERFERENCE SEARCHED			
Class	Subclass	Date	Examiner

SEARCH NOTES (INCLUDING SEARCH STRATEGY)		
	DATE	EXMR
East search → —	4/10/07 4/11/07	DTB DTB

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RESTON VA 20195

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APR 2 8 2005

OFFICE OF PETITIONS

In re Application of :
Amab Das et al :
Application No. 10/002,746 : DECISION GRANTING PETITION
Filed: November 2, 2001 : UNDER 37 CFR 1.137(b)
Attorney Docket No. 14-18 :

This is a decision on the petition under 37 CFR 1.137(b), filed January 10, 2005, to revive the above-identified application.

The petition is **GRANTED**.

The petition satisfies the conditions for revival pursuant to the provisions of 37 CFR 1.137(b) in that (1) the reply in the form of a Notice of Appeal; (2) the petition fee; and (3) the required statement of unintentional delay have been received. Accordingly, the reply to the final Office action of May 5, 2004, is accepted as having been unintentionally delayed.

Pursuant to 37 CFR 1.136, an extension of time must be filed prior to the expiration of the maximum period obtainable for reply to avoid abandonment. Accordingly, since the $2,160 extension of time submitted with the petition on January 10, 2005, was subsequent to the maximum period obtainable for reply, this fee is unnecessary and will be credited to petitioner's deposit account.

Telephone inquiries concerning this decision should be directed to the undersigned at (571) 272-3208.

This matter is being referred to Technology Center AU 2685.

Karen Creasy

Karen Creasy
Petitions Examiner
Office of Petitions
Office of the Deputy Commissioner
for Patent Examination Policy

UNITED STATES PATENT & TRADEMARK OFFICE
Washington, D.C. 20231

REQUEST FOR PATENT FEE REFUND

1 Date of Request: 4-25-05 | 2 Serial/Patent # 10/882746

3 Please refund the following fee(s):		4 PAPER NUMBER	5 DATE FILED	6 AMOUNT
	Filing			$
	Amendment			$
	Extension of Time		1-10-05	$ 2,160
	Notice of Appeal/Appeal			$
	Petition			$
	Issue			$
	Cert of Correction/Terminal Disc.			$
	Maintenance			$
	Assignment			$
	Other			$

7 TOTAL AMOUNT OF REFUND: $ 2,160

8 TO BE REFUNDED BY:

- [ ] Treasury Check
- [ ] Credit Deposit A/C #:

9 0 8 -- 9 7 5 0

10 REASON:

- [ ] Overpayment
- [ ] Duplicate Payment
- [ ] No Fee Due (Explanation):

Extension not necessary.

11 REFUND REQUESTED BY:

TYPED/PRINTED NAME: Karen Creasy TITLE: Pet. Exmr.

SIGNATURE: Karen Creasy PHONE: 272-3208

OFFICE: DAC for Patents

****

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APPROVED: Olivia Kelly DATE: 4/28/05

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FORM PTO 1577
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APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
10/002,746	11/02/2001	Amab Das	29250-002099/US

CONFIRMATION NO. 3832

HARNESS, DICKEY & PIERCE, P.L.C.
P.O. BOX 8910
RESTON, VA 20195

OC000000015889765
OC000000015889765

Date Mailed: 04/27/2005

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 01/10/2005.

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.

Karen O. Creasy

KAREN O CREASY
OP (571) 272-3208

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APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
10/002,746	11/02/2001	Amab Das	14-18

CONFIRMATION NO. 3832

OC000000015853564

OC000000015853564

Docket Administrator (Room 3J-219)
Lucent Technologies Inc.
101 Crawfords Corner Road
Holmdel, NJ 07733-3030

Date Mailed: 04/25/2005

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 01/10/2005.

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

Karen O. Creasy

KAREN O CREASY
OP (571) 272-3208

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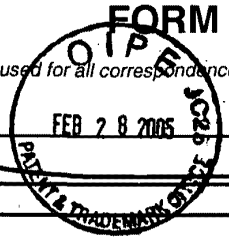
AF/SR DW

HDP/SB/21 based on PTO/SB/21 (08-00)

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TRANSMITTAL FORM

(to be used for all correspondence after initial filing)



Application Number	**10/002,746**
Filing Date	November 2, 2001
Inventor(s)	Arnab DAS et al.
Group Art Unit	2685
Examiner Name	Thuan T. Nguyen
Attorney Docket Number	29250-002099/US

ENCLOSURES *(check all that apply)*

☒ Fee Transmittal Form	☐ Assignment Papers *(for an Application)*	☐ After Allowance Communication to Group
☒ Fee Attached	☐ Letter to the Official Draftsperson and ____ Sheets of Formal Drawing(s)	☐ LETTER SUBMITTING APPEAL BRIEF AND APPEAL BRIEF (w/clean version of pending claims)
☐ Amendment	☐ Licensing-related Papers	☒ Appeal Communication to Group *(Notice of Appeal, Brief, Reply Brief)*
☐ After Final	☐ Petition	☐ Proprietary Information
☐ Affidavits/declaration(s)	☐ Petition to Convert to a Provisional Application	☐ Status Letter
☐ Extension of Time Request (contained in Notice of Appeal)	☐ Power of Attorney, Revocation Change of Correspondence Address	☐ Other Enclosure(s) *(please identify below):*
☐ Express Abandonment Request	☐ Terminal Disclaimer	
☐ Information Disclosure Statement	☐ Request for Refund	
☐ Certified Copy of Priority Document(s)	☐ CD, Number of CD(s) ____	
☐ Response to Missing Parts/ Incomplete Application	Remarks	
☐ Response to Missing Parts under 37 CFR 1.52 or 1.53		

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm *or* Individual name	Harness, Dickey & Pierce, P.L.C.	Attorney Name John E. Curtin	Reg. No. 37,602
Signature			
Date	February 28, 2005		

PTO/SB/17 (12-04)
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FEE TRANSMITTAL for FY 2005

Effective 10/01/2004. Patent fees are subject to annual revision.

☐ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT ($) 500

Complete if Known	
Application Number	10/002,746
Filing Date	November 2, 2001
First Named Inventor	Arnab DAS
Examiner Name	Thuan T. Nguyen
Art Unit	2685
Attorney Docket No.	29250-002099/US

METHOD OF PAYMENT *(check all that apply)*

☐ Check ☐ Credit card ☐ Money Order ☐ Other ☐ None

☒ Deposit Account:

Deposit Account Number: 08-0750

Deposit Account Name: Harness, Dickey & Pierce, PLC

The Director is authorized to: *(check all that apply)*
☐ Charge fee(s) indicated below ☐ Credit any overpayments
☐ Charge any additional fee(s) during the pendency of this application
☐ Charge fee(s) indicated below, **except for the filing fee** to the above-identified deposit account.

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1011	300	2011	150	Utility filing fee	
1012	200	2012	100	Design filing fee	
1013	200	2013	100	Plant filing fee	
1014	300	2014	150	Reissue filing fee	
1005	200	2005	100	Provisional filing fee	

SUBTOTAL (1) ($) 0

2. EXTRA CLAIM FEES FOR UTILITY AND REISSUE

			Extra Claims		Fee from below		Fee Paid
Total Claims		-20 ** =	0	X		=	0
Independent Claims		-3 ** =	0	X		=	0
Multiple Dependent						=	0

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
1202	50	2202	25	Claims in excess of 20
1201	200	2201	100	Independent claims in excess of 3
1203	360	2203	180	Multiple dependent claim, if not paid
1204	200	2204	100	** Reissue independent claims over original patent
1205	50	2205	25	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($) 0

**or number previously paid, if greater; For Reissues, see above

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1051	130	2051	65	Surcharge - late filing fee or oath	
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet.	
1053	130	1053	130	Non-English specification	
1812	2,520	1812	2,520	For filing a request for reexamination	
1804	920*	1804	920*	Requesting publication of SIR prior to Examiner action	
1805	1,840*	1805	1,840*	Requesting publication of SIR after Examiner action	
1251	120	2251	60	Extension for reply within first month	
1252	450	2252	225	Extension for reply within second month	
1253	1020	2253	510	Extension for reply within third month	
1254	1,590	2254	795	Extension for reply within fourth month	
1255	2,160	2255	1080	Extension for reply within fifth month	
1401	500	2401	250	Notice of Appeal	
1402	500	2402	250	Filing a brief in support of an appeal	500
1403	1000	2403	500	Request for oral hearing	
1452	500	2452	250	Petition to revive – unavoidable	
1453	1500	2453	750	Petition to revive – unintentional	
1501	1400	2501	700	Utility issue fee (or reissue)	
1502	800	2502	400	Design issue fee	
1460	130	1460	130	Petitions to the Commissioner	
1807	50	1807	50	Processing fee under 37 CFR 1.17 (q)	
1806	180	1806	180	Submission of Information Disclosure Stmt	
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	
1809	790	2809	395	Filing a submission after final rejection (37 CFR § 1.129(a))	
1810	790	2810	395	For each additional invention to be examined (37 CFR § 1.129(b))	
1801	790	2801	395	Request for Continued Examination (RCE)	
Other fee (specify) ____					

*Reduced by Basic Filing Fee Paid SUBTOTAL (3) ($)500

4. SEARCH/EXAMINATION FEES

1111	500	2111	250	Utility Search Fee	
1112	100	2112	50	Design Search Fee	
1113	300	2113	150	Plant Search Fee	
1114	500	2114	250	Reissue Search Fee	
1311	200	2311	100	Utility Examination Fee	
1312	130	2312	65	Design Examination Fee	
1313	160	2313	80	Plant Examination Fee	
1314	600	2314	300	Reissue Examination Fee	

SUBTOTAL (4) ($)0

SUBMITTED BY				Complete *(if applicable)*	
Name (Print/Type)	John E. Curtin	*Registration No. (Attorney/Agent)*	37,602	*Telephone*	(703) 668-8000
Signature				*Date*	February 28, 2005

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Appeal No. _____

Appellants:	Arnab DAS et al.
Application No.:	10/002,746
Group No.:	2685
Filed:	November 2, 2001
Examiner:	Thuan T. Nguyen
For:	VARIABLE RATE CHANNEL QUALITY FEEDBACK IN A WIRELESS COMMUNICATION SYSTEM
Attorney Docket No.:	29250-002099/US

BRIEF ON APPEAL ON BEHALF OF APPELLANT

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Alexandria, VA 22314
Mail Stop Appeal Brief - Patents

February 28, 2005

03/01/2005 SSITHIB1 00000140 10002746
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BRIEF ON BEHALF OF APPELLANT

In support of the Notice of Appeal filed January 10, 2005, appealing the Final Rejection mailed May 5, 2004, Appellant hereby provides the following remarks.

I. REAL PARTY IN INTEREST

The present application is assigned to Lucent Technologies Inc., by an Assignment recorded on November 2, 2001, Reel 012354, Frame 0991.

II. RELATED APPEALS AND INTERFERENCES

On January 10, 2005 the Appellants filed a Petition to Revive an Unintentionally Abandoned Application ("Petition"). Appellants are presently awaiting a decision on the Petition.

III. STATUS OF THE CLAIMS

The claims reproduced in the attached Appendix A are the claims on Appeal. Each of these claims is currently pending in the application.

IV. STATUS OF ANY PETITIONS OR AMENDMENTS FILED SUBSEQUENT TO THE FINAL REJECTION

Initially, Appellants refer the Board to the comments made in Section II above.

In addition, a Response After Final dated August 6, 2004 ("Response") was filed with the U.S. Patent and Trademark Office in response to the Final Rejection. Appellants presume this Response will be entered and considered if their Petition is granted.

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

The invention relates generally to wireless communication systems and, more particularly, to providing channel quality information from a mobile station to a base station in such systems.

In wireless communication systems, an air interface is used for the exchange of information between a mobile station and a base station or other communication system equipment. The air interface typically comprises a plurality of communication channels. In wireless transmission, a channel is time varying due to fading, mobility, and so on. More specifically, channel quality is affected by factors such as distance between the mobile and base station, speed of the mobile station, interference, and the like. Given the limited resources (e.g., bandwidth) of wireless transmission as well as the large number of mobile stations supported by a base station at any given time (and, therefore, competing for those limited resources) it is therefore important to maximize throughput of a wireless communication system. For example, in a time-multiplexed system in which the transmission time interval spans one or more time slots, system throughput can be maximized by allowing a user with the best channel quality to transmit ahead of users with comparatively low channel quality.

In one known arrangement, a mobile station performs a rate calculation based on measurements of a pilot signal from the base station once every time slot and then reports back the rate at which it is going to receive data from the base station. Alternatively, the mobile station can send channel quality feedback information to the base station. The base station can then select the appropriate rate corresponding to that channel quality. In general, the purpose of sending channel quality feedback information to the base station is to inform the base station of the transmission rate that best matches the current conditions (e.g., quality) of the channel at the present time. (See Specification, page 1.)

FIG. 1 (Appendix B) shows one example of wireless transmission based on the well-known 1x-EV-DO (data only) standard in which a so-called fast rate adaptation scheme is used

to maximize the system throughput by exploiting time varying channel conditions. More specifically, FIG. 1 shows a signaling diagram between a base station (BS) and a mobile station (MS). The data channel 100 for the downlink from the base station to the mobile station is divided into time slots 101-117, each of which has a duration τ. In the case of the 1x-EV-DO standard, the duration τ would be 1.67 milliseconds. In the example shown in FIG. 1, time slots 101-106 and 110-115 are not carrying transmissions from the base station to the mobile station. However, the base station is transmitting to the mobile station during time slots 107-109 and during time slots 116-117.

From the perspective of the mobile station, the uplink channel 200 is also divided into time slots 201-217, each of which has a duration τ. As shown in FIG. 1, the calculation and reporting rate for the dedicated control channel 200 (by the mobile station) is performed according to well-known methods once every time slot 201-217. More specifically, channel quality information (e.g., transmission rate in 1x-EV-DO systems) is transmitted via communications 151-165. For example, mobile station is transmitting channel quality information to the base station via communications 151-153 during time slots 201-203 indicating that rate R1 is the desired rate of transmission based on the channel quality. As shown in this example, this rate information is received at the base station during time slots 103-105, so there is some delay with respect to the calculation of the rate in the mobile station during a time slot and the subsequent reporting of that rate to the base station. In slot 204, the mobile station detected a change in channel quality and reported back to the base station that transmission should occur at rate R2. This channel quality feedback is received by the base station during its time slot 106. Because the base station is sending a transmission to the mobile station during

time slots 107-109 and because the base station is receiving channel quality feedback indicating rate R2 as the desired rate (e.g., R2 reported by mobile station during its time slots 204-206 and received by the base station during its time slots 106-108), the transmission by the base station during time slots 107-109 is therefore sent at rate R2. In time slots 207-212, the mobile station is reporting rate RI as the desired rate, but no transmissions are occurring from the base station during time slots 110-115. As shown, the mobile station reports rate R3 as the desired rate during time slots 213-216, which are received at the base station starting at time slot 115. Because the base station starts sending another transmission during time slot 116, this transmission therefore is sent at rate R3 based on the channel quality feedback received from the mobile station. (See Specification, pages 1-2.)

Another approach to providing rate feedback is described in U.S. Patent Application Serial No. 09/716,106, entitled *"Asymmetric Rate Feedback and Adjustment System for Wireless Communications"* and filed on November 17, 2000, the subject matter of which is incorporated herein by reference in its entirety. As described, rate calculation and prediction is still being performed at every time slot, but the reporting of this rate feedback from a mobile station to the base station occurs every third time slot. In this manner, the reporting of rate feedback from a plurality of mobile stations can be staggered such that each mobile station is only sending rate feedback every third time slot, but the base station is receiving rate feedback at each time slot (i.e., from different mobile stations).

There are several disadvantages to these constant rate feedback approaches. Performing rate calculation and prediction in every time slot uses up a large amount of processing overhead at the mobile station. Providing rate feedback to the base station at every time slot uses a large

amount of transmission overhead and, because rate feedback is being provided regardless of whether there is a transmission being sent from the base station, transmission resources are therefore being inefficiently used. Even if rate feedback is provided at a slower rate (e.g., every third time slot), there is still inefficient use of resources because the rate feedback is being provided regardless of whether the base station is transmitting.

To overcome the problems inherent in existing approaches, the present invention substantially reduces the processing of: (i) overhead for rate calculation/prediction; and (ii) transmission overhead for rate feedback in wireless transmissions, by varying the feedback rate for reporting channel quality information from a mobile station to a base station as a function of the presence or absence of a transmission from the base station to the mobile station.

More specifically, the present invention provides channel quality information (i.e., feedback) from the mobile station to the base station at a variable rate, such that the feedback rate is faster when the base station is transmitting to the mobile station and slower when there is no transmission occurring. Wireless resources can be more efficiently used because the rate at which the mobile station reports channel quality to the base station is varied as a function of the absence or presence of transmission from the base station.

In contrast, when the base station is not transmitting to the mobile station, the feedback rate for reporting channel quality from the mobile station is at a slower rate, which, in turn, frees up wireless resources that can be used for other purposes, e.g., for transmissions between the mobile station and the base station. When the base station is transmitting to the mobile station, the rate of reporting channel quality from the mobile station is increased so that rate adaptation can be carried out more accurately by the base station. Moreover, because of the short duration

of time slots in wireless transmission, it is highly unlikely that the rate or channel quality will change over a period of a few time slots under most operating conditions. (See Specification, pages 3-4.)

FIG. 2 (Appendix C) shows one exemplary embodiment for providing variable rate channel quality feedback according to the principles of the invention. By way of example only, this scheme will be described in the context of wireless transmission according to the 1x-EV-DO (data only) standard, but the teachings set forth herein are not at all limited to just this particular wireless implementation.

More specifically, FIG. 1 (Appendix B) shows a signaling diagram between a base station (BS) and a mobile station (MS). The data channel 300 for the downlink from the base station to the mobile station is divided into time slots 301-317, each of which has a duration τ, e.g., 1.67 milliseconds. In the example shown in FIG. 2 (Appendix C), time slots 301-306 and 310-315 are not carrying transmissions from the base station to the mobile station. However, the base station is transmitting to the mobile station during time slots 307-309 and during time slots 316-317. From the perspective of the mobile station, the uplink control channel 400 is also divided into corresponding time slots 401-417, each of which has a duration τ.

As shown in FIG. 2, the calculation and reporting of the rate for the dedicated control channel 400 by the mobile station is performed using a variable rate in contrast to the prior art methods. In general, when there is no data transmission from the base station (e.g., time slots 301-306), the channel quality information (e.g., rate information) is sent from the mobile station every two (2) slots as shown by communications 352, 354, 361, 363, and 365. As previously described, there is a delay factor with respect to the uplink transmission (from the mobile station)

and the downlink transmission (from the base station). When the mobile station is receiving a transmission over the forward link (e.g., downlink from the base station), the channel quality feedback is sent every slot as shown by communications 356-359. As such, the rate at which channel quality feedback is provided when there is a transmission from the base station is faster than the rate at which channel quality feedback is provided when there is no transmission from the base station. (See Specification, pages 4-5.)

More specifically, FIG. 2 depicts the mobile station transmitting channel quality information (e.g., rate information) to the base station via communications 352 at time slot 402 indicating that rate R1 is the desired rate of transmission based on the channel quality. As shown in this example, this rate information is received at the base station during time slot 304 because of the aforementioned delay factor. In slot 404, the mobile station detected a change in channel quality-and~feported back to the base station that transmission should occur at rate R2. This channel quality feedback is received by the base station during its time slot 306. Because the base station is sending a transmission to the mobile station during time slots 307-309 and because the base station is receiving channel quality feedback indicating rate R2 as the desired rate (e.g., R2 reported by mobile station in time slot 404 and received by the base station in time slot 306), the transmission by the base station during time slots 307-309 is therefore sent at rate R2. Because the base station is now transmitting data to the mobile station during time slots 307-309, the mobile station is adapted to send the channel quality feedback at a faster rate (e.g., every time slot) for the corresponding time slots 407-409, e.g., as shown by communications 357-359. It should be noted that, because transmission did not start until time slot 307 by the base station and because of the delay factor, the channel quality feedback information indicating

rate R2 via communication 356 is still being sent at the slower rate (e.g., every two (2) slots). The faster rate of reporting channel quality feedback does not begin until time slots 407-409 at the mobile station which correspond to time slots 307-309 where transmission is occurring from the base station. (See Specification, pages 5-6.)

When transmission from the base station ends and there is no further transmission, the mobile station resumes its reporting of channel quality information at the slower rate (e.g., every two (2) slots) as shown by communication 361. For example, there is no transmission from the base station in time slot 310, so the next report of rate information from the mobile station is sent at time slot 411, e.g., two time slots after time slot 409, which corresponded to time slot 309 when transmission ended from the base station.

It should be noted that the feedback rate for transmitting the channel quality information and the point in time when the information is reported (e.g., at the leading edge, during, or at the trail edge of the time slot) are all matters of design choice. As such, the example shown in FIG. 2 where the slower first rate is every two (2) slots and the faster second rate is every one (1) slot, and where the channel quality information is sent at the end of the corresponding time slot at the mobile station are all meant to be illustrative and not limiting in any way. However, those skilled in the art will appreciate that a large value for the reporting interval (time between the reports of channel quality from the mobile station) will reduce the channel quality feedback overhead. However, the resulting slower rate channel quality feedback may also result in large errors in channel quality estimates at the base station and performance degradation. Again, these are matters of design choice that are well understood by one skilled in the art.

According to another aspect of the invention, there are numerous implementations for providing rate feedback at a faster rate after detection of a transmission from the base station. For example, upon detection of a transmission from the base station, the mobile station can report channel quality information at a second rate for a prescribed duration after the detection of the transmission. In this manner, the rate feedback may therefore be provided at a faster rate for a period of time even though transmission from the base station has ended. By way of example, a mobile station may report rate feedback every 100 milliseconds in the absence of a transmission. Upon detection of a transmission from the base station, the mobile station can then provide rate feedback every 20 milliseconds for a prescribed period of time regardless of whether transmission ends from the base station. At the end of that prescribed period of time and assuming there is an absence of a transmission, the mobile station would then resume reporting of rate feedback at the first rate of 100 milliseconds (e.g., the slower rate). In yet another example, the mobile station, upon detection of a transmission from the base station, can report channel quality information at a plurality of rates over a prescribed time period after detection of the transmission, wherein the plurality of rates are different than the first rate. More specifically, upon detection of a transmission, the mobile station would begin reporting rate feedback at a second rate that is faster than the first rate for a prescribed time period. At the end of this prescribed time period and assuming there is an absence of a transmission, the mobile station could then report rate feedback at a third rate that is different than the first and second rates, and so on. Other variations will also be apparent to those skilled in the art and are contemplated by the teachings herein.

On the downlink transmission from the base station, the total capacity is shared by a large number of mobile stations. Due to the bursty nature of the data traffic, the mobile stations are active only a fraction of the time. Therefore, an increased rate of channel quality feedback during the time of data transmission for a given mobile station will not result in any significant increase of overhead. The fast channel quality feedback rate during a transmission from the base station will result in better channel quality estimates that will be used for appropriate selection of transport format for new transmissions and retransmissions. Note that due to the bursty nature of the traffic, when a transmission is sent to a mobile station, it is likely that more transmissions or retransmissions will occur to the same mobile station within a short period of time. (See Specification, pages 6-7.)

According to another aspect of the invention, the increased feedback rate during data transmission also helps to estimate the quality of a transmission so that, in case of retransmissions, the appropriate amount of redundancy or repetition can be included in the retransmissions. This aspect of the invention is advantageous since it is possible that a transmission might initially start from the base station with a less accurate transmission rate (e.g., not matching up to the actual, current channel quality) since a slower feedback rate is being used before transmission commences. So, although rate adaptation will be accurately performed once the feedback rate increases (e.g., to every time slot), there may be initial portions of the transmission that will require retransmission under certain circumstances. As such, the ability to estimate the quality of the transmission in the current feedback scheme will be helpful for the retransmission process. For example, these estimates can be used for selecting an appropriate

transport format (e.g., modulation, number of codes, etc.) for retransmissions for the corresponding previous transmissions.

The embodiment shown in FIG. 3 (Appendix D) helps to illustrate this aspect of the invention. Data channel 500 represents the downlink (forward link) from the base station to the mobile station and is shown as comprising two (2) millisecond frames or transmission time intervals (TTIs) 506. More specifically, data channel 500 shows multiple transmissions for the same user in data blocks 501-505, wherein data blocks 501-504 contain new transmissions while data block 505 contains a retransmission corresponding to the transmission in data block 501. As in the preceding embodiments, control channel 600 represents the uplink (reverse link) from the mobile station. The example shown in FIG. 3 depicts two (2) millisecond transmission time intervals 602, each of which comprises three (3) time slots 601 of .67 milliseconds each. This format is characteristic of the aforementioned HSDPA standard.

As in the preceding embodiments, the feedback rate for channel quality information from the mobile station is at a slower rate when there is no data transmission, e.g., as shown for time periods 603 and 604. However, when the mobile station detects transmission from the base station, the channel quality feedback rate is increased to once every transmission time interval (HI), e.g., two (2) milliseconds, as shown by communications 610-614. In this example, the transport format for the retransmission 505 for data block A (RTX A) can be based on the most recent channel quality feedback (i.e. *m)* as well as the channel quality estimates *k* and *I* that, in turn, provide an estimate of the quality of the previous transmission 501 of data block A (NTX A). Accordingly, the appropriate rate, modulation, and coding scheme can be derived

more accurately for the retransmission according to the principles of the invention. (See Specification, pages 7-8.)

In another exemplary embodiment of the invention, the feedback rate for channel quality information from the mobile station is varied as a function of the number of base stations that the mobile station is communicating with. In particular, this embodiment is particularly advantageous when handling so-called "soft handoffs" in CDMA wireless communication systems. As is well known, a "handoff" is the act of transferring support of a mobile station from one base station to another base station. A "soft handoff" occurs when the mobile station makes a connection to a new base station (e.g., cell) before leaving the current base station (e.g., cell) that is supporting the mobile station. In particular, a "soft handoff" is designed to ensure that there is connectivity with the old (e.g., current) base station while the new base station has been assigned to take control over the communication link with. the mobile station. As such, a mobile station may be simultaneously communicating with multiple base stations at a given instant of time during such handoffs. According to the principles of the invention, the feedback rate for reporting channel quality information is adapted or otherwise varied to be slower when the mobile station is communicating with only one base station and faster during a "soft handoff" when the mobile station is communicating with two or more base stations. By increasing the rate of reporting quality information during "soft handoffs, the base stations can effectively and accurately perform the appropriate rate adaptations during such critical times such as "soft handoffs" and the like. It should be noted that other variations to this aspect of the invention will be apparent to those skilled in the art and are therefore contemplated by the teachings herein.

In general, the foregoing embodiments are merely illustrative of the principles of the invention. Those skilled in the art will be able to devise numerous arrangements, which, although not explicitly shown or described herein, nevertheless embody those principles that are within the scope of the invention. For example, although the invention was described in the context of wireless transmission according to the CDMA2000 1x-EV-DO standard, the invention could also be applicable to other known or to-be-developed wireless transmission standards. For example, the teachings of the invention may be applied to wireless transmission according to the well-known High Speed Downlink Packet Access (HSDPA) specification in the Universal Mobile Telecommunication System (UMTS) standard. Other modifications or substitutions will be apparent to those skilled in the art and are contemplated by the teachings herein. (See Specification, pages 9-10.)

Appellants respectfully note that the above summary of the invention, including any indication of reference numerals, drawings, figures, paragraphs, page numbers, etc. (collectively referred to as "descriptions" of the application) have been provided solely to comply with the U.S. Patent and Trademark Office's rules concerning the appeal of the claims of the present application. As such, the descriptions above are merely exemplary and should not be construed to limit the claims of the present application in any way whatsoever.

VI. ISSUES TO BE REVIEWED ON APPEAL

(i) Whether claims 4-15 are anticipated by U.S. Patent No. 6,067,458 to Chen ("Chen").

VII. ARGUMENTS

A. The Section 102(b) Rejections

Claims 1 and 4-15 were rejected under 35 U.S.C. §102(b) as being anticipated by Chen. Appellants respectfully traverse these rejections for the reasons set forth below.

i. Claims 13-15

Appellants submit that claims 13-15 are not anticipated by Chen. As a preliminary matter, neither the Final Office Action nor the previous Office Action sets forth with any particularity how the specific limitations recited in these claims are anticipated by Chen. In both Office Actions, the rejection of claims 13-15 was supported only by reference to the reasons used for rejection of claims 1-10 in the Office Action without any acknowledgement of the different, additional limitations in claims 13-15. Secondly, the Final Office Action did not address arguments provided in Appellants' response (Appendix E) to a previous non-final Office Action with regard to the distinctions between claims 13-15 and the Chen reference.

Most importantly, Appellants submit that claims 13-15 are not anticipated by Chen because each and every element of claims 13-15 is not described, either expressly or impliedly by Chen. For example, there are absolutely no teachings in Chen that either expressly or impliedly disclose varying the rate for reporting channel quality information as a function of the number of base stations that the mobile is communicating with, as recited in Appellants' claim 13. This feature of the claimed invention, which is particularly advantageous for handling "soft handoffs", is supported in the specification, see, e.g., pages 11-13, *infra* or page 9, lines 1-22 in the specification.

Because Chen does not disclose each of the limitations recited in claim 13, Appellants submit that the Chen reference cannot anticipate claim 13. In addition, because claims 14 and 15 depend from claim 13, these dependent claims are therefore also believed to be allowable for the same reasons set forth above for claim 13 as well as for other novel features therein. Accordingly, Appellants respectfully request that the board reverse the decision of the Examiner and grant allowance of claims 13-15.

ii. Claims 1 and 4-12

Appellants submit that claims 1 and 4-12 are not anticipated by Chen because each and every element of claims 1 and 4-12 is not described, either expressly or impliedly by Chen. Contrary to the Examiner's assertion otherwise, Appellants submit that Chen does not describe, either expressly or impliedly, at least the following limitations recited in Appellants' claim I (and claim 11 which has similar limitations):

- mobile station reports channel quality information at a first rate in the absence of a reception of a data transmission from the base station and
- upon detection of a reception of a data transmission from the base station, the mobile station reports channel quality information at a second rate for a prescribed duration.

Chen appears to be concerned with adjusting the appropriate power level for transmitting data in order to avoid data loss, to extend battery life in a mobile, and so on. Power control, as described by Chen, is important especially for higher rate data transmissions because transmitting data at higher rates requires higher power (see, e.g., col. 3, lines 40-47 and col. 6, lines 49-59). In one embodiment, Chen describes a mobile (receiver) being instructed by the base station to send more power control information (e.g., at a higher rate) for a specified time

period preceding the data transmission, so that appropriate adjustments to power can be made by the base station before sending the high rate data transmission to the mobile (see, e.g., col. 3, lines 48-54). In yet another embodiment, Chen describes the case where: 1) the link can be operating at the idle rate; 2) that data is then received at the base station for *subsequent* transmission to the mobile; 3) that the base station instructs the mobile to send more power control information (e.g., on the reverse link); and 4) thereafter, the base station adjusts its power level and then sends the data transmission at a higher rate to the mobile (see, e.g., col. 11, line 40 to col. 13, line 10).

These teachings are different from Appellants' claimed invention. As recited in claim 1, a mobile sends channel quality feedback to a base station at different rates depending on whether there is an absence or presence of a data transmission from the base station to the mobile. That is, the trigger for changing the rate of channel quality feedback from the mobile to the base station is whether there is a data transmission received by the mobile from the base station. Using the actual data transmission from the base station as a trigger for the mobile station to change its rate of transmitting channel quality information back to the base station, as claimed by Appellants, is different from the teachings of Chen. In Chen, the rate of transmission of power control information over the reverse link (assuming for argument purposes that the power control information is "feedback") is varied as a function of the mobile receiving an instruction from the base station before (i.e., in preparation of) the base station sending the data transmission to the mobile. Accordingly, Chen does not teach varying feedback from the mobile based on the absence or presence of a data transmission from the base station to the mobile.

Furthermore, Appellants respectfully submit that Chen fails to disclose or suggest, contrary to the Examiner's assertion otherwise, a mobile station that, upon detection of a reception of a data transmission, reports channel quality information at a second rate for a prescribed duration. In particular, Chen only teaches that the bandwidth, and hence the rate of transmission, of power control information from the mobile station is increased in response to the instruction from the base station. Chen is silent about transmitting this information at a different rate for a prescribed duration.

Referring now to the Examiner's responses to Appellants' previous arguments in conjunction with Chen's FIG. 7 and accompanying description (col. 11, line 40 to col. 14, line 20), Appellants respectfully submit that routine 300 described by Chen must be viewed in a larger context instead of any particular step in isolation. As described for step 320, data is "presented" to the base station for a high rate transfer to the mobile. Step 330 recites "tell the receiver to increase bandwidth of power control information about forward link". Note that Chen does not teach that data transmission occurs yet, but only that the base station and mobile are preparing for such data transmission by one instructing the other to increase the rate of sending power control information so that appropriate power adjustments can be made to support the subsequent data transmission. Subsequent steps, including step 360, describe the adjustments then made to the forward link (i.e., power) culminating in the subsequent data transmission from the base station to the mobile in step 380.

Step 360, in particular, recites "control the power level of the transmitter using low, full or high rates...to set the correct high rate power level for the transmitter". As described throughout the specification, Chen is referring specifically to the process that occurs before any

data transmission occurs, whether it's via the forward link from base station to mobile as described in the embodiments, or whether its via the reverse link as inferred by the Examiner in the Office Action. Accordingly, Chen does not disclose or even suggest varying the rate of channel quality feedback from the mobile to the base station as a function of the mobile receiving the data transmission from the base station. Instead, Chen only describes the base station receiving data for subsequent transmission to the mobile and, to prepare for such transmission, instructing the mobile to vary the rate of feedback (power control information) from the mobile to the base station so that appropriate power levels can be set at the base station before sending the data transmission to the mobile.

Appellants also respectfully disagree with the Examiner's interpretation and characterization of the teachings in Chen at col. *13,* lines 20-65 and lines 55-65 in particular. This portion of Chen (or any other portion for that matter) does not describe varying the rate for reporting channel quality information from a mobile to a base station as a function of the absence or detection, by the mobile, of a data transmission from the base station, contrary to the Examiner's assertion otherwise.

While Appellants might conditionally agree with the Examiner that Chen may disclose that a mobile [and base station] can estimate and then test the proper power level necessary to send data at a high rate, this disclosure in Chen simply reinforces the fact that Chen teaches a mobile and base station that exchanges and adjusts power control information (estimating, testing, etc) prior to actual high rate data transmissions between the mobile and the base station. This is different from Appellants' claimed invention in which the rate of the channel quality

information provided by the mobile is varied based on the presence or absence of data transmissions from the base station to the mobile.

Moreover, the cited portion of disclosure from Chen at col. 13, lines 20-65 (see lines 20-32 in particular), describe a completely different scheme than that being claimed by Appellants. For example, in this cited portion, Chen discloses that the base station stores a power level that was previously measured when data was previously sent and the base station simply recalls a previous power level for a subsequent data transmission. Here, Chen is not even describing varying the rate of any power control information feedback from the mobile to the base station.

With regard to the cited portion of Chen at col. 13, lines 33-40 discussing the situation of a transmission that is to occur via the reverse link from mobile to base station, Appellants again must disagree with the Examiner's characterization of the Chen teaching as being anticipatory of Appellants' claimed invention. Chen is describing a situation in which the reverse link is operating at idle (e.g., $1/8^{th}$ rate) and "data is received for transmission along the reverse link". Appellants submit that, upon careful reading and consistent with the entire disclosure in Chen, this statement simply refers to data being received at the mobile (e.g., from a user) for subsequent transmission along the reverse link (i.e., to the base station as the Examiner points out). That is, this embodiment refers somewhat to the converse of preceding embodiments, wherein here the mobile receives data for subsequent transmission to the base station (but not from the base station) and, in response, the mobile increases to the full rate thus increasing the feedback bandwidth to the base station. Again, this embodiment in Chen is still is not the same as a mobile, in response to a data transmission from the base station, varying the rate of channel quality feedback, as claimed by Appellants.

Finally, while the Examiner appropriately acknowledges that the teachings in Chen are primarily directed toward the control being effected on the base station side, Appellants do not agree with the inferences or conclusions being drawn with respect to the capabilities of a mobile station in the context of the Chen teachings. In particular, the Examiner states that, in the context of the Chen teachings, the mobile station can have "its own capability in detecting the status of the base station in order to request or adjust to the appropriate power levels necessary whether to send data or channel quality reports back to the base station at a low rate or at a high rate".

First, Appellants do not at all agree that Chen suggests this capability for a mobile (or a base station for that matter) and have respectfully invited the Examiner to specifically point out how the teachings in Chen support such an interpretation. Instead, Appellants submit that the capabilities of a mobile are more accurately summarized by what Appellants stated previously. That is, consistent with the teachings of Chen as a whole, the capabilities to infer for the mobile would be that, in preparation for a subsequent data transmission over the reverse link to a base station, that the mobile may adjust its rate of transmission of power control information to the base station. As stated previously by Appellants, this is quite different than a mobile adjusting its channel quality feedback based on the presence or absence of a data transmission from the base station (e.g., over the forward link).

Moreover, Appellants respectfully submit that such general and liberal extensions of the teachings in Chen are not only unsupported by the disclosure in Chen, but are also not sufficient to establish a case for anticipation in which each and every element of the claimed invention must be found in Chen, which Appellants believe not to be the case for all the reasons set forth hereinabove.

Because Chen fails to disclose or suggest each and every recited limitation in claims 1 and 11, Appellants submit that Chen cannot anticipate claims 1 and 11. Because claims 4-10 and 12 each depend from respective base claims 1 or 11, these dependent claims are therefore also believed to be allowable for the same reasons set forth above for claims 1 and 11 as well as for other novel features therein that are not disclosed by Chen.

For example, with regard to claim 8, Chen does not disclose or suggest estimated channel quality being used to derive a transmission format for a subsequent transmission, wherein the transmission format includes one or more parameters selected from modulation format, number of codes, and transmission rate. As previously discussed, Chen only teaches deriving the proper power level for a subsequent high-speed transmission. With regard to claim 9, Appellants respectfully disagree that the cited portions or any other portions of the Chen reference disclose or suggest a base station receiving channel quality information from a mobile, estimating channel quality therefrom, and then calculating an amount of redundancy for retransmissions accordingly. At most, Chen describes transmitting a new transmission to a mobile using a previously stored power level for the link. This teaching is not at all the same or even suggestive of using estimated channel quality to calculate an amount of redundancy for retransmission of a previous transmission as claimed by Appellants.

In view of the foregoing, Appellants submit that Chen fails to describe, either expressly or impliedly, each and every element of Appellants' claims. As such, Appellants' claims cannot be anticipated by Chen. Accordingly, Appellants respectfully request that the Board reverse the decision of the Examiner and grant allowance of claims 1 and 4-12.

IX. CONCLUSION

Accordingly, for at least the aforementioned reasons, Appellants respectfully request that the Honorable Members of the Board of Patent Appeals and Interferences reverse each of the outstanding rejections, and allow each of the pending claims in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No.08-0750 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

Respectfully submitted,

HARNESS, DICKEY, & PIERCE, P.L.C.

By: _____

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APPENDIX A

1. (Previously Presented) A method for transmitting channel quality information in a wireless communication system comprising at least one base station and at least one mobile station, the method comprising:

varying a rate for reporting channel quality information from a mobile station to a base station as a function of the presence or absence of a reception of a data transmission at the mobile station, wherein the mobile station reports channel quality information at a first rate in the absence of a reception of a data transmission from the base station and, upon detection of a reception of a data transmission from the base station, the mobile station reports channel quality information at a second rate for a prescribed duration.

2. (Cancelled)

3. (Cancelled)

4. (Previously Presented) The method according to claim 1, wherein, upon detection of a reception of a data transmission from the base station, the mobile station reports channel quality information at a plurality of rates over a prescribed time period after detection of the reception of a data transmission, wherein the plurality of rates are different than the first rate.

5. (Previously Presented) The method according to claim 4, wherein the prescribed time period includes a plurality of time intervals such that the channel quality information is reported at different ones of the plurality of rates during different ones of the plurality of time intervals.

6. (Previously Presented) The method according to claim 1, wherein the second rate is faster than the first rate.

7. (Previously Presented) The method according to claim 1, further comprising the step of estimating channel quality at the base station while the mobile station is reporting at the second rate, wherein estimated channel quality is used to derive a transmission format for a subsequent transmission.

8. (Original) The method according to claim 7, wherein the transmission format includes one or more parameters selected from the group consisting of modulation format, number of codes, and transmission rate.

9. (Previously Presented) The method according to claim 1, further comprising the step of estimating channel quality at the base station while the mobile station is reporting at the second rate, wherein estimated channel quality is used to calculate an amount of redundancy needed for a retransmission of a previous data transmission.

10. (Original) The method according to claim 1, wherein the channel quality information comprises a transmission rate calculated by the mobile station based on one or more channel conditions.

11. (Previously Presented) A method for adapting the rate of reporting channel quality information in a wireless communication system including at least one base station and at least one mobile station, the method comprising:

reporting channel quality information from the at least one mobile station to the at least one base station at a first rate in the absence of a reception of a data transmission at the at least one mobile station; and

in the presence of a reception of a data transmission at the at least one mobile station, adapting the rate for reporting channel quality information from the at least one mobile station to the at least one base station from the first rate to a second rate for a prescribed duration.

12. (Original) The method according to claim 11, wherein the second rate is faster than the first rate.

13. (Original) A method for transmitting channel quality information in a wireless communication system including at least one base station and at least one mobile station, the method comprising:

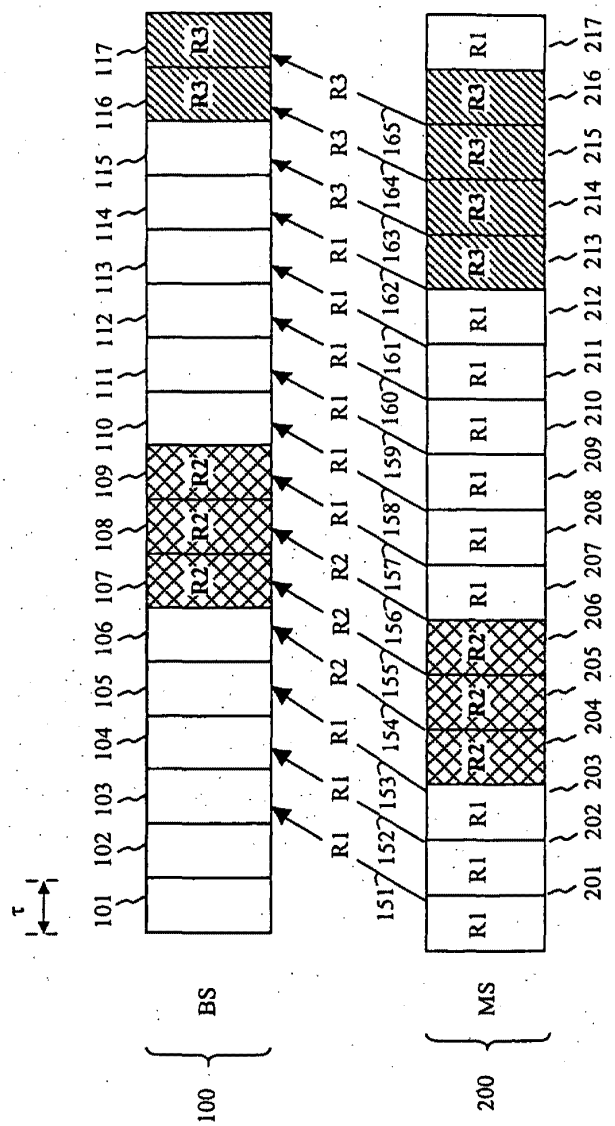
varying a rate for reporting channel quality information from a mobile station to a base station as a function of the number of base stations that the mobile station is communicating with.

14. (Original) The method according to claim 13, wherein the mobile station reports channel quality information at a first rate when the mobile station is communicating with one base station and wherein the mobile station reports channel quality information at a second rate when the mobile station is communicating with a plurality of base stations.

15. (Original) The method according to claim 14 wherein the second rate is faster than the first rate.

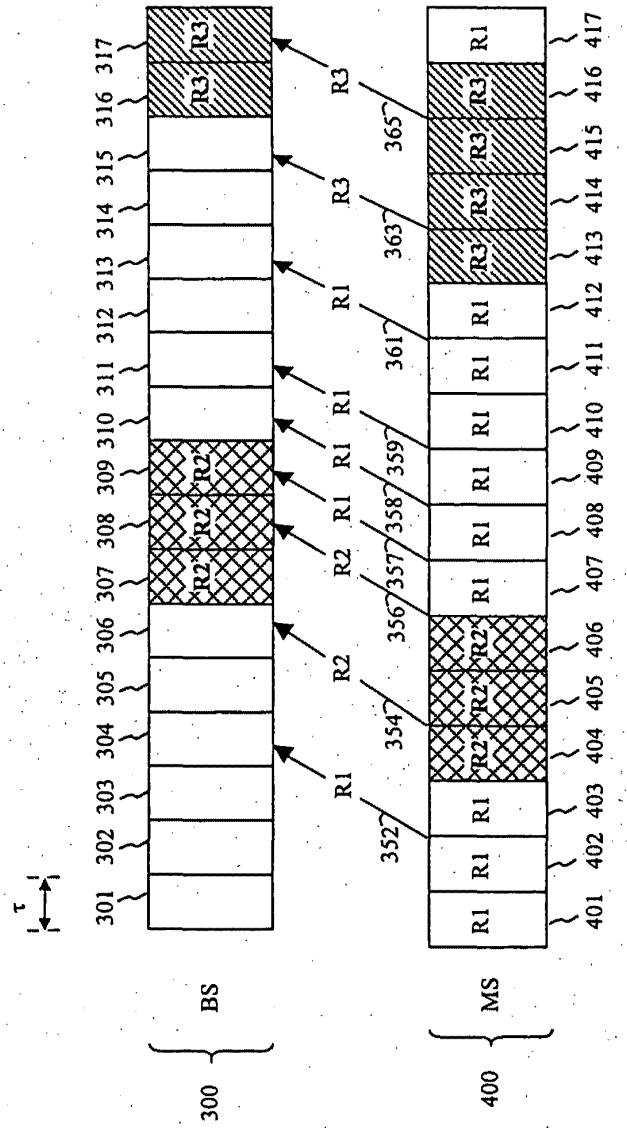
OIPE
FEB 28 2005
JC25
PATENT & TRADEMARK OFFICE

FIG. 1



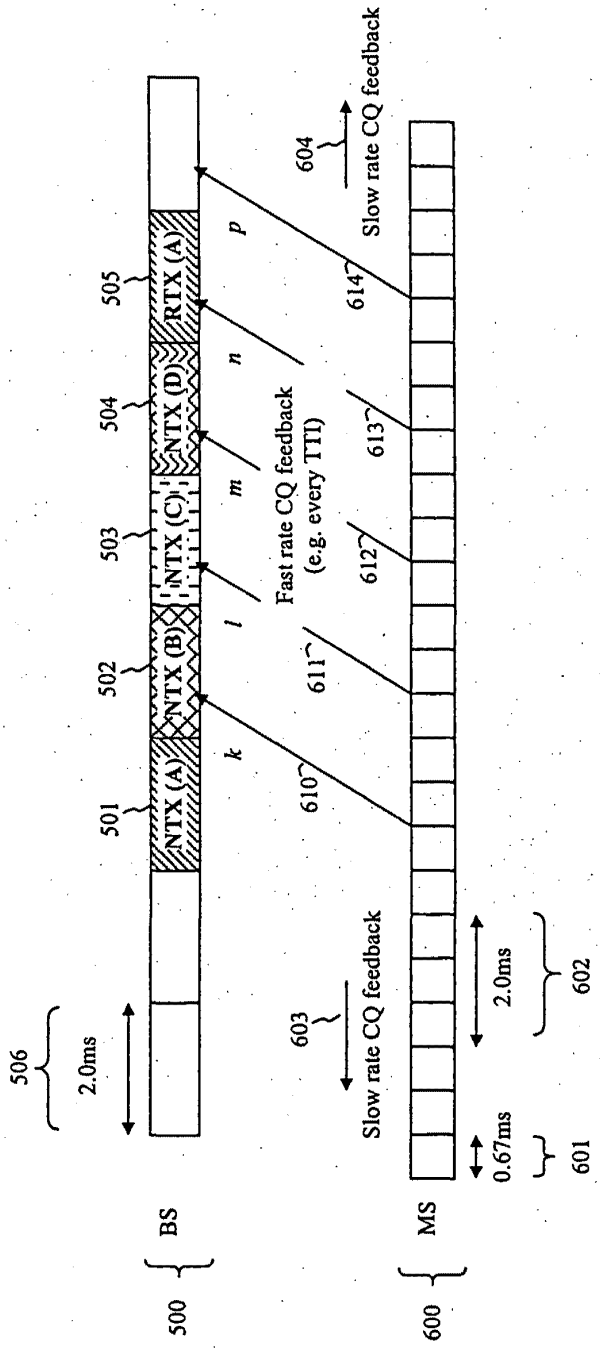
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FIG. 2



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FIG. 3



APPENDIX E



CERTIFICATION OF FACSIMILE TRANSMISSION

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Gregory J. Murgia — 2/2/04 (Date)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent Application

Inventors	Arnab Das Farooq Ullah Khan
Case	14-18
Serial No.	10/002,746
Filing Date	November 2, 2001
Examiner	Thuan T. Nguyen
Group	2685
Title	Variable Rate Channel Quality Feedback in a Wireless Communication System

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

AMENDMENT

Sir:

In response to the Office Action dated October 2, 2003, please enter the following amendments and remarks in the above-identified application, in which:

Amendments to the claims begin on page 2 of this paper; and

Remarks begin on page 5 of this paper.

In the Claims

Please substitute the following claims for those currently on file in the application:

1. (Currently Amended) A method for transmitting channel quality information in a wireless communication system comprising at least one base station and at least one mobile station, the method comprising:

varying a rate for reporting channel quality information from a mobile station to a base station as a function of the presence or absence of a reception of a data transmission at the mobile station, wherein the mobile station reports channel quality information at a first rate in the absence of a reception of a data transmission from the base station and, upon detection of a reception of a data transmission from the base station, the mobile station reports channel quality information at a second rate for a prescribed duration.

2. **(Canceled)**

3. **(Canceled)**

4. (Currently Amended) The method according to claim 1, wherein ~~the mobile station reports channel quality information at a first rate in the absence of a reception of a transmission from the base station and~~, upon detection of a reception of a data transmission from the base station, the mobile station reports channel quality information at a plurality of rates over a prescribed time period after detection of the reception of a data transmission, wherein the plurality of rates are different than the first rate.

5. (Currently Amended) The method according to claim 4, wherein the prescribed time period includes a plurality of time intervals such that the channel quality information is reported at different ones of the plurality of rates during different ones of the plurality of time intervals.

6. (Currently Amended) The method according to claim ~~2~~ 1, wherein the second rate is faster than the first rate.

7. (Currently Amended) The method according to claim ~~6~~ 1, further comprising the step of estimating channel quality at the base station while the mobile station is reporting at the second rate, wherein estimated channel quality is used to derive a transmission format for a subsequent transmission.

8. (Original) The method according to claim **7**, wherein the transmission format includes one or more parameters selected from the group consisting of modulation format, number of codes, and transmission rate.

9. (Currently Amended) The method according to claim ~~6~~ **1**, further comprising the step of estimating channel quality at the base station while the mobile station is reporting at the second rate, wherein estimated channel quality is used to calculate an amount of redundancy needed for a retransmission of a previous data transmission.

10. (Original) The method according to claim **1**, wherein the channel quality information comprises a transmission rate calculated by the mobile station based on one or more channel conditions.

11. (Currently Amended) A method for adapting the rate of reporting channel quality information in a wireless communication system including at least one base station and at least one mobile station, the method comprising:

reporting channel quality information from the at least one mobile station to the at least one base station at a first rate in the absence of a reception of a data transmission at the at least one mobile station; and

in the presence of a reception of a data transmission at the at least one mobile station, adapting the rate for reporting channel quality information from the at least one mobile station to the at least one base station from the first rate to a second rate for a prescribed duration.

12. (Original) The method according to claim **11**, wherein the second rate is faster than the first rate.

13. (Original) A method for transmitting channel quality information in a wireless communication system including at least one base station and at least one mobile station, the method comprising:

varying a rate for reporting channel quality information from a mobile station to a base station as a function of the number of base stations that the mobile station is communicating with.

14. (Original) The method according to claim **13**, wherein the mobile station reports channel quality information at a first rate when the mobile station is communicating with one base station and wherein the mobile station reports channel quality information at a second rate when the mobile station is communicating with a plurality of base stations.

15. (Original) The method according to claim **14** wherein the second rate is faster than the first rate

REMARKS

By this amendment, claims 1, 4-7, 9 and 11 have been amended and claims 2-3 have been canceled. Accordingly, claims 1 and 4-15 are still pending in the application for further consideration by the Examiner.

35 U.S.C. 102(b) Rejection

Claims 1-15 were rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 6,067,458 ("Chen"). Claims 1, 4-7, 9 and 11 have been amended, claims 2-3 have been canceled, and all rejections of the remaining claims are respectfully traversed as set forth below.

Claims 1-12

Briefly, the Chen reference appears to be directed to controlling the power level of transmissions between base stations and mobile stations and, in particular, to controlling power for higher rate data transmissions. Applicants acknowledge that Chen describes and it is well known for a mobile station to send power control information (e.g., messages) to a base station corresponding to the measured power level received at the mobile station. Furthermore, Applicants acknowledge that Chen describes how a variable rate vocoder is used to transmit voice and/or data at a plurality of rates over a link, e.g., col. 6, lines 10 et seq.

However, Applicants respectfully submit that Chen does not teach or suggest every limitation set forth in Applicants' claims and, as such, does not anticipate Applicants' claims. Applicants' claim 1, as amended, recites that the mobile station reports channel quality information at a first rate in the absence of a reception of a data transmission from the base station and, upon detection of a reception of a data transmission from the base station, the mobile station reports channel quality information at a second rate for a prescribed duration. Independent claim 11 recites similar limitations.

Chen is only concerned with power control and, as such, only describes a mobile station transmitting power control information to a base station, wherein power control information is characterized throughout the specification as either a signal corresponding to the measured power level, a signal or message indicating that the power level deviated from a predefined threshold, or other similar variations of communicating the power information. By contrast, Applicants' independent claims 1 and 11 each recite the mobile station reporting channel quality information to the base station, which Applicants respectfully submit is different than power control information. While the Office Action references one statement in Chen (e.g., col. 14, lines 35-39) in which the patentee obliquely mentions that the invention would be applicable to a "communication system that operates in accordance with the claims to provide channel quality monitoring and power control", Applicants respectfully submit that this statement alone does not

supply an anticipatory and enabling teaching for a mobile station reporting channel quality information in the manner in which it is now being claimed by Applicants.

Notwithstanding at least the above distinction, Applicants respectfully submit that Chen also fails to teach or suggest varying the rate for reporting channel quality information from a mobile station as a function of the absence or detection of a data transmission from the base station.

In FIG. 7 and the accompanying description in col. 11, lines 35 et seq., Chen describes a routine for changing power levels for sending data at a high rate after sending data at one of the low rates. More specifically, Chen describes the base station operating at an idle rate, e.g., sending no voice/data to the mobile. After data is "presented to the base station" for a high rate transfer to the mobile (col. 11, lines 49-50), the base station (step 330, FIG. 7) first sends a signal to the mobile station to increase the bandwidth of the power control information transmitted by the mobile (col. 11, lines 64-67). According to Chen, increasing power control bandwidth causes power control information to be sent at a higher rate from the mobile (col. 11, line 67 to col. 12, line 3). More specifically, Chen clearly discloses that the base station sends an encoded signal to the mobile, which then decodes the signal and, in response thereto, increases the bandwidth of its power control information, e.g., by transmitting one or more power control messages per several frames (col. 12, lines 3-13). Chen describes that this increased power control information is necessary to predict the power needed to then subsequently transmit data at the higher data rate (col. 12, lines 14-62).

Again, in col. 13, lines 48 to col. 14, line 41, Chen describes generally that the routine shown in FIG. 7 allows the mobile and base station to estimate and test the proper power level before sending data at a higher rate and, in particular, that the transmission rate of power control information can be increased from the mobile so that the base station can estimate the proper power level for transmitting subsequent frames of data at high rates to the mobile. Consequently, all teachings in Chen describe increasing power control feedback from the mobile based on the base station sending a message or signal instructing such action in preparation for a subsequent high data rate transmission.

By contrast, Applicants' claimed invention sets forth a mobile station that changes its rate of transmitting channel quality information based on the mobile's detection of the absence or presence of a data transmission from the base station. That is, the mobile station receives a data transmission from the base station and, in response thereto, begins transmitting channel quality information back to the base station at a second rate. Using the actual data transmission from the base station as a trigger for the mobile station to change its rate of transmitting channel

quality information back to the base station is quite different from using a separate signaling message from the base station to the mobile telling the mobile to transmit more power control information (i.e., so that the base station can then adjust power for the subsequent higher speed data transmission) as described by Chen.

Furthermore, Applicants respectfully submit that neither the cited portion of Chen (col. 6, lines 18-48) nor any other portion of the reference teaches or suggests a mobile station that, upon detection of a reception of a data transmission, reports channel quality information at a second rate for a prescribed duration. In particular, Chen only teaches that the bandwidth, and hence the rate of transmission, of power control information from the mobile station is increased in response to the instruction from the base station. Chen fails to teach or suggest transmitting this information at a different rate for a prescribed duration.

Among other advantages, transmitting channel quality information at a second rate for a prescribed duration as set forth in Applicants' claims addresses the problem of delay with respect to uplink transmissions (from the mobile) and downlink transmissions (from the base station). In particular, there is delay with respect to the calculation of rate information by the mobile during a time slot and the subsequent reporting of that rate (vis-à-vis channel quality feedback) to the base station, *see, e.g.,* Applicants' specification on page 2, line 8-33. By way of example, this delay can cause problems in adapting the rate of channel quality feedback (and subsequent changes to transmission rate), especially when dealing with the bursty nature of data traffic (e.g., all packets may not come at once or in immediate succession). In particular, reporting channel quality information at a second rate for a prescribed duration as claimed by Applicants will solve the problem of undesirable (e.g., premature) switching back and forth between rates just because there may be some gaps in packet transmission. By maintaining transmission of channel quality information at a second rate for a prescribed duration as claimed by Applicants, insignificant gaps in packet transmission will not trigger an unnecessary switch in the feedback rate (*see, e.g.,* Applicants' specification, page 6, line 26 through page 7, line 27). Applicants respectfully submit that there are no such teachings in Chen.

Because Chen fails to teach or suggest every recited limitation in claims 1 and 11 (as amended), Applicants submit that Chen therefore does not anticipate claims 1 and 11 and respectfully request that the Examiner withdraw the rejections accordingly.

Because claims 4-10 and 12 each depend from respective base claims 1 or 11, these dependent claims are therefore also believed to be allowable for the same reasons set forth above for claims 1 and 11 as well as for other novel features therein.

With regard to claim 8, for example, Chen does not teach or suggest estimated channel quality being used to derive a transmission format for a subsequent transmission, wherein the transmission format includes one or more parameters selected from modulation format, number of codes, and transmission rate. As previously discussed, Chen only teaches deriving the proper power level for a subsequent high-speed transmission. That is, the base station receives a data transmission that is to be transmitted at a higher rate (defined *a priori*) and, upon receiving the power control information from the mobile station, the base station then adjusts the power level to a proper level for transmission of the higher rate data transmission. As such, there is no teaching in Chen for deriving modulation format, number of codes, and/or transmission rate for a subsequent transmission after estimating channel quality based on feedback from the mobile, as is now being claimed by Applicants.

With regard to claim 9, Applicants respectfully disagree that the cited portions or any other portions of the Chen reference teach or suggest a base station receiving channel quality information from a mobile, estimating channel quality therefrom, and then calculating an amount of redundancy for retransmissions accordingly. At most, Chen describes transmitting a new transmission to a mobile using a previously stored power level for the link. This teaching is not at all the same or even suggestive of using estimated channel quality to calculate an amount of redundancy for retransmission of a previous transmission as claimed by Applicants.

Claims 13-15

Applicants also respectfully submit that Chen does not teach or suggest every limitation recited in independent claim 13. The distinctions noted above for the Chen reference and Applicants' claims 1 and 11, relating to channel quality information as claimed by Applicants versus power control information as disclosed by Chen, apply equally to claim 13 and will not be repeated here for sake of brevity. Furthermore, there are absolutely no teachings in Chen, nor are any cited in the Office Action, that either expressly or impliedly suggest varying the rate for reporting channel quality information as a function of the number of base stations that the mobile is communicating with, as is recited in Applicants' claim 13. This feature of Applicants' claimed invention, which is particularly advantageous for handling "soft handoffs", is supported in Applicants' specification, see, e.g., page 9, lines 1-22.

Because Chen does not teach or suggest each of the limitations recited in claim 13, Applicants' submit that the Chen reference therefore does not anticipate claim 13 and respectfully request that the Examiner withdraw the rejection accordingly. Because claims 14 and 15 depend from claim 13, these dependent claims are therefore also believed to be

allowable for the same reasons set forth above for claim 13 as well as for other novel features therein.

Conclusion

In view of the foregoing, Applicants believe that all pending claims stand in condition for allowance. Accordingly, Applicants respectfully request reconsideration of the application and passage of the case to issue. Any questions can be directed to the Applicants' attorney at the number below.

Respectfully submitted,

By: _____

Gregory J. Murgia
Reg. No. 41,209
Attorney for Applicants
(732) 949-3578

Lucent Technologies Inc.
Date: 2/2/04

OIPE JC177
JAN 10 2005
PATENT & TRADEMARK OFFICE

MAIL STOP AF
RESPONSE UNDER
37 C.F.R. § 1.116
EXPEDITED PROCEDURE
EXAMINING GROUP 2685

PATENT
29250-002099/US

IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicant:	Arnab DAS et al.	Conf.:	3832
Appl. No.:	10/002,746	Group:	2685
Filed:	November 2, 2001	Examiner:	Thuan T. Nguyen
For:	VARIABLE RATE CHANNEL QUALITY FEEDBACK IN A WIRELESS COMMUNICATION SYSTEM		
Docket No.:	29250-002099/US		

NOTICE OF APPEAL FROM THE
PRIMARY EXAMINER TO THE BOARD OF APPEALS

U.S. Patent and Trademark Office
220 20th Street S.
Customer Window Mail Stop AF
Crystal Plaza Two, Lobby, Room 1B03
Arlington, VA 22202

January 10, 2005

Sir:

Applicants hereby appeal to the Board of Appeals from the decision dated May 5, 2004 of the Primary Examiner finally rejecting claims 1 and 4-15.

☐ The enclosed document is being transmitted via the Certificate of Mailing provisions of 37 C.F.R. § 1.8.

Applicants hereby petition for an extension of **five (5) month(s)** pursuant to 37 C.F.R. §§ 1.17 and 1.136(a).

The fee has been calculated as shown below:

☒ NO extensions of time have been previously obtained for responding to the Final Rejection. Thus a fee of $2,160.00 is required for the full period of the above-requested extension of time.

01/11/2005 ZJUHAR1 00000016 10002746
01 FC:1401 500.00 OP

☐ An extension of _____ (____) **month(s)** for responding to the Final Rejection was previously requested and paid for on . Thus a fee of $ is required.

☐ Applicant claims small entity status. See 37 C.F.R. § 1.27.

The Government fee for filing a Notice of Appeal to the Board of Appeals is calculated as follows:

☒ Large entity - $500.00

☐ Small Entity - $250.00

Therefore, the TOTAL FEE due for the filing of this Notice of Appeal is $2,660.

Payment of the above TOTAL FEE is being made in the following manner:

☒ Check in the amount of $4,160.00 is enclosed (this also includes a Petition to Revive fee).

☐ Please charge Deposit Account No. 08-0750 in the amount of $0.00. A triplicate copy of this sheet is attached.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 08-0750 for any additional fees required under 37 C.F.R. §§1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

HARNESS, DICKEY, & PIERCE, P.L.C.

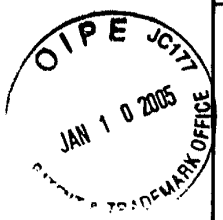
By _____

John E. Curtin, Reg. No. 37,602

P.O. Box 8910
Reston, Virginia 20195
(703) 668-8000

JEC:psy

PTO/SB/22 (10-00)
Approved for use through 10/31/2002. 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.



PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)	Docket Number (Optional) 29250-002099/US

In re Application of Arnab DAS et al.	
Application Number 10/002,746	Filed November 2, 2001
For VARIABLE RATE CHANNEL QUALITY FEEDBACK IN A WIRELESS COMMUNICATION SYSTEM	
Group Art Unit 2685	Examiner Thuan T. Nguyen

Applicant(s) hereby petition(s) for an extension of five (r) month(s) pursuant to 37 C.F.R. §§ 1.17 and 1.136(a).

The fee has been calculated as shown below:

☒ NO extensions of time have been previously obtained for responding to the Final Rejection. Thus a fee of $2,160.00 is required for the full period of the above-requested extension of time.

☐ An extension of _____( ) month(s) for responding to the Final Rejection was previously requested and paid for on _____. Thus a fee of $0.00 is required to obtain an additional _____( ) month(s) for filing the _____.

☐ Applicant claims small entity status. See 37 CFR 1.27. Therefore, the fee amount shown above is reduced by one-half, and the resulting fee is: $ _____ .

☐ A check in the amount of the fee is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☐ The Commissioner has already been authorized to charge fees in this application to a Deposit Account.

☐ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number _____ .

I have enclosed a duplicate copy of this sheet.

I am the ☐ applicant/inventor.

☐ assignee of record of the entire interest. See 37 CFR 3.71

Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96).

☒ attorney or agent of record.

☐ attorney or agent under 37 CFR 1.34(a).

Registration number if acting under 37 CFR 1.34(a). _____ .

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

January 10, 2005
Date

Signature

John E. Curtin, Reg. No. 37,602
Typed or printed name

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

☐ *Total of _____ forms are submitted.

Burden Hour Statement: This form is estimated to take 0.1 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

01/11/2005 ZJUHAR1 00000016 10002746
02 FC:1255 2160.00 OP

BEST AVAILABLE COPY

OIPE JC177 JAN 10 2005 PATENT & TRADEMARK OFFICE

PATENT
ATTORNEY DOCKET NO. 29250-002099/US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANTS:	Arnab DAS et al.	CONF. NO.:	3832
SERIAL NO.:	10/002,746	GROUP:	2685
FILED:	November 2, 2001	EXAMINER:	Thuan T. Nguyen
FOR:	VARIABLE RATE CHANNEL QUALITY FEEDBACK IN A WIRELESS COMMUNICATION SYSTEM		

REVOCATION OF POWER OF ATTORNEY, SUBSTITUTE POWER OF ATTORNEY, AND CHANGE IN CORRESPONDENCE ADDRESS

U.S. Patent and Trademark Office
220 20th Street S.
Customer Window
Crystal Plaza Two, Lobby, Room 1B03
Arlington, VA 22202

Dear Sir:

The Assignee of the above-identified patent application, Lucent Technologies, Inc. having a business office at 600 Mountain Avenue, P.O. Box 636, Murray Hill, NJ 07974-0636, as evidenced by the recordation at Reel 012354 and Frame 0991, hereby revokes any and all previous powers of attorney for the above-identified patent application or issued patent, and hereby appoints the firms of Harness, Dickey & Pierce, P.L.C. and Lucent Technologies as the attorneys of the Assignee to receive all correspondence relating to the above-identified application or patent and to transact all business in the United States Patent and Trademark Office connected therewith, with full power of substitution and revocation, and the Assignee ratifies any act done by the Assignee's attorneys in respect of this patent. The new correspondence address is:

HARNESS, DICKEY & PIERCE, P.L.C.
P.O. Box 8910
Reston, VA 20195

BEST AVAILABLE COPY

Customer Number 30594

The undersigned (whose title is supplied below) is empowered to sign this Revocation and Substitute Power of Attorney on behalf of the Assignee.

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

1/4/05
Date

Gregory J. Murgia
Signature

Gregory J. Murgia

Corporate Counsel
Title

DAC ~~2685~~

Please type a plus sign (+) inside this box → +

HDP/SB/21 based on PTO/SB/21 (08-00)

PTO JC21 JAN 10 2005 PATENT & TRADEMARK OFFICE

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application Number	**10/002,746**
Filing Date	November 2, 2001
Inventor(s)	Arnab DAS et al.
Group Art Unit	2685
Examiner Name	Thuan T. Nguyen
Attorney Docket Number	29250-002099/US

ENCLOSURES *(check all that apply)*

☒ Fee Transmittal Form	☐ Assignment Papers *(for an Application)*	☐ After Allowance Communication to Group
☒ Fee Attached	☐ Letter to the Official Draftsperson and _____ Sheets of Formal Drawing(s)	☐ LETTER SUBMITTING APPEAL BRIEF AND APPEAL BRIEF (w/clean version of pending claims)
☐ Amendment	☐ Licensing-related Papers	☒ Appeal Communication to Group *(Notice of Appeal, Brief, Reply Brief)*
☐ After Final	☒ Petition	☐ Proprietary Information
☐ Affidavits/declaration(s)	☐ Petition to Convert to a Provisional Application	☐ Status Letter
☒ Extension of Time Request	☒ Power of Attorney, Revocation Change of Correspondence Address	☐ Other Enclosure(s) *(please identify below):*
☐ Express Abandonment Request	☐ Terminal Disclaimer	
☐ Information Disclosure Statement	☐ Request for Refund	
☐ Certified Copy of Priority Document(s)	☐ CD, Number of CD(s) ____	
☐ Response to Missing Parts/ Incomplete Application	Remarks	
☐ Response to Missing Parts under 37 CFR 1.52 or 1.53		

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm *or* Individual name	Harness, Dickey & Pierce, P.L.C.	Attorney Name John E. Curtin	Reg. No. 37,602
Signature			
Date	January 10, 2005		

PTO/SB/17 (12-04)
Approved for use through 07/31/2006. 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.

OIPE JC#7 JAN 10 2005 PATENT & TRADEMARK OFFICE

FEE TRANSMITTAL for FY 2005

Effective 10/01/2004. Patent fees are subject to annual revision.

☒ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT ($) 4,160

Complete if Known	
Application Number	10/002,746
Filing Date	November 2, 2001
First Named Inventor	Arnab DAS et al.
Examiner Name	Thuan T. Nguyen
Art Unit	2685
Attorney Docket No.	29250-002099/US

METHOD OF PAYMENT *(check all that apply)*

☒ Check ☐ Credit card ☐ Money Order ☐ Other ☐ None

☐ Deposit Account:

Deposit Account Number: 08-0750

Deposit Account Name: Harness, Dickey & Pierce, PLC

The Director is authorized to: *(check all that apply)*
☐ Charge fee(s) indicated below ☐ Credit any overpayments
☐ Charge any additional fee(s) during the pendency of this application
☐ Charge fee(s) indicated below, **except for the filing fee** to the above-identified deposit account.

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1011	300	2011	150	Utility filing fee	
1012	200	2012	100	Design filing fee	
1013	200	2013	100	Plant filing fee	
1014	300	2014	150	Reissue filing fee	
1005	200	2005	100	Provisional filing fee	

SUBTOTAL (1) ($) 0

2. EXTRA CLAIM FEES FOR UTILITY AND REISSUE

			Extra Claims		Fee from below		Fee Paid
Total Claims		-20 ** =	0	X		=	0
Independent Claims		-3 ** =	0	X		=	0
Multiple Dependent						=	0

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
1202	50	2202	25	Claims in excess of 20
1201	200	2201	100	Independent claims in excess of 3
1203	360	2203	180	Multiple dependent claim, if not paid
1204	200	2204	100	** Reissue independent claims over original patent
1205	50	2205	25	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($) 0

**or number previously paid, if greater; For Reissues, see above

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
1051	130	2051	65	Surcharge - late filing fee or oath	
1052	50	2052	25	Surcharge - late provisional filing fee or cover sheet.	
1053	130	1053	130	Non-English specification	
1812	2,520	1812	2,520	For filing a request for reexamination	
1804	920*	1804	920*	Requesting publication of SIR prior to Examiner action	
1805	1,840*	1805	1,840*	Requesting publication of SIR after Examiner action	
1251	120	2251	60	Extension for reply within first month	
1252	450	2252	225	Extension for reply within second month	
1253	1020	2253	510	Extension for reply within third month	
1254	1,590	2254	795	Extension for reply within fourth month	
1255	2,160	2255	1080	Extension for reply within fifth month	2,160
1401	500	2401	250	Notice of Appeal	500
1402	500	2402	250	Filing a brief in support of an appeal	
1403	1000	2403	500	Request for oral hearing	
1452	500	2452	250	Petition to revive – unavoidable	
1453	1500	2453	750	Petition to revive – unintentional	1500
1501	1400	2501	700	Utility issue fee (or reissue)	
1502	800	2502	400	Design issue fee	
1460	130	1460	130	Petitions to the Commissioner	
1807	50	1807	50	Processing fee under 37 CFR 1.17 (q)	
1806	180	1806	180	Submission of Information Disclosure Stmt	
8021	40	8021	40	Recording each patent assignment per property (times number of properties)	
1809	790	2809	395	Filing a submission after final rejection (37 CFR § 1.129(a))	
1810	790	2810	395	For each additional invention to be examined (37 CFR § 1.129(b))	
1801	790	2801	395	Request for Continued Examination (RCE)	

Other fee (specify) ____

*Reduced by Basic Filing Fee Paid **SUBTOTAL (3)** ($)4,160

4. SEARCH/EXAMINATION FEES

1111	500	2111	250	Utility Search Fee	
1112	100	2112	50	Design Search Fee	
1113	300	2113	150	Plant Search Fee	
1114	500	2114	250	Reissue Search Fee	
1311	200	2311	100	Utility Examination Fee	
1312	130	2312	65	Design Examination Fee	
1313	160	2313	80	Plant Examination Fee	
1314	600	2314	300	Reissue Examination Fee	

SUBTOTAL (4) ($)0

SUBMITTED BY				Complete *(if applicable)*	
Name (Print/Type)	John E. Curtin	*Registration No. (Attorney/Agent)*	37,602	*Telephone*	(703) 668-8000
Signature				*Date*	January 10, 2005

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

OIPE JC171
JAN 10 2005
PATENT & TRADEMARK OFFICE

MAIL STOP PETITION
PATENT

IN THE U.S. PATENT AND TRADEMARK OFFICE

APPLICANT: Arnab DAS et al.

APPL. NO.: 10/002,746

FILED: November 2, 2001

FOR: VARIABLE RATE CHANNEL QUALITY FEEDBACK IN A WIRELESS COMMUNICATION SYSTEM

PETITION TO REVIVE AN UNINTENTIONALLY ABANDONED APPLICATION UNDER 37 C.F.R. §1.137(b)

U.S. Patent and Trademark Office
220 20th Street S.
Customer Window Mail Stop PETITION
Crystal Plaza Two, Lobby, Room 1B03
Arlington, VA 22202

January 10, 2005

Sir:

The above-identified application became abandoned for applicant's unintentional failure to timely respond throughout duration of entirety to the Examiner's Final Office Action dated May 5, 2004.

APPLICANT HEREBY PETITIONS FOR REVIVAL OF THIS APPLICATION

1. Petition Fee
_____ Small Entity - fee $_____ (37 CFR 1.17(m))
_____ Small Entity Statement enclosed herewith.
_____ Small Entity Statement previously filed.
_X_ Other than Small Entity - fee **$1,500.00** (37 C.FR 1.17(m))

01/11/2005 ZJUHAR1 00000016 10002746
03 FC:1453 1500.00 OP

2. Reply and/or Fee

A. The filing fee (no reply is necessary) of $_____:
_____ has been filed previously on
_____ is enclosed herewith.

B. The issue fee of $_____
_____ has been paid previously on _____.
_____ is enclosed herewith.

3. Terminal Disclaimer with disclaimer fee

_X_ Since this utility/plant application was filed on or after June 8, 1995, no terminal disclaimer is required.

__ A Terminal Disclaimer (and disclaimer fee (37 CFR 1.20(d)) of $_____ for a small entity or _____ for other than a small entity) equivalent to the number of months from abandonment to the filing of this petition.

4. Statement. The entire delay in filing the required reply from the due date for the reply until the filing of a grantable petition under 37 CFR 1.137(b) was unintentional.

As of this date, no Notice of Abandonment has been received from the U.S. Patent and Trademark Office.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 08-0750 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17; particularly, extension of time fees.

January 10, 2005
Date

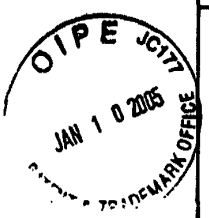
Signature

(703) 668-8000
Telephone Number

John E. Curtin
Reg. No. 37,602
P.O. Box 8910
Reston, Virginia 20195
(703) 668-8000

Enclosure: Fee Payment

PTO/SB/22 (10-00)
Approved for use through 10/31/2002. 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.



PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)	Docket Number (Optional) 29250-002099/US

In re Application of Arnab DAS et al.	
Application Number 10/002,746	Filed November 2, 2001
For VARIABLE RATE CHANNEL QUALITY FEEDBACK IN A WIRELESS COMMUNICATION SYSTEM	
Group Art Unit 2685	Examiner Thuan T. Nguyen

Applicant(s) hereby petition(s) for an extension of five (r) month(s) pursuant to 37 C.F.R. §§ 1.17 and 1.136(a).

The fee has been calculated as shown below:

☒ NO extensions of time have been previously obtained for responding to the Final Rejection. Thus a fee of $2,160.00 is required for the full period of the above-requested extension of time.

☐ An extension of _____( ) month(s) for responding to the Final Rejection was previously requested and paid for on _____. Thus a fee of $0.00 is required to obtain an additional _____( ) month(s) for filing the _____.

☐ Applicant claims small entity status. See 37 CFR 1.27. Therefore, the fee amount shown above is reduced by one-half, and the resulting fee is: $ _____.

☐ A check in the amount of the fee is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☐ The Commissioner has already been authorized to charge fees in this application to a Deposit Account.

☐ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number _____.

I have enclosed a duplicate copy of this sheet.

I am the ☐ applicant/inventor.

☐ assignee of record of the entire interest. See 37 CFR 3.71

Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96).

☒ attorney or agent of record.

☐ attorney or agent under 37 CFR 1.34(a).

Registration number if acting under 37 CFR 1.34(a). _____.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

January 10, 2005
Date

Signature

John E. Curtin, Reg. No. 37,602
Typed or printed name

Adjustment date: 04/28/2005 AKELLEY 00000016 10002745
01/11/2005 ZJUHAR1 -2160.00 OP
02 FC:1255

Repln. Ref: 04/28/2005 AKELLEY 00000016
DAM:060750 Name/Number:
FC: 9204

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

☐ *Total of _____ forms are submitted.

Burden Hour Statement: This form is estimated to take 0.1 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

01/11/2005 ZJUHAR1 00000016 10002746
02 FC:1255 2160.00 OP

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

APPLICATION NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NO.
10/002,746			

EXAMINER	
NGUYEN, T	
ART UNIT	PAPER NUMBER

DATE MAILED:

INTERVIEW SUMMARY

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

(1) JOHN CURTIN (3) _____

(2) TONY T. NGUYEN (4) _____

Date of Interview 11/22/04

Type: ☐ Telephonic ☑ Personal (copy is given to ☐ applicant ☑ applicant's representative).

Exhibit shown or demonstration conducted: ☐ Yes ☑ No If yes, brief description: _____

Agreement ☐ was reached. ☑ was not reached.

Claim(s) discussed: 1

Identification of prior art discussed: Chen

Description of the general nature of what was agreed to if an agreement was reached, or any other comments:

Applicant's Rep. and the Examiner discuss about the varying rate for claimed quality report, and the Examiner suggests the claim language should be revised in a clear manner, maybe to further include the negative limitation of "without considering power control ... etc. for in better condition for allowance.

(A fuller description, if necessary, and a copy of the amendments, if available, which the examiner agreed would render the claims allowable must be attached. Also, where no copy of the amendments which would render the claims allowable is available, a summary thereof must be attached.)

1. ☑ It is not necessary for applicant to provide a separate record of the substance of the interview.

Unless the paragraph above has been checked to indicate to the contrary. A FORMAL WRITTEN RESPONSE TO THE LAST OFFICE ACTION IS NOT WAIVED AND MUST INCLUDE THE SUBSTANCE OF THE INTERVIEW. (See MPEP Section 713.04). If a response to the last Office action has are ready been filed, APPLICANT IS GIVEN ONE MONTH FROM THIS INTERVIEW DATE TO FILE A STATEMENT OF THE SUBSTANCE OF THE INTERVIEW.

2. ☐ Since the Examiner's interview summary above (including any attachments) reflects a complete response to each of the objections, rejections and requirements that may be present in the last Office action, and since the claims are now allowable, this completed form is considered to fulfill the response requirements of the last Office action. Applicant is not relieved from providing a separate record of the interview unless box 1 above is also checked.

Examiner Note: You must sign this form unless it is an attachment to another form.

FORM PTOL-413 (REV.1-96) 11.26.04

TONY T. NGUYEN
PATENT EXAMINER

E.O.T.
1 month

CERTIFICATION OF FACSIMILE TRANSMISSION

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Gregory J. Murgia 8/6/04
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PATENT APPLICATION

Inventor(s):	**Arnab Das** **Farooq Ullah Khan**		
Case Name/No.:	**14-18**		
Serial No.:	**10/002,746**	**Group Art Unit:**	**2685**
Filing Date:	**November 2, 2001**	**Examiner:**	**T. Nguyen**
Title:	**Variable Rate Channel Quality Feedback In A Wireless Communication System**		

COMMISSIONER FOR PATENTS
P.O. BOX 1450
ALEXANDRIA, VA 22313-1450

PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)

SIR:

Applicants petition the Commissioner for Patents to extend the period for filing a reply in the above-identified application for:

one month (37 CFR 1.17(a)(1)).

Please charge **Lucent Technologies Deposit Account No. 12-2325** in the amount of **$110.00** to cover the cost of the extension. In the event of non-payment or improper payment of a required fee, the Commissioner is authorized to charge or to credit **Deposit Account No. 12-2325** as required to correct the error. Duplicate copies of this petition are enclosed.

11/05/2004 LBADZE 00000028 122325 10002746
01 FC:1251 110.00 DA

Respectfully,

Gregory J. Murgia
Attorney for Applicants
Reg. No.: 41,209

Date: 8/6/04
Lucent Technologies Inc.
101 Crawfords Corner Road
Room 3J-219
Holmdel, New Jersey 07733-3030

OT 070 (1/03)
PAGE 3/12 * RCVD AT 8/6/2004 5:57:45 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-1/0 * DNIS:8729306 * CSID:7329490102 * DURATION (mm-ss):03-44

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/002,746	11/02/2001	Amab Das	14-18	3832

7590 11/04/2004

Docket Administrator (Room 3J-219)
Lucent Technologies Inc.
101 Crawfords Corner Road
Holmdel, NJ 07733-3030

EXAMINER	
NGUYEN, THUAN T	
ART UNIT	PAPER NUMBER
2685	

DATE MAILED: 11/04/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

SERIAL NUMBER	FILING DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NO.

EXAMINER	
ART UNIT	PAPER NUMBER

DATE MAILED:

Below is a communication from the EXAMINER in charge of this application

COMMISSIONER OF PATENTS AND TRADEMARKS

ADVISORY ACTION

☑ THE PERIOD FOR RESPONSE:

a) ☑ is extended to run _____ or continues to run 3 mos. from the date of the final rejection

b) ☑ expires three months from the date of the final rejection or as of the mailing date of this Advisory Action, whichever is later. In no event however, will the statutory period for the response expire later than six months from the date of the final rejection.

Any extension of time must be obtained by filing a petition under 37 CFR 1.136(a), the proposed response and the appropriate fee. The date on which the response, the petition , and the fee have been filed is the date of the response and also the date for the purposes of determining the period of extension and the corresponding amount of the fee. Any extension fee pursuant to 37 CFR 1.17 will be calculated from the date of the originally set shortened statutory period for response or as set forth in b) above.

☐ Appellant's Brief is due in accordance with 37 CFR 1.192(a).

☑ Applicant's response to the final rejection, filed 8/6/04 has been considered with the following effect, but it is not deemed to place the application in condition for allowance:

1. ☑ The proposed amendments to the claim and /or specification will not be entered and the final rejection stands because:

   a. ☐ There is no convincing showing under 37 CFR 1.116(b) why the proposed amendment is necessary and was not earlier presented.

   b. ☐ They raise new issues that would require further consideration and/or search. (See Note).

   c. ☐ They raise the issue of new matter. (See Note).

   d. ☑ They are not deemed to place the application in better form for appeal by materially reducing or simplifying the issues for appeal.

   e. ☐ They present additional claims without cancelling a corresponding number of finally rejected claims.

   NOTE: _____

2. ☐ Newly proposed or amended claims _____ would be allowed if submitted in a separately filed amendment cancelling the non-allowable claims.

3. ☑ Upon the filing an appeal, the proposed amendment ☐ will be entered ☑ will not be entered and the status of the claims will be as follows:

   Claims allowed: NONE
   Claims objected to: NONE
   Claims rejected: 1, and 4-15

   However;

   ☐ Applicant's response has overcome the following rejection(s): _____

4. ☑ The ~~affidavit, exhibit or~~ request for reconsideration has been considered but does not overcome the rejection because claim languages do not appear to be in a better form for allowance, and the arguments do not convince. See Final office action and further in Chen, col 10, lines 12-37

5. ☐ The affidavit or exhibit will not be considered because applicant has not shown good and sufficent reasons why it was not earlier presented. for the B.S. receives signals from the mobile for adjusting power levels

☐ The proposed drawing correction ☐ has ☐ has not been approved by the examiner.

☐ Other A.U. 2685

EDWARD F. URBAN
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2600

PTOL-303 (REV. 5-89)

*U.S. GPO: 1997-417-381/62704



2685

IN THE UNITED STATES

PATENT AND TRADEMARK OFFICE

PATENT APPLICATION

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Inventor(s): **Arnab Das**
Farooq Ullah Khan

Case: **14-18**

Serial No.: **10/002746**

Filing Date: **November 2, 2001**

Examiner: **T. Nguyen** Group Art Unit: **2685**

Title: **Variable Rate Channel Quality Feedback In A Wireless Communication System**

COMMISSIONER FOR PATENTS
P.O. BOX 1450
ALEXANDRIA, VA 22313-1450

SIR:

INFORMATION DISCLOSURE STATEMENT
PETITION AND CERTIFICATION UNDER 37 CFR 1.97(d)

The Commissioner is hereby petitioned to consider the enclosed Information Disclosure Statement.

In accordance with 37 CFR 1.97(d), the enclosed Information Disclosure Statement, with attached reference(s), is submitted for consideration in the above-identified application.

I certify that each item of information contained in the Information Disclosure Statement was cited in a communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this statement. Copies of the listed documents are enclosed together with the search report that listed these documents.

08/20/2004 HALI11 00000024 122325 10002746

01 FC:1806 180.00 DA

Certificate of Mailing

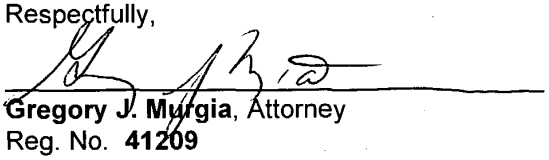
I hereby certify that this correspondence (and any paper referred to as being transmitted therewith) is being deposited with the United States Postal Service with sufficient postage as First Class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313 on the date indicated below.

8/16/04
Date

Sharon Lobosco
Sharon Lobosco

Please charge the amount of $180.00 to **Lucent Technologies Deposit Account No. 12-2325.** Duplicate copies of this letter are enclosed.

Respectfully,



Gregory J. Murgia, Attorney
Reg. No. **41209**
732-949-3578

Date: 8/16/04

Docket Administrator (Room 3J-219)
Lucent Technologies Inc.
101 Crawfords Corner Road
Holmdel, NJ 07733-3030

PT968-1.97d

INFORMATION DISCLOSURE STATEMENT	Case Name.	A. Das 14-18
	Serial No.	10/002746
	Applicant:	A. Das, et al.
	Filing Date:	November 2, 2001
	Group:	2685

OIPE SC11
AUG 19 2004
PATENT & TRADEMARK OFFICE

U.S. PATENT DOCUMENTS

Examiner Initial		Document Number	Date	Name	Class	Subclass	Filing Date
	AA	6,229,792 B1	5/8/01	Anderson et al.	370	280	6/7/95

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FOREIGN PATENT DOCUMENTS

		Document Number	Date	Country	Class	Subclass	Translation

OTHER (including Author, Title, Date, Pertinent Pages, etc.)

EXAMINER	DATE CONSIDERED

***Examiner:** Initial if reference 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

PT968-1.97Form

RESPONSE UNDER 37 CFR 1.116 EXPEDITED PROCEDURE - EXAMINING GROUP 2685 -

FAX COVER SHEET

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RE:	**OFFICIAL PAPER — AFTER FINAL**
TO:	**Examiner Thuan T. Nguyen U.S. Patent and Trademark Office**
GAU:	**2685**
PHONE: FAX:	**703-308-5860 703-872-9306**

FROM:	**Gregory J. Murgia Reg. No. 41,209 Lucent Technologies Inc.**
PHONE: FAX:	**(732) 949-3578 (732) 949-0102**

DATE:	**August 6, 2004**
Pages (Incl. Cover):	**12**

Case No.:	**A. Das 14-18**
Ser. No.:	**10/002,746**
File Date:	**November 2, 2001**
Title:	**Variable Rate Channel Quality Feedback In A Wireless Communication System**

Certification of Facsimile Transmission

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August 6, 2004
DATE

GREGORY J. MURGIA

IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE

PATENT APPLICATION

Arnab Das
Farooq Ullah Khan

CASE 14-18

Serial No. 10/002746 **Group Art Unit** 2685

Filed November 2, 2001

Examiner T. Nguyen

Title Variable Rate Channel Quality Feedback In A Wireless Communication System

COMMISSIONER FOR PATENTS
P.O. BOX 1450
ALEXANDRIA, VA 22313-1450

SIR:

Enclosed is an amendment in the above-identified application.

NO ADDITIONAL FEE REQUIRED

In the event of non-payment or improper payment of a required fee, the Commissioner is authorized to charge or to credit **Deposit Account No. 12-2325** as required to correct the error.

Respectfully,

Gregory J. Murgia, Attorney
Reg. No. 41209
732-949-3578.

Date: 8/6/04

Docket Administrator (Room 3J-219)
Lucent Technologies Inc.
101 Crawfords Corner Road
Holmdel, NJ 07733-3030

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August 6, 2004 Gregory J. Murgia

PT 16 (10/01) Page 1 of 1

PAGE 2/12 * RCVD AT 8/6/2004 5:57:45 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-1/0 * DNIS:8729306 * CSID:7329490102 * DURATION (mm-ss):03-44

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Serial No. 10/002,746

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RESPONSE UNDER 37 CFR 1.116 EXPEDITED PROCEDURE - EXAMINING GROUP 2685 -

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATION OF FACSIMILE TRANSMISSION

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Gregory J. Murgia 8/6/04 Date

Patent Application

Inventors	Arnab Das Farooq Ullah Khan
Case	14-18
Serial No.	10/002,746
Filing Date	November 2, 2001
Examiner	Thuan T. Nguyen
Group	2685
Title	Variable Rate Channel Quality Feedback in a Wireless Communication System

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

Response After Final Under 37 CFR 1.116

Sir:

In response to the Final Office Action dated May 5, 2004, Applicants respectfully request entry and consideration of this response, in which:

Listing of Claims begin on page 2 of this paper; and

Remarks begin on page 4 of this paper.

PAGE 4/12 * RCVD AT 8/6/2004 5:57:45 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-1/0 * DNIS:8729306 * CSID:7329490102 * DURATION (mm-ss):03-44

Listing of Claims

1. (Previously Presented) A method for transmitting channel quality information in a wireless communication system comprising at least one base station and at least one mobile station, the method comprising:

varying a rate for reporting channel quality information from a mobile station to a base station as a function of the presence or absence of a reception of a data transmission at the mobile station, wherein the mobile station reports channel quality information at a first rate in the absence of a reception of a data transmission from the base station and, upon detection of a reception of a data transmission from the base station, the mobile station reports channel quality information at a second rate for a prescribed duration.

2. (Canceled)

3. (Canceled)

4. (Previously Presented) The method according to claim 1, wherein, upon detection of a reception of a data transmission from the base station, the mobile station reports channel quality information at a plurality of rates over a prescribed time period after detection of the reception of a data transmission, wherein the plurality of rates are different than the first rate.

5. (Previously Presented) The method according to claim 4, wherein the prescribed time period includes a plurality of time intervals such that the channel quality information is reported at different ones of the plurality of rates during different ones of the plurality of time intervals.

6. (Previously Presented) The method according to claim 1, wherein the second rate is faster than the first rate.

7. (Previously Presented) The method according to claim 1, further comprising the step of estimating channel quality at the base station while the mobile station is reporting at the second rate, wherein estimated channel quality is used to derive a transmission format for a subsequent transmission.

8. (Original) The method according to claim 7, wherein the transmission format includes one or more parameters selected from the group consisting of modulation format, number of codes, and transmission rate.

PAGE 5/12 * RCVD AT 8/6/2004 5:57:45 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-1/0 * DNIS:8729306 * CSID:7329490102 * DURATION (mm-ss):03-44

9. (Previously Presented) The method according to claim 1, further comprising the step of estimating channel quality at the base station while the mobile station is reporting at the second rate, wherein estimated channel quality is used to calculate an amount of redundancy needed for a retransmission of a previous data transmission.

10. (Original) The method according to claim 1, wherein the channel quality information comprises a transmission rate calculated by the mobile station based on one or more channel conditions.

11. (Previously Presented) A method for adapting the rate of reporting channel quality information in a wireless communication system including at least one base station and at least one mobile station, the method comprising:

reporting channel quality information from the at least one mobile station to the at least one base station at a first rate in the absence of a reception of a data transmission at the at least one mobile station; and

in the presence of a reception of a data transmission at the at least one mobile station, adapting the rate for reporting channel quality information from the at least one mobile station to the at least one base station from the first rate to a second rate for a prescribed duration.

12. (Original) The method according to claim 11, wherein the second rate is faster than the first rate.

13. (Original) A method for transmitting channel quality information in a wireless communication system including at least one base station and at least one mobile station, the method comprising:

varying a rate for reporting channel quality information from a mobile station to a base station as a function of the number of base stations that the mobile station is communicating with.

14. (Original) The method according to claim 13, wherein the mobile station reports channel quality information at a first rate when the mobile station is communicating with one base station and wherein the mobile station reports channel quality information at a second rate when the mobile station is communicating with a plurality of base stations.

15. (Original) The method according to claim 14 wherein the second rate is faster than the first rate

PAGE 6/12 * RCVD AT 8/6/2004 5:57:45 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-1/0 * DNIS:8729306 * CSID:7329490102 * DURATION (mm-ss):03-44

REMARKS

Claims 1 and 4-15 remain pending in the application for further consideration by the Examiner. Applicants respectfully request that the Examiner enter this response after Final Office Action since it is believed that the remarks provided herein overcome all rejections and that the application stands in condition for allowance.

35 U.S.C. 102(b) Rejection

Claims 1 and 4-15 were rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 6,067,458 ("Chen"). All rejections are traversed for the reasons set forth below.

Claims 13-15

Applicants submit that claims 13-15 are not anticipated by Chen. As a preliminary matter, neither the Final Office Action nor the previous Office Action sets forth with any particularity how the specific limitations recited in these claims are anticipated by Chen. In both Office Actions, the rejection of claims 13-15 was supported only by reference to the reasons used for rejection of claims 1-10 in the Office Action without any acknowledgement of the different, additional limitations in claims 13-15. Secondly, the Final Office Action did not address Applicants' arguments provided in the previous Office Action response with regard to the distinctions between claims 13-15 and the Chen reference. Accordingly, Applicants respectfully submit that entry of this Response After Final is appropriate for at least this reason.

Most importantly, Applicants submit that claims 13-15 are not anticipated by Chen because each and every element of claims 13-15 is not described, either expressly or impliedly by Chen. For example, there are absolutely no teachings in Chen that either expressly or impliedly suggest varying the rate for reporting channel quality information as a function of the number of base stations that the mobile is communicating with, as recited in Applicants' claim 13. This feature of Applicants' claimed invention, which is particularly advantageous for handling "soft handoffs", is supported in Applicants' specification, see, e.g., page 9, lines 1-22. Because Chen does not teach or suggest each of the limitations recited in claim 13, Applicants' submit that the Chen reference therefore does not anticipate claim 13 and respectfully request that the Examiner withdraw the rejection accordingly. Because claims 14 and 15 depend from claim 13, these dependent claims are therefore also believed to be allowable for the same reasons set forth above for claim 13 as well as for other novel features therein.

Claims 1, 4-12

Applicants submit that claims 1 and 4-12 are not anticipated by Chen because each and every element of claims 1 and 4-12 is not described, either expressly or impliedly by Chen. Contrary to the Examiner's assertion otherwise, both in the statements of the rejections and in

PAGE 7/12 * RCVD AT 8/6/2004 5:57:45 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-1/0 * DNIS:8729306 * CSID:7329490102 * DURATION (mm-ss):03-44

response to Applicants' arguments from the previous Office Action response, Applicants submit that Chen does not describe, either expressly or impliedly, at least the following limitations recited in Applicants' claim 1 (and claim 11 which has similar limitations):

- mobile station reports channel quality information at a first rate in the absence of a reception of a data transmission from the base station; and
- upon detection of a reception of a data transmission from the base station, the mobile station reports channel quality information at a second rate for a prescribed duration.

Chen is concerned with adjusting the appropriate power level for transmitting data in order to avoid data loss, to extend battery life in a mobile, and so on. Power control, as described by Chen, is important especially for higher rate data transmissions because transmitting data at higher rates requires higher power (see, e.g., col. 3, lines 40-47 and col. 6, lines 49-59). In one embodiment, Chen describes a mobile (receiver) being instructed by the base station to send more power control information (e.g., at a higher rate) for a specified time period preceding the data transmission, so that appropriate adjustments to power can be made by the base station before sending the high rate data transmission to the mobile (see, e.g., col. 3, lines 48-54). In yet another embodiment, Chen describes the case where: 1) the link can be operating at the Idle rate; 2) that data is then received at the base station for *subsequent* transmission to the mobile; 3) that the base station instructs the mobile to send more power control information (e.g., on the reverse link); and 4) thereafter, the base station adjusts its power level and then sends the data transmission at a higher rate to the mobile (see, e.g., col. 11, line 40 to col. 13, line 10).

These teachings are quite different from Applicants' claimed invention. As recited in claim 1, a mobile sends channel quality feedback to a base station at different rates depending on whether there is an absence or presence of a data transmission from the base station to the mobile. That is, the trigger for changing the rate of channel quality feedback from the mobile to the base station is whether there is a data transmission received by the mobile from the base station. Using the actual data transmission from the base station as a trigger for the mobile station to change its rate of transmitting channel quality information back to the base station, as claimed by Applicants, is quite different from the teachings of Chen. In Chen, the rate of transmission of power control information over the reverse link (assuming for argument purposes that the power control information is "feedback") is varied as a function of the mobile receiving an instruction from the base station before (i.e., in preparation of) the base station sending the data transmission to the mobile. Accordingly, Chen does not teach varying

PAGE 8/12 * RCVD AT 8/6/2004 5:57:45 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-1/0 * DNIS:8729306 * CSID:7329490102 * DURATION (mm-ss):03-44

feedback from the mobile based on the absence or presence of a data transmission from the base station to the mobile.

Furthermore, Applicants respectfully submit that Chen fails to teach or suggest, contrary to the Examiner's assertion otherwise, a mobile station that, upon detection of a reception of a data transmission, reports channel quality information at a second rate for a prescribed duration. In particular, Chen only teaches that the bandwidth, and hence the rate of transmission, of power control information from the mobile station is increased in response to the instruction from the base station. Chen is silent about transmitting this information at a different rate for a prescribed duration.

Referring now to the Examiner's responses to Applicants' previous arguments in conjunction with Chen's FIG. 7 and accompanying description (col. 11, line 40 to col. 14, line 20), portions of which are cited in the Examiner's response to Applicants' arguments, Applicants respectfully submit that routine 300 described by Chen must be viewed in a larger context instead of any particular step in isolation. As described for step 320, data is "presented" to the base station for a high rate transfer to the mobile. Step 330 recites "tell the receiver to increase bandwidth of power control information about forward link". Note that Chen does not teach that data transmission occurs yet, but only that the base station and mobile are preparing for such data transmission by one instructing the other to increase the rate of sending power control information so that appropriate power adjustments can be made to support the subsequent data transmission. Subsequent steps, including step 360, describe the adjustments then made to the forward link (i.e., power) culminating in the subsequent data transmission from the base station to the mobile in step 380.

Step 360, in particular, recites "control the power level of the transmitter using low, full or high rates...to set the correct high rate power level for the transmitter". As described throughout the specification, Chen is referring specifically to the process that occurs before any data transmission occurs, whether it's via the forward link from base station to mobile as described in the embodiments, or whether its via the reverse link as inferred by the Examiner in the Office Action. Accordingly, Chen does not describe or even suggest varying the rate of channel quality feedback from the mobile to the base station as a function of the mobile receiving the data transmission from the base station. Instead, Chen only describes the base station receiving data for subsequent transmission to the mobile and, to prepare for such transmission, instructing the mobile to vary the rate of feedback (power control information) from the mobile to the base station so that appropriate power levels can be set at the base station before sending the data transmission to the mobile.

PAGE 9/12 * RCVD AT 8/6/2004 5:57:45 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-1/0 * DNIS:8729306 * CSID:7329490102 * DURATION (mm-ss):03-44

With respect to the Examiner's response to Applicants' arguments from the first Office Action, Applicants respectfully disagree with the Examiner's interpretation and characterization of the teachings in Chen at col. 13, lines 20-65 and lines 55-65 in particular. This portion of Chen (or any other portion for that matter) does not describe varying the rate for reporting channel quality information from a mobile to a base station as a function of the absence or detection, by the mobile, of a data transmission from the base station, contrary to the Examiner's assertion otherwise.

Applicants do agree generally with the Examiner's statement that Chen teaches that the mobile [and base station] can estimate and then test the proper power level necessary to send data at the high rate. However, this statement simply reinforces the fact that Chen teaches a mobile and base station exchanging and adjusting power control information (estimating, testing, etc) prior to the actual high rate data transmission occurring between the mobile and the base station. This is quite different than Applicants' claimed invention in which the rate of the channel quality information provided by the mobile is varied based on the presence or absence of the data transmission from the base station to the mobile.

Moreover, the cited portion of disclosure from Chen at col. 13, lines 20-65 (see lines 20-32 in particular), describe a completely different scheme than that being claimed by Applicants. For example, in this cited portion, Chen discloses that the base station stores a power level that was previously measured when data was previously sent and the base station simply recalls a previous power level for a subsequent data transmission. Here, Chen is not even describing varying the rate of any power control information feedback from the mobile to the base station.

With regard to the cited portion of Chen at col. 13, lines 33-40 discussing the situation of a transmission that is to occur via the reverse link from mobile to base station, Applicants again must disagree with the Examiner's characterization of the Chen teaching as being anticipatory of Applicants' claimed invention. Chen is describing a situation in which the reverse link is operating at idle (e.g., $1/8^{th}$ rate) and "data is received for transmission along the reverse link" (emphasis added). Applicants submit that, upon careful reading and consistent with the entire disclosure in Chen, this statement simply refers to data being received at the mobile (e.g., from a user) for subsequent transmission along the reverse link (i.e., to the base station as the Examiner points out). That is, this embodiment refers somewhat to the converse of preceding embodiments, wherein here the mobile receives data for subsequent transmission to the base station (but not from the base station) and, in response, the mobile increases to the full rate thus increasing the feedback bandwidth to the base station. Again, this embodiment in Chen is still

PAGE 10/12 * RCVD AT 8/6/2004 5:57:45 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-1/0 * DNIS:8729306 * CSID:7329490102 * DURATION (mm-ss):03-44

is not the same as a mobile, in response to a data transmission from the base station, varying the rate of channel quality feedback, as claimed by Applicants.

Finally, while the Examiner appropriately acknowledges that the teachings in Chen are primarily directed toward the control being effected on the base station side, Applicants do not agree with the inferences or conclusions being drawn with respect to the capabilities of a mobile station in the context of the Chen teachings. In particular, the Examiner states that, in the context of the Chen teachings, the mobile station can have "its own capability in detecting the status of the base station in order to request or adjust to the appropriate power levels necessary whether to send data or channel quality reports back to the base station at a low rate or at a high rate" (emphasis added).

First, Applicants do not at all agree that Chen suggests this capability for a mobile (or a base station for that matter) and respectfully invite the Examiner to specifically point out how the teachings in Chen support such an interpretation. Instead, Applicants submit that the capabilities of a mobile are more accurately summarized by what Applicants stated previously. That is, consistent with the teachings of Chen as a whole, the capabilities to infer for the mobile would be that, *in preparation* for a subsequent data transmission over the reverse link to a base station, that the mobile may adjust its rate of transmission of power control information to the base station. As stated previously by Applicants, this is quite different than a mobile adjusting its channel quality feedback based on the presence or absence of a data transmission from the base station (e.g., over the forward link).

Moreover, Applicants respectfully submit that such general and liberal extensions of the teachings in Chen are not only unsupported by the disclosure in Chen, but are also not sufficient to establish a case for anticipation in which each and every element of the claimed invention must be found in Chen, which Applicants believe not to be the case for all the reasons set forth hereinabove.

Because Chen fails to teach or suggest each and every recited limitation in claims 1 and 11, Applicants submit that Chen therefore does not anticipate claims 1 and 11 and respectfully request that the Examiner withdraw the rejections accordingly. Because claims 4-10 and 12 each depend from respective base claims 1 or 11, these dependent claims are therefore also believed to be allowable for the same reasons set forth above for claims 1 and 11 as well as for other novel features therein that are not disclosed by Chen.

With regard to claim 8, for example, Chen does not teach or suggest estimated channel quality being used to derive a transmission format for a subsequent transmission, wherein the transmission format includes one or more parameters selected from modulation format, number

PAGE 11/12 * RCVD AT 8/6/2004 5:57:45 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-1/0 * DNIS:8729306 * CSID:7329490102 * DURATION (mm-ss):03-44

of codes, and transmission rate. As previously discussed, Chen only teaches deriving the proper power level for a subsequent high-speed transmission. With regard to claim 9, Applicants respectfully disagree that the cited portions or any other portions of the Chen reference teach or suggest a base station receiving channel quality information from a mobile, estimating channel quality therefrom, and then calculating an amount of redundancy for retransmissions accordingly. At most, Chen describes transmitting a new transmission to a mobile using a previously stored power level for the link. This teaching is not at all the same or even suggestive of using estimated channel quality to calculate an amount of redundancy for retransmission of a previous transmission as claimed by Applicants.

In view of the foregoing, Applicants submit that Chen fails to describe, either expressly or impliedly, each and every element of Applicants' claims and, as such, Applicants' claims are not anticipated by Chen. Accordingly, Applicants' respectfully request entry of this Response After Final, reconsideration, and withdrawal of the rejections of claims 1 and 4-15.

Conclusion

Applicants believe that all pending claims stand in condition for allowance. Accordingly, Applicants earnestly solicit a Notice of Allowance. Any questions can be directed to the Applicants' attorney at the number below.

Respectfully submitted,

By: Gregory J. Murgia

Gregory J. Murgia
Reg. No. 41,209
Attorney for Applicants
(732) 949-3578

Lucent Technologies Inc.
Date: 8/6/04

PAGE 12/12 * RCVD AT 8/6/2004 5:57:45 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-1/0 * DNIS:8729306 * CSID:7329490102 * DURATION (mm-ss):03-44

CERTIFICATION OF FACSIMILE TRANSMISSION

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Gregory J. Murgia 8/6/04 Date

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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PATENT APPLICATION

Inventor(s):	**Arnab Das** **Farooq Ullah Khan**		
Case Name/No.:	**14-18**		
Serial No.:	**10/002,746**	**Group Art Unit:**	**2685**
Filing Date:	**November 2, 2001**	**Examiner:**	**T. Nguyen**
Title:	**Variable Rate Channel Quality Feedback In A Wireless Communication System**		

COMMISSIONER FOR PATENTS
P.O. BOX 1450
ALEXANDRIA, VA 22313-1450

PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)

SIR:

Applicants petition the Commissioner for Patents to extend the period for filing a reply in the above-identified application for:

one month (37 CFR 1.17(a)(1)).

Please charge **Lucent Technologies Deposit Account No. 12-2325** in the amount of **$110.00** to cover the cost of the extension. In the event of non-payment or improper payment of a required fee, the Commissioner is authorized to charge or to credit **Deposit Account No. 12-2325** as required to correct the error. Duplicate copies of this petition are enclosed.

Respectfully,

Gregory J. Murgia
Attorney for Applicants
Reg. No.: 41,209

Date: 8/6/04

Lucent Technologies Inc.
101 Crawfords Corner Road
Room 3J-219
Holmdel, New Jersey 07733-3030

RT 970 (1/03)

PAGE 3/12 * RCVD AT 8/6/2004 5:57:45 PM [Eastern Daylight Time] * SVR:USPTO-EFXRF-1/0 * DNIS:8729306 * CSID:7329490102 * DURATION (mm-ss):03-44

PATENT APPLICATION FEE DETERMINATION RECORD
Effective October 1, 2001

Application or Docket Number: 10/002,746

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS	16	
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	16 minus 20=	*
INDEPENDENT CLAIMS	3 minus 3 =	*
MULTIPLE DEPENDENT CLAIM PRESENT		☐

* If the difference in column 1 is less than zero, enter "0" in column 2

SMALL ENTITY TYPE ☐		OR	OTHER THAN SMALL ENTITY	
RATE	FEE		RATE	FEE
BASIC FEE	370.00	OR	BASIC FEE	740.00
X$ 9=		OR	X$18=	
X42=		OR	X84=	
+140=		OR	+280=	
TOTAL		OR	TOTAL	740

CLAIMS AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 15	Minus	** 20	=
Independent	* 3	Minus	*** 3	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X42=		OR	X84=	
+140=		OR	+280=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 13	Minus	** 20	= 0
Independent	* 3	Minus	*** 3	= 0
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X42=		OR	X84=	
+140=		OR	+280=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AF (PE) 9-2-04

AMENDMENT C

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Coiumn 3) PRESENT EXTRA
Total	* 13	Minus	** 20	= 0
Independent	* 3	Minus	*** 3	= 0
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X42=		OR	X84=	
+140=		OR	+280=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

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

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/002,746	11/02/2001	Amab Das	14-18	3832

7590 05/05/2004

Docket Administrator (Room 3J-219)
Lucent Technologies Inc.
101 Crawfords Corner Road
Holmdel, NJ 07733-3030

EXAMINER	
NGUYEN, THUAN T	
ART UNIT	**PAPER NUMBER**
2685	6

DATE MAILED: 05/05/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)	
	10/002,746	DAS ET AL.	
	Examiner	Art Unit	
	THUAN T. NGUYEN	2685	

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

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1 and 4-15* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1, 4-15* is/are rejected.

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

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

Application Papers

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

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

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

Priority under 35 U.S.C. § 119

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

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Remark

1. Claims 2-3 were canceled in the amendment dated 2/2/04.

Claim Rejections - 35 USC 102

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

> *A person shall be entitled to a patent unless --*
>
> *(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.*

3. Claims 1, and 4-15 are rejected under 35 U.S.C. 102(b) as being anticipated by Chen (U.S. Patent No. 6,067,458).

Regarding claim 1, Chen discloses a method for transmitting channel quality information in a wireless communication system with at least a base station and at least a mobile station (Fig. 2), the method comprising varying a rate for reporting channel quality information from a mobile station to a base station as a function of the presence or absence of a reception of a transmission at the mobile station (see col. 6/lines 10-48 for varying rate information exchange between mobile station and base station, in idle time or absence of a reception of a data transmission at the mobile station, rate is communicated at the eighth rate, and higher rate is used when voice or data communicating between these two components; and col. 13/lines 48-65 as mobile station communicates to base station & col. 14/lines 32-42 for channel quality monitoring and control). Chen further discloses the mobile station reports channel quality information at an idle rate (or the eighth rate) and either at a first rate set and a second

rate set in the absence and in the presence of a transmission from the base station, respectively, and upon the detection of the absence and presence of the transmission from the base station (col. 6/lines 18-48; and col. 13/lines 20-65, see Examiner's discussion in the Conclusion afterward).

As for claim 4, in view of claim 1, Chen discloses a plurality of rates over a prescribed time period after the detection of reception of a data transmission, particularly, ranging from a first rate set for transmitting speech data up to a second rate set of 64 kbps for exchanging voice and other data (col. 6/lines 29-48 & col. 13/lines 48-51).

As for claim 5, in view of claim 4, Chen discloses a plurality of rates can be transmitted or reported at different ones of the plurality of rates on a reverse link from the mobile station to the base station during different ones of the plurality of time intervals (Figs. 1A- F shows an example within one time interval of 20ms, and col. 2/line 53 to col. 3/line 3).

As for claim 6, in view of claim 1, Chen further discloses that the second rate is faster than the first rate, i.e., the second rate either at the first rate set or at the second rate set is faster than the first rate at idle time (or at the eighth rate, see col. 6/lines 18-48).

As for claim 7, in view of claim 1, Chen further discloses that the base station determines the channel quality collected from the mobile station for deriving a transmission format for a next transmission (col. 13/line 55 to col. 14/line 20).

As for claim 8, in further view of claim 7, Chen further includes within the transmission format one or more parameters selected from the group consisting of

modulation format, number of codes, and transmission rate (col. 12/line 22 to col. 13/line 40).

As for claim 9, in view of claim 6, Chen further addresses the calculation an amount of redundancy needed for a retransmission of a previous transmission by using a routine 300 in recalculating the necessary step whether to use the previous transmission or not (Fig. 7, and col. 11/lines 40-63 & col. 13/lines 20-33 for recalled or previously stored power transmission control setting).

As for claim 10, in view of claim 1, Chen further discloses wherein the channel quality information comprises a transmission rate calculated by the mobile station based on one or more channel conditions (col. 12/line 63 to col. 13/line 47 for more additional conditions can be collected by the base stations).

As for claims 11-15, these claims for same limitations are rejected for the reasons given in the scope of claims 1-10 as already disclosed above.

Response to Arguments

4. Applicant's arguments filed on 2/02/04 have been fully considered but they are not persuasive.

Applicants mainly concerns and argues that Chen does not teach or suggest the step of varying the rate for reporting channel quality information from a mobile station to a base station as a function of the absence or detection of a data transmission the base station, which in fact, Chen does disclose this feature. On column 13, lines 20-65, Chen teaches that, for instance, at step 360, as the mobile station can estimate and then test the proper power level necessary before sending data at high rates (col. 13/lines 55-65). Before this step or this suggestion, it suggests that the mobile station has its own capability in detecting the idle status or not from the

base station because "the reverse link" can be detected whether at "idle" or not (col. 13/lines 33-40), and to any one of ordinary skill in the art, "the reverse link" refers to the communication link or signal transmitting from the mobile station to the base station, whereas "the forward link" means the reverse process. Chen tends to lean much for details on the base station side for power level control in most parts of the reference because the base station is the controller in the wireless communication systems, but it does not mean the mobile station does not have its own capability in detecting the status of the base station in order to request or adjust to the appropriate power levels necessary whether to send data or channel quality reports back to the base station at a low rate or at a high rate (as already discussed in the Office Action).

Therefore, the Examiner disagrees with the Applicants' arguments and stands with the disclosure and teaching of Chen as disclosed and discussed in this Final Office Action.

Conclusion

5. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

6. **Any response to this action should be mailed to:**

Commissioner of Patents and Trademarks

Washington, D.C. 20231

or faxed to:

(703) 872-9306, (for Technology Center 2600 only)

Hand-delivered responses should be brought to Crystal Park II,

2121 Crystal Drive, Arlington. VA., Sixth Floor (Receptionist).

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tony Thuan Nguyen whose telephone number is (703) 308-5860. The examiner can normally be reached on Monday-Friday from 9:30 AM to 7:00 PM, with alternate Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner s supervisor, Edward Urban, can be reached at (703) 305-4385.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the **Technology Center 2600 Customer Service Office** whose telephone number is **(703) 306-0377**.

TONY T. NGUYEN
PATENT EXAMINER, FSA

Tony T. Nguyen
Art Unit 2685
April 30, 2004

S/N: 10/002,746

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RE:	**OFFICIAL PAPER**
TO:	**Examiner T. Nguyen** **U.S. Patent and Trademark Office**
GAU:	**2685**
PHONE: **FAX:**	**703-308-5860** **703-872-9314**
FROM:	**Gregory J. Murgia** **Reg. No. 41,209** **Lucent Technologies Inc.**
PHONE: **FAX:**	**(732) 949-3578** **(732) 949-0102**
DATE:	**February 2, 2004**
Pages (incl. Cover):	12

Case No.:	**Das 14-18**
Ser. No.:	**10/002746**
File Date:	**November 2, 2001**
Title:	**Variable Rate Channel Quality Feedback In A Wireless Communication System**

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I hereby certify that this correspondence (and any paper referred to as being transmitted therewith) is being facsimile transmitted to the United States Patent and Trademark Office on the date indicated below:

2/2/04 GREGORY J. MURGIA

PAGE 1/12 * RCVD AT 2/2/2004 10:36:21 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-1/0 * DNIS:8729314 * CSID:7329490102 * DURATION (mm-ss):03-38

IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE

PATENT APPLICATION

Arnab Das
Farooq Ullah Khan

CASE 14-18

Serial No. 10/002746 **Group Art Unit** 2685

Filed November 2, 2001

Examiner T. Nguyen

Title Variable Rate Channel Quality Feedback In A Wireless Communication System

COMMISSIONER FOR PATENTS
P.O. BOX 1450
ALEXANDRIA, VA 22313-1450

SIR:

Enclosed is an amendment in the above-identified application.

NO ADDITIONAL FEE REQUIRED

In the event of non-payment or improper payment of a required fee, the Commissioner is authorized to charge or to credit **Deposit Account No. 12-2325** as required to correct the error.

Respectfully,

Gregory J. Murgia, Attorney
Reg. No. 41209
732-949-3578.

Date: 2/2/04

Docket Administrator (Room 3J-219)
Lucent Technologies Inc.
101 Crawfords Corner Road
Holmdel, NJ 07733-3030

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February 2, 2004

Gregory J. Murgia

PT 16 (10/01) Page 1 of 1

PAGE 2/12 * RCVD AT 2/2/2004 10:36:21 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-1/0 * DNIS:8729314 * CSID:7329490102 * DURATION (mm-ss):03-38

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Gregory J. Murgia — Date 2/2/04

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent Application

Inventors	Arnab Das Farooq Ullah Khan
Case	14-18
Serial No.	10/002,746
Filing Date	November 2, 2001
Examiner	Thuan T. Nguyen
Group	2685
Title	Variable Rate Channel Quality Feedback in a Wireless Communication System

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

AMENDMENT

Sir:

In response to the Office Action dated October 2, 2003, please enter the following amendments and remarks in the above-identified application, in which:

Amendments to the claims begin on page 2 of this paper; and
Remarks begin on page 5 of this paper.

01 FC:1251 110.00 DA
02/06/2004 KVESTAL 00000002 122325 10002746

PAGE 4/12 * RCVD AT 2/2/2004 10:36:21 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-1/0 * DNIS:8729314 * CSID:7329490102 * DURATION (mm-ss):03-38

In the Claims

Please substitute the following claims for those currently on file in the application:

1. (Currently Amended) A method for transmitting channel quality information in a wireless communication system comprising at least one base station and at least one mobile station, the method comprising:

varying a rate for reporting channel quality information from a mobile station to a base station as a function of the presence or absence of a reception of a data transmission at the mobile station, wherein the mobile station reports channel quality information at a first rate in the absence of a reception of a data transmission from the base station and, upon detection of a reception of a data transmission from the base station, the mobile station reports channel quality information at a second rate for a prescribed duration.

2. **(Canceled)**

3. **(Canceled)**

4. (Currently Amended) The method according to claim 1, wherein ~~the mobile station reports channel quality information at a first rate in the absence of a reception of a transmission from the base station and~~, upon detection of a reception of a data transmission from the base station, the mobile station reports channel quality information at a plurality of rates over a prescribed time period after detection of the reception of a data transmission, wherein the plurality of rates are different than the first rate.

5. (Currently Amended) The method according to claim 4, wherein the prescribed time period includes a plurality of time intervals such that the channel quality information is reported at different ones of the plurality of rates during different ones of the plurality of time intervals.

6. (Currently Amended) The method according to claim ~~2~~ 1, wherein the second rate is faster than the first rate.

7. (Currently Amended) The method according to claim ~~6~~ 1, further comprising the step of estimating channel quality at the base station while the mobile station is reporting at the second rate, wherein estimated channel quality is used to derive a transmission format for a subsequent transmission.

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8. (Original) The method according to claim 7, wherein the transmission format includes one or more parameters selected from the group consisting of modulation format, number of codes, and transmission rate.

9. (Currently Amended) The method according to claim 6 1, further comprising the step of estimating channel quality at the base station while the mobile station is reporting at the second rate, wherein estimated channel quality is used to calculate an amount of redundancy needed for a retransmission of a previous data transmission.

10. (Original) The method according to claim 1, wherein the channel quality information comprises a transmission rate calculated by the mobile station based on one or more channel conditions.

11. (Currently Amended) A method for adapting the rate of reporting channel quality information in a wireless communication system including at least one base station and at least one mobile station, the method comprising:

reporting channel quality information from the at least one mobile station to the at least one base station at a first rate in the absence of a reception of a data transmission at the at least one mobile station; and

in the presence of a reception of a data transmission at the at least one mobile station, adapting the rate for reporting channel quality information from the at least one mobile station to the at least one base station from the first rate to a second rate for a prescribed duration.

12. (Original) The method according to claim 11, wherein the second rate is faster than the first rate.

13. (Original) A method for transmitting channel quality information in a wireless communication system including at least one base station and at least one mobile station, the method comprising:

varying a rate for reporting channel quality information from a mobile station to a base station as a function of the number of base stations that the mobile station is communicating with.

PAGE 6/12 * RCVD AT 2/2/2004 10:36:21 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-1/0 * DNIS:8729314 * CSID:7329490102 * DURATION (mm-ss):03-38

14. (Original) The method according to claim **13**, wherein the mobile station reports channel quality information at a first rate when the mobile station is communicating with one base station and wherein the mobile station reports channel quality information at a second rate when the mobile station is communicating with a plurality of base stations.

B1

15. (Original) The method according to claim **14** wherein the second rate is faster than the first rate

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REMARKS

By this amendment, claims 1, 4-7, 9 and 11 have been amended and claims 2-3 have been canceled. Accordingly, claims 1 and 4-15 are still pending in the application for further consideration by the Examiner.

35 U.S.C. 102(b) Rejection

Claims 1-15 were rejected under 35 U.S.C. §102(b) as being anticipated by U.S. Patent No. 6,067,458 ("Chen"). Claims 1, 4-7, 9 and 11 have been amended, claims 2-3 have been canceled, and all rejections of the remaining claims are respectfully traversed as set forth below.

Claims 1-12

Briefly, the Chen reference appears to be directed to controlling the power level of transmissions between base stations and mobile stations and, in particular, to controlling power for higher rate data transmissions. Applicants acknowledge that Chen describes and it is well known for a mobile station to send power control information (e.g., messages) to a base station corresponding to the measured power level received at the mobile station. Furthermore, Applicants acknowledge that Chen describes how a variable rate vocoder is used to transmit voice and/or data at a plurality of rates over a link, e.g., col. 6, lines 10 et seq.

However, Applicants respectfully submit that Chen does not teach or suggest every limitation set forth in Applicants' claims and, as such, does not anticipate Applicants' claims. Applicants' claim 1, as amended, recites that the mobile station reports channel quality information at a first rate in the absence of a reception of a data transmission from the base station and, upon detection of a reception of a data transmission from the base station, the mobile station reports channel quality information at a second rate for a prescribed duration. Independent claim 11 recites similar limitations.

Chen is only concerned with power control and, as such, only describes a mobile station transmitting power control information to a base station, wherein power control information is characterized throughout the specification as either a signal corresponding to the measured power level, a signal or message indicating that the power level deviated from a predefined threshold, or other similar variations of communicating the power information. By contrast, Applicants' independent claims 1 and 11 each recite the mobile station reporting channel quality information to the base station, which Applicants respectfully submit is different than power control information. While the Office Action references one statement in Chen (e.g., col. 14, lines 35-39) in which the patentee obliquely mentions that the invention would be applicable to a "communication system that operates in accordance with the claims to provide channel quality monitoring and power control", Applicants respectfully submit that this statement alone does not

PAGE 8/12 * RCVD AT 2/2/2004 10:36:21 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-1/0 * DNIS:8729314 * CSID:7329490102 * DURATION (mm-ss):03-38

supply an anticipatory and enabling teaching for a mobile station reporting channel quality information in the manner in which it is now being claimed by Applicants.

Notwithstanding at least the above distinction, Applicants respectfully submit that Chen also fails to teach or suggest varying the rate for reporting channel quality information from a mobile station as a function of the absence or detection of a data transmission from the base station.

In FIG. 7 and the accompanying description in col. 11, lines 35 et seq., Chen describes a routine for changing power levels for sending data at a high rate after sending data at one of the low rates. More specifically, Chen describes the base station operating at an idle rate, e.g., sending no voice/data to the mobile. After data is "presented to the base station" for a high rate transfer to the mobile (col. 11, lines 49-50), the base station (step 330, FIG. 7) first sends a signal to the mobile station to increase the bandwidth of the power control information transmitted by the mobile (col. 11, lines 64-67). According to Chen, increasing power control bandwidth causes power control information to be sent at a higher rate from the mobile (col. 11, line 67 to col. 12, line 3). More specifically, Chen clearly discloses that the base station sends an encoded signal to the mobile, which then decodes the signal and, in response thereto, increases the bandwidth of its power control information, e.g., by transmitting one or more power control messages per several frames (col. 12, lines 3-13). Chen describes that this increased power control information is necessary to predict the power needed to then subsequently transmit data at the higher data rate (col. 12, lines 14-62).

Again, in col. 13, lines 48 to col. 14, line 41, Chen describes generally that the routine shown in FIG. 7 allows the mobile and base station to estimate and test the proper power level before sending data at a higher rate and, in particular, that the transmission rate of power control information can be increased from the mobile so that the base station can estimate the proper power level for transmitting subsequent frames of data at high rates to the mobile. Consequently, all teachings in Chen describe increasing power control feedback from the mobile based on the base station sending a message or signal instructing such action in preparation for a subsequent high data rate transmission.

By contrast, Applicants' claimed invention sets forth a mobile station that changes its rate of transmitting channel quality information based on the mobile's detection of the absence or presence of a data transmission from the base station. That is, the mobile station receives a data transmission from the base station and, in response thereto, begins transmitting channel quality information back to the base station at a second rate. Using the actual data transmission from the base station as a trigger for the mobile station to change its rate of transmitting channel

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quality information back to the base station is quite different from using a separate signaling message from the base station to the mobile telling the mobile to transmit more power control information (i.e., so that the base station can then adjust power for the subsequent higher speed data transmission) as described by Chen.

Furthermore, Applicants respectfully submit that neither the cited portion of Chen (col. 6, lines 18-48) nor any other portion of the reference teaches or suggests a mobile station that, upon detection of a reception of a data transmission, reports channel quality information at a second rate for a prescribed duration. In particular, Chen only teaches that the bandwidth, and hence the rate of transmission, of power control information from the mobile station is increased in response to the instruction from the base station. Chen fails to teach or suggest transmitting this information at a different rate for a prescribed duration.

Among other advantages, transmitting channel quality information at a second rate for a prescribed duration as set forth in Applicants' claims addresses the problem of delay with respect to uplink transmissions (from the mobile) and downlink transmissions (from the base station). In particular, there is delay with respect to the calculation of rate information by the mobile during a time slot and the subsequent reporting of that rate (vis-à-vis channel quality feedback) to the base station, *see, e.g.*, Applicants' specification on page 2, line 8-33. By way of example, this delay can cause problems in adapting the rate of channel quality feedback (and subsequent changes to transmission rate), especially when dealing with the bursty nature of data traffic (e.g., all packets may not come at once or in immediate succession). In particular, reporting channel quality information at a second rate for a prescribed duration as claimed by Applicants will solve the problem of undesirable (e.g., premature) switching back and forth between rates just because there may be some gaps in packet transmission. By maintaining transmission of channel quality information at a second rate for a prescribed duration as claimed by Applicants, insignificant gaps in packet transmission will not trigger an unnecessary switch in the feedback rate (*see, e.g.*, Applicants' specification, page 6, line 26 through page 7, line 27). Applicants respectfully submit that there are no such teachings in Chen.

Because Chen fails to teach or suggest every recited limitation in claims 1 and 11 (as amended), Applicants submit that Chen therefore does not anticipate claims 1 and 11 and respectfully request that the Examiner withdraw the rejections accordingly.

Because claims 4-10 and 12 each depend from respective base claims 1 or 11, these dependent claims are therefore also believed to be allowable for the same reasons set forth above for claims 1 and 11 as well as for other novel features therein.

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With regard to claim 8, for example, Chen does not teach or suggest estimated channel quality being used to derive a transmission format for a subsequent transmission, wherein the transmission format includes one or more parameters selected from modulation format, number of codes, and transmission rate. As previously discussed, Chen only teaches deriving the proper power level for a subsequent high-speed transmission. That is, the base station receives a data transmission that is to be transmitted at a higher rate (defined *a priori*) and, upon receiving the power control information from the mobile station, the base station then adjusts the power level to a proper level for transmission of the higher rate data transmission. As such, there is no teaching in Chen for deriving modulation format, number of codes, and/or transmission rate for a subsequent transmission after estimating channel quality based on feedback from the mobile, as is now being claimed by Applicants.

With regard to claim 9, Applicants respectfully disagree that the cited portions or any other portions of the Chen reference teach or suggest a base station receiving channel quality information from a mobile, estimating channel quality therefrom, and then calculating an amount of redundancy for retransmissions accordingly. At most, Chen describes transmitting a new transmission to a mobile using a previously stored power level for the link. This teaching is not at all the same or even suggestive of using estimated channel quality to calculate an amount of redundancy for retransmission of a previous transmission as claimed by Applicants.

Claims 13-15

Applicants also respectfully submit that Chen does not teach or suggest every limitation recited in independent claim 13. The distinctions noted above for the Chen reference and Applicants' claims 1 and 11, relating to channel quality information as claimed by Applicants versus power control information as disclosed by Chen, apply equally to claim 13 and will not be repeated here for sake of brevity. Furthermore, there are absolutely no teachings in Chen, nor are any cited in the Office Action, that either expressly or impliedly suggest varying the rate for reporting channel quality information as a function of the number of base stations that the mobile is communicating with, as is recited in Applicants' claim 13. This feature of Applicants' claimed invention, which is particularly advantageous for handling "soft handoffs", is supported in Applicants' specification, see, e.g., page 9, lines 1-22.

Because Chen does not teach or suggest each of the limitations recited in claim 13, Applicants' submit that the Chen reference therefore does not anticipate claim 13 and respectfully request that the Examiner withdraw the rejection accordingly. Because claims 14 and 15 depend from claim 13, these dependent claims are therefore also believed to be

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allowable for the same reasons set forth above for claim 13 as well as for other novel features therein.

Conclusion

In view of the foregoing, Applicants believe that all pending claims stand in condition for allowance. Accordingly, Applicants respectfully request reconsideration of the application and passage of the case to issue. Any questions can be directed to the Applicants' attorney at the number below.

Respectfully submitted,

By: _____

Gregory J. Murgia
Reg. No. 41,209
Attorney for Applicants
(732) 949-3578

Lucent Technologies Inc.
Date: 2/2/04

PAGE 12/12 * RCVD AT 2/2/2004 10:36:21 PM [Eastern Standard Time] * SVR:USPTO-EFXRF-1/0 * DNIS:8729314 * CSID:7329490102 * DURATION (mm-ss):03-38

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/002,746	11/02/2001	Amab Das	14-18	3832

7590 10/02/2003

Docket Administrator (Room 3J-219)
Lucent Technologies Inc.
101 Crawfords Corner Road
Holmdel, NJ 07733-3030

EXAMINER	
NGUYEN, THUAN T	

ART UNIT	PAPER NUMBER
2685	4

DATE MAILED: 10/02/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)	
	10/002,746	DAS ET AL.	
	Examiner	Art Unit	
	THUAN T. NGUYEN	2685	

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

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-15 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-15 is/are rejected.

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

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

Application Papers

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

10)☒ The drawing(s) filed on 02 November 2001 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

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

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 3 .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 102

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

> *A person shall be entitled to a patent unless --*
>
> *(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.*

2. Claims 1-15 are rejected under 35 U.S.C. 102(b) as being anticipated by Chen (U.S. Patent No. 6,067,458).

Regarding claim 1, Chen discloses a method for transmitting channel quality information in a wireless communication system with at least a base station and at least a mobile station (Fig. 2), the method comprising varying a rate for reporting channel quality information from a mobile station to a base station as a function of the presence or absence of a reception of a transmission at the mobile station (see col. 6/lines 10-48 for varying rate information exchange between mobile station and base station, in idle time or absence of a reception of a transmission at the mobile station, rate is communicated at the eighth rate, and higher rate is used when voice or data communicating between these two components; and col. 13/lines 48-65 as mobile station communicates to base station & col. 14/lines 32-42 for channel quality monitoring and control).

As for claims 2 and 3, in view of claim 1, Chen discloses the mobile station reports channel quality information at an idle rate (or the eighth rate) and either at a first rate set and a second rate set in the absence and in the presence of a transmission from the base station, respectively, and upon the detection of the absence and presence of the transmission from the base station (col. 6/lines 18-48 as discussed above in claim 1).

As for claim 4, in view of claim 1, Chen discloses a plurality of rates over a prescribed time period after the detection of reception of a transmission, particularly, ranging from a first rate set for transmitting speech data up to a second rate set of 64 kbps for exchanging voice and other data (col. 6/lines 29-48 & col. 13/lines 48-51).

As for claim 5, in view of claim 4, Chen discloses a plurality of rates can be transmitted on a reverse link from the mobile station to the base station in a plurality of time intervals (Figs. 1A- F shows an example within one time interval of 20ms, and col. 2/line 53 to col. 3/line 3).

As for claim 6, in view of claim 2, Chen further discloses that the second rate is faster than the first rate, i.e., the second rate either at the first rate set or at the second rate set is faster than the first rate at idle time (or at the eighth rate, see col. 6/lines 18-48).

As for claim 7, in view of claim 6, Chen further discloses that the base station determines the channel quality collected from the mobile station for

deriving a transmission format for a next transmission (col. 13/line 55 to col. 14/line 20).

As for claim 8, in further view of claim 7, Chen further includes within the transmission format one or more parameters selected from the group consisting of modulation format, number of codes, and transmission rate (col. 12/line 22 to col. 13/line 40).

As for claim 9, in view of claim 6, Chen further addresses the calculation an amount of redundancy needed for a retransmission of a previous transmission by using a routine 300 in recalculating the necessary step whether to use the previous transmission or not (Fig. 7, and col. 11/lines 40-63 & col. 13/lines 20-33 for recalled or previously stored power transmission control setting).

As for claim 10, in view of claim 1, Chen further discloses wherein the channel quality information comprises a transmission rate calculated by the mobile station based on one or more channel conditions (col. 12/line 63 to col. 13/line 47 for more additional conditions can be collected by the base stations).

As for claims 11-15, these claims for same limitations are rejected for the reasons given in the scope of claims 1-10 as already disclosed above.

Conclusion

3. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

Chen (US Patent 6,330,462 B1) disclose a related system to Chen '458.

Bhaskar et al. (US Patent 6,154,499) disclose a communications system using nested coder and compatible channel coding.

Wijk et al. (US Patent 5,995,836) disclose method and system for variable handoff in a radio communication system.

Parkvall et al (US PUB no. 2002/0080719 A1) disclose scheduling transmission of data over a transmission channel based on signal quality of a receive channel.

4. **Any response to this action should be mailed to:**

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or faxed to:

(703) 872-9314, (for Technology Center 2600 only)

Hand-delivered responses should be brought to Crystal Park II,

2121 Crystal Drive, Arlington. VA., Sixth Floor (Receptionist).

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tony Thuan Nguyen whose telephone number is (703) 308-5860. The examiner can normally be reached on Monday-Friday from 9:30 AM to 7:00 PM, with alternate Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Edward Urban, can be reached at (703) 305-4385.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the **Technology Center 2600 Customer Service Office** whose telephone number is **(703) 306-0377**.

TONY T. NGUYEN
PATENT EXAMINER

Tony T. Nguyen
Art Unit 2685
September 17, 2003

Notice of References Cited	Application/Control No. 10/002,746	Applicant(s)/Patent Under Reexamination DAS ET AL.	
	Examiner THUAN T. NGUYEN	Art Unit 2685	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
	A	US-6,067,458	05-2000	Chen, Tao	455/522
	B	US-6,330,462 B1	12-2001	Chen, Tao	455/572
	C	US-2002/0080719 A1	06-2002	Parkvall et al.	370/235
	D	US-6,154,499	11-2000	Bhaskar et al.	375/259
	E	US-5,995,836	11-1999	Wijk et al.	455/436
	F	US-			
	G	US-			
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	I	US-			
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	K	US-			
	L	US-			
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FOREIGN PATENT DOCUMENTS

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NON-PATENT DOCUMENTS

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

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

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INFORMATION DISCLOSURE STATEMENT

Case Name.	A. Das 14-18
Serial No.	10/002746
Applicant:	A. Das, et al.
Filing Date:	November 2, 2001
Group:	~~2684~~ 2685

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U.S. PATENT DOCUMENTS

*Examiner Initial		Document Number	Date	Name	Class	Subclass	Filing Date
	AA						

FOREIGN PATENT DOCUMENTS

		Document Number	Date	Country	Class	Subclass	Translation
	AB	WO 00 16613 A	03/23/2000	PCT	H04L	1/12, 1/00	Yes
	AC	WO 01 22645 A1	03/29/2001	PCT	H04L	1/18	Yes
	AD	WO 99 49610	09/30/1999	PCT	H04L	1/12	Yes
	AE	EP 0 938 207 A	08/25/1999	EPC	H04L	1/12	Yes

OTHER (including Author, Title, Date, Pertinent Pages, etc.)

	AF	Naijoh et al, "ARQ Schemes with Adaptive Modulation/TDMA/TDD Systems for WirelessMultimedia Communication Services", ***PERSONAL, INDOOR AND MOBILE RADIO COMMUNICATIONS, 1997. WAVES OF THE YEAR 2000, PIMRC '97, THE 8th IEEE INTERNATIONAL SYMPOSIUM ON HELSINSKI, FINLAND 1-4 SEPT. 1997, NEW YORK, NY, USA***, pp 709-713

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PATENT APPLICATION

Inventor(s): **Arnab Das**
Farooq Ullah Khan

Case: **14-18**

Serial No.: **10/002746**

Filing Date: **November 2, 2001**

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Examiner: Group Art Unit: **2681**

Title: **Variable Rate Channel Quality Feedback In A Wireless Communication System**

ASSISTANT COMMISSIONER FOR PATENTS
WASHINGTON, D. C. 20231

SIR:

INFORMATION DISCLOSURE STATEMENT
UNDER 37 CFR 1.97(b)

In accordance with 37 CFR 1.97(b), the enclosed Information Disclosure Statement, with attached reference(s), is submitted for consideration in the above-identified application.

Copies of the listed documents are enclosed together with the search report that listed these documents.

NO FEE IS REQUIRED

In the event of any non-payment or improper payment of a required fee, the Commissioner is authorized to charge or to credit **Lucent Technologies Deposit Account No. 12-2325** as required to correct the error.

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Respectfully,

Gregory J. Murgia, Attorney
Reg. No. **41209**
732-949-3578

Date: 9/6/02

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Lucent Technologies Inc.
101 Crawfords Corner Road
Holmdel, NJ 07733-3030

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(30) Priority Data:
09/154,046 16 September 1998 (16.09.98) US

(71) Applicant: TELEFONAKTIEBOLAGET LM ERICSSON (publ) [SE/SE]; S–126 25 Stockholm (SE).

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(74) Agent: ERICSSON RADIO SYSTEMS AB; Patent Support/Ericsson Research, S–164 80 Stockholm (SE).

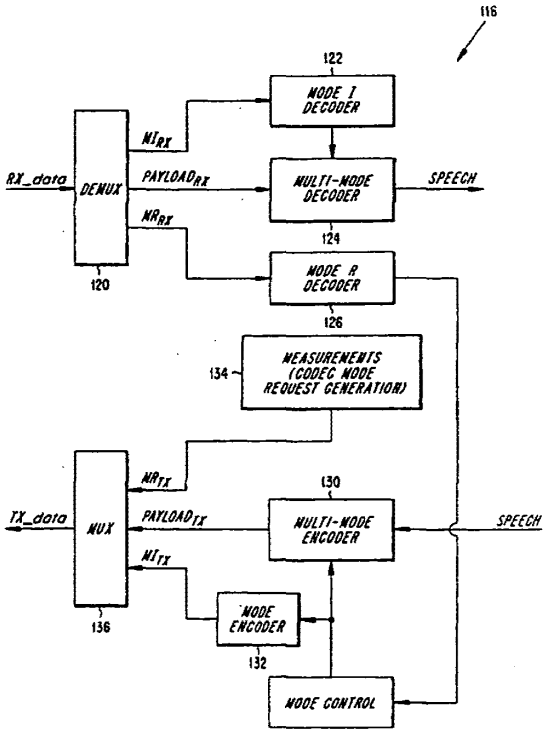
(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, 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: METHOD AND SYSTEM FOR ALTERNATING TRANSMISSION OF CODEC MODE INFORMATION

(57) Abstract

A communication system supports multiple source coding/channel coding schemes. A mode indicator can be transmitted with payload data to inform the receiver of the particular scheme currently being employed. Similarly, a mode request can be transmitted to inform the receiver of a particular scheme to be employed for information to be transmitted on the return radio link. The rate of change of the mode indications and mode requests can be decimated so that they need not both be transmitted in each frame to thereby reduce the overhead capacity consumption associated with the transmission of mode information. According to one exemplary embodiment, the mode indication and the mode request can be tramsmitted independently on alternating frames.



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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		

METHOD AND SYSTEM FOR ALTERNATING TRANSMISSION OF CODEC MODE INFORMATION

BACKGROUND

The present invention generally relates to mode handling in the field of communication systems and, more particularly, to handling the transmission of information associated with requesting and identifying coding modes in digital communication systems that support multiple speech/ forward error correction coding schemes.

The growth of commercial communication systems and, in particular, the explosive growth of cellular radiotelephone systems, have compelled system designers to search for ways to increase system capacity without reducing communication quality beyond consumer tolerance thresholds. One technique to achieve these objectives involved changing from systems wherein analog modulation was used to impress data onto a carrier wave, to systems wherein digital modulation was used to impress the data on carrier waves.

In wireless digital communication systems, standardized air interfaces specify most of the system parameters, including speech coding type(s), burst format, communication protocol, etc. For example, the European Telecommunication Standard Institute (ETSI) has specified a Global System for Mobile Communications (GSM) standard that uses time division multiple access (TDMA) to communicate control, voice and data information over radio frequency (RF) physical channels or links using a Gaussian Minimum Shift Keying (GMSK) modulation scheme at a symbol rate of 271 ksps. In the U.S., the Telecommunication Industry Association (TIA) has published a number of Interim Standards, such as IS-54 and IS-136, that define various versions of digital advanced mobile phone service (D-AMPS), a TDMA system that uses a differential quadrature phase shift keying (DQPSK) modulation scheme for communicating data over RF links.

TDMA systems subdivide the available frequency into one or more RF channels. The RF channels are further divided into a number of physical channels corresponding to timeslots in TDMA frames. Logical channels are formed of one or several physical channels where modulation and coding is specified. In these systems, the mobile stations communicate with a plurality of scattered base stations by transmitting and receiving bursts of digital information over uplink and downlink RF channels.

The growing number of mobile stations in use today has generated the need for more voice and data channels within cellular telecommunication systems. As a result, base stations have become more closely spaced, with an increase in interference between mobile stations operating on the same frequency in neighboring or closely spaced cells. In fact, some systems now employ code division multiple access (CDMA), using a form of spread spectrum modulation wherein signals intentionally share the same time and frequency. Although digital techniques provide a greater number of useful channels from a given frequency spectrum, there still remains a need to maintain interference at acceptable levels, or more specifically to monitor and control the ratio of the carrier signal strength to interference, (i.e., carrier-to-interference (C/I) ratio).

Another factor which is increasingly important in providing various communication services is the desired/required user bit rate for data to be transmitted over a particular connection. For example, for voice and/or data services, user bit rate corresponds to voice quality and/or data throughput, with a higher user bit rate producing better voice quality and/or higher data throughput. The total user bit rate is determined by a selected combination of techniques for speech coding, channel coding, modulation, and resource allocation, e.g., for a TDMA system, this latter technique may refer to the number of assignable time slots per connection, for a CDMA system, this latter parameter may refer to the number of assignable codes per connection.

Speech coding (or more generally "source coding" to include techniques associated with the compression of data) techniques are used to compress the input information into a format which uses an acceptable amount of bandwidth but from which an intelligible output signal can be reproduced. Many different types of speech coding algorithms exist, e.g., residual excited linear predictive (RELP), regular-pulse excitation (RPE), etc., the details of which are not particularly relevant to this invention. More significant in this context is the fact that various speech coders have various output bit rates and that, as one

would expect, speech coders having a higher output bit rate tend to provide greater consumer acceptance of their reproduced voice quality than those having a lower output bit rate. As an example, consider that more traditional, wire-based telephone systems use PCM speech coding at 64 kbps, while GSM systems employ an RPE speech coding scheme operating at 13 kbps.

In addition to speech coding, digital communication systems also employ various techniques to handle erroneously received information. Generally speaking, these techniques include those which aid a receiver to correct the erroneously received information, e.g., forward error correction (FEC) techniques, and those which enable the erroneously received information to be retransmitted to the receiver, e.g., automatic retransmission request (ARQ) techniques. FEC techniques include, for example, convolutional or block coding (collectively referred to herein as "channel coding") of the data prior to modulation. Channel coding involves representing a certain number of data bits using a certain number of code bits. Thus, for example, it is common to refer to convolutional codes by their code rates, e.g., 1/2 and 1/3, wherein the lower code rates provide greater error protection but lower user bit rates for a given channel bit rate.

Conventionally, each of the techniques which impacted the user bit rate were fixed for any given radiocommunication system, or at least for the duration of a connection established by a radiocommunication system. That is, each system established connections that operated with one type of speech coding, one type of channel coding, one type of modulation and one resource allocation. More recently, however, dynamic adaptation of these techniques has become a popular method for optimizing system performance in the face of the numerous parameters which may vary rapidly over time, e.g., the radio propagation characteristics of radiocommunication channels, the loading of the system, the user's bit rate requirements, etc.

For example, different modulations have been dynamically assigned to selectively take advantage of the strengths of individual modulation schemes and to provide greater user bit rates and/or increased resistance to noise and interference. An example of a communication system employing multiple modulation schemes is found in U.S. Patent No. 5,577,087. Therein, a technique for switching between 16QAM and QPSK is described. The decision to switch between modulation types is made based on quality measurements, however this system employs a constant user bit rate which means that a

change in modulation scheme also requires a change in channel bit rate, e.g., the number of timeslots used to support a transmission channel.

It is envisioned that many different combinations of these processing techniques may be selectively employed both as between different connections supported by a radiocommunication system and during the lifetime of a single connection. However, there will then be a need for some type of "handshaking" between the transmitting and receiving entities to inform the receiving entity of a transmission mode being employed and/or for the receiving entity to request a particular transmission mode from the transmitting entity. For example, there are two general categories of techniques for informing a receiver about processing techniques associated with a radio signal: (1) explicit information, i.e., a message field within the transmitted information having a mode value that is indicative of the processing type(s) and (2) implicit information, which is sometimes referred to as "blind" decoding, whereupon the receiver determines the processing performed by the transmitter by analyzing the received signal. This latter technique is employed in CDMA systems operating in accordance with the TIA/EIA IS-95 standard. Explicit information is sometimes considered to be preferable because it reduces processing delay at the receiver, but comes at the cost of the need for the transmitter to include additional overhead bits along with the user data.

Of particular interest for the present invention are mode indicators which reflect the transmitter's currently employed speech coding/channel coding combination and mode requests which reflect the receiver's request for a particular speech coding/channel coding mode to be employed. For example, when channel conditions are good, the receiver may send a mode request in the uplink for a speech coding/channel coding mode which provides for a high source coding bit rate and a relatively low degree of error protection. When the transmitter transmits information using the requested mode, it will also include a corresponding mode indicator in its downlink transmissions.

Alternatively, when channel conditions are poor, then a coding mode which provides a low bit rate speech coding technique coupled with a relatively high degree of error protection may be requested by the receiver. The transmitter would then provide a corresponding indicator associated with this other mode in the return link. Systems can rapidly change between these different coding modes based upon varying changes in

channel conditions, so the mode requests and/or indicators need to be transmitted relatively frequently.

Thus, mode indicators and mode requests are communicated between transmitting and receiving entities to enable variable codec mode operation. Typically, these mode indicators/requests may include just a few, e.g., two, bits which are conveyed along with the data fields. Thus, it will be appreciated that it is particularly important for the receiver/transmitter to be able to accurately and rapidly decode the mode indicator/request since, otherwise, an entire frame of data may be unrecoverable by the receiver or a sub-optimal transmission mode may be employed. This desire for accurate and rapid reception of the mode indicator/request may lead designers to strongly protect the mode indicator/request with heavy channel coding.

However, usage of heavy channel coding implies higher redundancy, which means more bits to be transmitted for the mode indicator and/or request field. This is, as explained earlier, undesirable since overhead bits should be minimized, not increased. Thus, it would be desirable to provide techniques and systems for increasing the likelihood that mode indicators and requests, such as the coding mode indicator and request, will be properly decoded, while at the same time minimizing the number of overhead bits which are transmitted with the payload data and reducing the delay associated with processing mode information.

SUMMARY

These and other drawbacks and limitations of conventional methods and systems for communicating information are overcome according to the present invention, wherein the rate of transmission of mode information is decimated to reduce the bandwidth utilization associated therewith and/or permit heavier channel coding of the mode information.

The mode information may comprise, for example, a mode indicator which informs a receiver of the combination of speech coding/channel coding currently used to encode the payload data, a mode request which informs a transmitter of a particular codec mode desired by a receiver for subsequently transmitted information blocks or frames and/or channel measurement information, which acts as an implicit request for a particular codec mode to be provided by the transmitter. According to exemplary embodiments of the

present invention, the rate of change of mode information is constrained to be less than every frame. For example, the mode indication and mode requests can be constrained to change no more than once every other frame. Under these circumstances, the transmission of mode indicators and mode requests can also be alternated to reduce the transmission capacity used by these indicators and minimize processing delays associated with mode changes.

According to other exemplary embodiments of the present invention, when links become inactive, e.g., when a speaker becomes silent, the transmission of mode information can be further reduced or adjusted in accordance therewith.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects, features and advantages of the present invention will become more apparent upon reading from the following detailed description, taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a block diagram of an exemplary GSM communication system which advantageously uses the present invention;

FIG. 2(a) depicts a codec mode used in a conventional GSM system;

FIG. 2(b) depicts a conventional mapping of bits in a speech frame for unequal error protection coding;

FIG. 3(a) is a block diagram illustrating multiple codec modes, individual ones of which can be selected for processing data to be transmitted and a correspoding mode indicator according to an exemplary embodiment of the present invention;

FIG. 3(b) is another block diagram illustrating another exemplary technique for generating multiple codec modes;

FIG. 4 depicts a block diagram of a receiver including a mode likelihood processor and a mode information model;

FIG. 5 is a block diagram of an exemplary transceiver according to the present invention; and

FIG. 6 illustrates alternating transmission of mode indicators and mode requests according to an exemplary embodiment of the present invention.

DETAILED DESCRIPTION

The following exemplary embodiments are provided in the context of TDMA radiocommunication systems. However, those skilled in the art will appreciate that this access methodology is merely used for the purposes of illustration and that the present invention is readily applicable to all types of access methodologies including frequency division multiple access (FDMA), TDMA, code division multiple access (CDMA) and hybrids thereof.

Moreover, operation in accordance with GSM communication systems is described in European Telecommunication Standard Institute (ETSI) documents ETS 300 573, ETS 300 574 and ETS 300 578, which are hereby incorporated by reference. Therefore, the operation of the GSM system is only described herein to the extent necessary for understanding the present invention. Although, the present invention is described in terms of exemplary embodiments in a GSM system, those skilled in the art will appreciate that the present invention could be used in a wide variety of other digital communication systems, such as those based on PDC or D-AMPS standards and enhancements thereof.

Referring to FIG. 1, a communication system 10 according to an exemplary embodiment of the present invention is depicted. The system 10 is designed as a hierarchical network with multiple levels for managing calls. Using a set of uplink and downlink frequencies, mobile stations 12 operating within the system 10 participate in calls using time slots allocated to them on these frequencies. At an upper hierarchical level, a group of Mobile Switching Centers (MSCs) 14 are responsible for the routing of calls from an originator to a destination. In particular, these entities are responsible for setup, control and termination of calls. One of the MSCs 14, known as the gateway MSC, handles communication with a Public Switched Telephone Network (PSTN) 18, or other public and private networks.

At a lower hierarchical level, each of the MSCs 14 are connected to a group of base station controllers (BSCs) 16. Under the GSM standard, the BSC 16 communicates with a MSC 14 under a standard interface known as the A-interface, which is based on the Mobile Application Part of CCITT Signaling System No. 7.

At a still lower hierarchical level, each of the BSCs 16 controls a group of base transceiver stations (BTSs) 20. Each BTS 20 includes a number of TRXs (not shown) that use the uplink and downlink RF channels to serve a particular common geographical area, such as one or more communication cells 21. The BTSs 20 primarily provide the RF links

for the transmission and reception of data bursts to and from the mobile stations 12 within their designated cell. In an exemplary embodiment, a number of BTSs 20 are incorporated into a radio base station (RBS) 22. The RBS 22 may be, for example, configured according to a family of RBS-2000 products, which products are offered by Telefonaktiebolaget L M Ericsson, the assignee of the present invention. For more details regarding exemplary mobile station 12 and RBS 22 implementations, the interested reader is referred to U.S. Patent Application Serial No. 08/921,319, entitled "A Link Adaptation Method For Links using Modulation Schemes That Have Different Symbol Rates", to Magnus Frodigh et al., and filed on August 29, 1997, the disclosure of which is expressly incorporated here by reference.

According to exemplary embodiments of the present invention, information transmitted between a BTS 20 and a mobile station 12 can be processed according using different codec modes. The phrase "codec mode" as it is used herein refers to a combination of source coding (e.g., speech coding) and channel coding, although the present invention is also applicable to the transmission and reception of other types of mode information and, even more generally, to the transmission and reception of other information over an air interface. To more fully understand the exemplary modes for which indicators, requests and information associated therewith can be protected, transmitted and decoded, consider the exemplary GSM codec mode illustrated in FIGS. 2(a) and 2(b).

FIG. 2(a) depicts a portion of the transmit signal processing path downstream of the A/D converter (not shown) which digitizes an exemplary input audio signal. A block of 160 samples is presented to an RPE speech coder 30 which operates in accordance with the well known GSM specifications (e.g., GSM 06.53) to produce two categories of output bits, 182 class 1 bits and 78 class 2 bits, for a total output bit rate of 13 kbps. As seen in FIG. 2(b), the class 1 bits are further divided into class 1a bits and class 1b bits, both of which are input to a channel coder 32, which performs rate ½ convolutional encoding. This results in an output of 378 bits from the channel coder 32, including 3 parity bits associated with the class 1a bits and four tail bits associated with the class 1b bits. This composite process can be considered to be one example of a single codec mode.

However, Applicants envision future systems that provide for a plurality of different codec modes. For example, as conceptually illustrated in FIG. 3(a), there may be

two different speech coders and two different channel coders which can be used in various combinations to encode bits prior to transmission. A first speech coder 40 may operate to process digital samples and provide an output bit rate of X kbps, while a second speech coder 42 may process the input digital samples to provide an output bit rate of Y kbps, where X>Y. Similarly, two different channel coders 44 and 46 (in this example convolutional coders, although one or both could alternatively be block coders) provide different degrees of error protection by virtue of their different rates 1/A and 1/B, respectively, where A>B. Thus, it can be seen that by using mode control processor 48 in conjunction with multiplexors 50 and 52 to select a path, i.e., a combination of speech coder and channel coder for this example, for processing a particular block or frame of payload data, four different codec modes are available.

Many other techniques are, of course, available to create multiple codec modes in a transmitter. Consider the example in FIG. 3(b), wherein a plurality of source (e.g., speech) coders 60, 62, 64, and 66 are provided in selectable transmit signal processing paths. Each coder has a different output rate (X>Y>Z>A kbps) and is associated with a different one of the channel coders 68, 70, 72 and 74. To provide a uniform output data rate of F kbps as between the different, selectable paths (which may be desirable for similar resource allocation/connection), the channel coders may be designed so that the amount of redundancy added to the source coded data stream is higher for the lower bit rate source coder and lower for the higher bit rate source coders. As in the earlier example, the particular codec mode selected for any given data block or frame is controllable by, for example, a mode control processor 76 and multiplexor 78.

Regardless of the technique used at the transmit side to provide different codec modes, in order to be able to correctly decode the received data, a receiver will need to know the codec mode used by the transmitter to process any given block or frame of received data. According to exemplary embodiments of the present invention, this can be accomplished by transmitting a mode indicator from the transmitter to the receiver in conjunction with, or in advance of, the block or frame of data to which it relates. In the example of FIGS. 3(a) and 3(b), a two bit mode indicator field would suffice to inform the receiver of the combination of speech coder and channel coder used to process data prior to transmission. Additionally, the receiver may transmit a request for a particular codec mode to the transmitter in the return radio link or the receiver may transmit signal quality

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measurements associated with the downlink channel (i.e., BTS to mobile station link) to the transmitter which the transmitter then uses to identify an appropriate codec mode. In any of these three cases, some type of mode information is exchanged between the transmitter and the receiver over the air interface, which phrase is used to include each of these three specific examples, as well as other types of mode information.

In any event, since the mode information is also communicated over the air interface between the BTS 20 and the mobile station 12, it should also be protected against channel errors as well as the data. However, adding heavy channel coding, i.e., with a large amount of redundancy, is not desirable since it adds further to overhead (i.e., non-payload data) transmissions and reduces the user's effective bit rate. It is also desirable to maintain low coding delay so that codec modes can be changed quickly to account for rapid changes in transmission channel conditions.

According to the above-identified, related patent application, these objectives may be achieved by encoding the mode information with a relatively weak (i.e., with a small amount of redundancy) channel code. In FIG. 3(a), this is exemplified by channel coder 54 which employs a rate 1/C convolutional code. In FIG. 3(b), this is exemplified by a block coder 67 employing (8,2) block coding. However, the present invention addresses the capacity consumption issue associated with the transmission of mode information by reducing the rate of change of certain mode information as will be described below.

At the receiver side, as exemplified by the block diagram of FIG. 4, an antenna 100 of the receiver apparatus, for instance, receives radio signals over a certain radio channel. The signals (e.g., data/speech messages) transmitted over this channel may become strongly distorted, for, instance due to fading, so that the TDMA-bursts give rise to a highly distorted speech frame.

Demodulation takes place in the radio receiver 102 at a given radio frequency (in the GSM-system 865-935 MHZ) in a known manner, so as to obtain a baseband modulated signal. The signal strength level(s) of the radio signals incoming to the radio receiver 102 can be measured and are referenced s_m in FIG. 4. The baseband modulated signal is demodulated in the demodulator 104 within the IF-range, this demodulator also including an equalizer for compensating or correcting the multipath propagation to which the incoming signal has been subjected during transmission, in a known manner. For example, the well known Viterbi equalizer can be used for this purpose.

So-called soft information associated with the likelihood of any given symbol estimate is obtained from the Viterbi equalizer in the demodulator 104, this soft information being referenced s_j in FIG. 4. A deinterleaver 106 is connected downstream of the demodulator/equalizer 104 and recovers the time divided bursts intended for the receiver, in a known manner.

The receiver also includes a mode indication decoder 107 that operates to identify a codec mode based upon received mode information. The mode indication decoder provides an output to the channel decoder 109 and the speech decoder 112, indicating the techniques used by the transmitter to process the received data block or frame prior to transmission. Exemplary techniques for implementing the mode indication decoder 107 can be found in the above-identified and incorporated by reference application and, accordingly are not further described here.

More generally, a transceiver (either in a remote device or at the network side) according to the present invention will include functionality for transmitting mode indication information, transmitting mode request information, receiving mode indication information and receiving mode request information as represented by the block diagram of Figure 5. Therein, RX_data received by a transceiver 116 on a first link is separated into its component fields and provided to an appropriate decoding block or algorithm by demultiplexor 120. For simplicity in describing the present invention, Figure 5 refers only to mode and payload information, although those skilled in the art will appreciate that other types of information may be received by the transceiver.

If the received frame includes mode indication information, then that information is provided to the mode indication decoder 122, which determines the codec mode used to encode the received payload data. The decoded mode indication information is provided to multi-mode decoder 124 so that properly decoded payload data, e.g., speech, can be output. If, on the other hand, the received frame includes mode request information, then that information is provided to the mode request decoder 126. The mode request decoder determines the codec mode requested by the other transceiver (not shown), which information is then forwarded to the transmitter side of this transceiver.

On the transmit side, the requested mode is presented to mode control unit 128 which selects an appropriate codec mode for processing incoming payload, e.g, speech, information. This mode information is passed to a multi-mode encoder 130 which, for

example, speech encodes and error correction encodes incoming speech frames. The mode information is also passed to the mode encoder 132 which creates a mode indication to be transmitted to the other transceiver (not shown) on a second (return) link which identifies the mode employed by the multi-mode encoder 130. Additionally, the transmit side of transceiver 116 includes a measurement or codec mode request function 134 which, for example based on the measured quality on the first link, provides a mode request or measurement information to be transmitted on the second link. The mode request, payload information and mode indication are presented to multiplexor 136 for selective transmission using well known techniques, e.g., modulation, upconversion, etc.

According to exemplary embodiments of the present invention, the tension between protecting the mode information against transmission errors and providing low delay, on the one hand, and reducing the amount of bandwidth consumed by the transmission of mode information, on the other hand, is resolved by decimating the permissible change rate associated with mode information and alternating the transmissions of the mode indicators and transmissions of the mode requests (or measurement information). This can be accomplished in a number of different ways according to exemplary embodiments of the present invention.

For example, the codec mode changes at the transmitting entity can be constrained to occur only every n-th frame. As a result of this constraint, codec mode indications will only change at a decimated rate of once per n frames, where, for example, n can be equal to 2 or a multiple thereof. Similarly, codec mode requests generated by the receiver can be subsampled with a decimation factor of n, the result being that codec mode requests can only change at a maximum rate of once per n frames. These constraints on the changeability of the mode indications and mode requests can, in turn be used to alternate the transmission of mode indications and mode requests whereby the total bandwidth consumed by the transmission of mode information can be reduced by a factor of $1/n$.

Consider the example illustrated in Figure 6 with respect to communications between an exemplary GSM mobile station 150 and base station 152. Therein, the mobile station 150 transmits information to the base station 152 on the uplink and receives information transmitted by the base station on the downlink. For the purposes of this example, the alternating transmission characteristic of mode information received by e.g., transceiver 116, according to the present invention is illustrated on the downlink. Therein,

the information contained in several consecutive channel frames (after deinterleaving to simplify the illustration) are shown. In particular, in frame *n*, mobile station 150 receives a mode request (MR) from the base station 150 indicating the codec mode with which the mobile station should transmit to the base station on the uplink. Since no mode indication is transmitted in frame *n*, the mobile station continues to decode information using the codec mode indicated in frame *n*-1 (not shown). Analogously, since no mode request information is transmitted in frame *n*+1, the mode request from frame *n* remains valid for frame *n*+1.

In frame *n+1*, however, the base station 152 transmits a mode indication(MI) instead of a mode request. Thus, the mobile station uses this mode information to switch codec modes (if a new codec mode is indicated) to decode the payload information found in this (and/or a subsequent) frame. Then, in frame *n*+2, this link once again contains a mode request which is decoded by the mobile station 150 and used in its transmit side processing as described above with respect to FIG. 5. As indicated in FIG. 6, each frame may also include other overhead information including, for example, synchronization information. Those skilled in the art will further appreciate that, although not explicitly described here, the mobile station 150 can similarly alternate transmissions of mode requests and mode indications to the base station 152 on the uplink. Moreover, although not explicitly illustrated in FIG. 6, note that the mode information MI and MR may occupy the same bit positions within each frame.

In an even more specific, yet purely illustrative example, the mode information in the previous example may comprise eight gross bits (full rate, four gross bits half rate) and the decimation factor *n* equals two. Mode requests are transmitted on even frames and mode indications on odd frames. After diagonal interleaving, the gross bits belonging to each code word are distributed individually on separate bursts, thereby providing optimum interleaving gain for frequency hopping channels.

By transmitting the mode indications and mode requests in only every other frame, for example, the total bandwidth for transmitting these overhead fields is reduced by a factor of two, regardless of the amount of redundancy added by virtue of the error correction coding. The particular manner used to select the alternating pattern may, of course, be varied. For example, consecutive codec mode requests may be transmitted using frames (1...*n*/2)+*k***n*, where *k* is an integer value. Then, codec mode indications would be

transmitted using frames $(n/2+1...n)+k*n$. Alternatively, codec mode requests can be sent only using odd-numbered frames, while mode indications can be sent only using even-numbered frames although this latter solution may increase the transmission delay.

Since these exemplary embodiments of the present invention provide for alternating the transmission of mode indications and mode requests, it is important that some form of synchronization of mode information transmission/decoding be provided so that a receiving entity knows when it is receiving a mode indication and when it is receiving a mode request. Otherwise, erroneous decoding of the mode information may occur. One way to provide synchronization for the mode information is to align the transmission of mode information to the time frame structure of the radiocommunication system. For example, in the GSM system, the mode information could be aligned with the SACCH (Slow Associated Control Channel) such that, e.g., mode indications are sent in even frames relative to the SACCH while mode requests are sent using odd frames. Alternatively, when both links are active, it could be understood that the first transmission will always be a specified one of the mode request or mode indication.

According to other aspects of the present invention, the usage of discontinuous transmission (DTX) or voice operated transmissions (VOX) in some radiocommunication systems can be accounted for in conjunction with the transmission of mode information. DTX and VOX are mechanisms for transmitting frames of information only during speech periods while the transmitter is switched off during speech inactivity to reduce power consumption and interference. In two-way communication systems employing DTX, there can thus occur the situations where both links are active (e.g., when the active speaker during a conversation changes), one link active/one link inactive or both links inactive. The transmitters having inactive links typically still transmit some information, commonly referred to as silence descriptor (SID) frames or comfort noise information, that allows the receiver to generate an appropriate background noise output rather than the listener experiencing pops and cracks associated with a complete absence of reproduced sound. However these SID frames are transmitted with a reduced frame transmission rate relative to active speech frames.

In addition to SID frames, in the types of systems described above, mode information also needs to be transmitted. However, instead of alternating mode information as described above, the occurrence of inactive links can be recognized and

used by the system to further reduce the transmission of mode information. For example, mode indications need not be transmitted for inactive links since coded speech frames are not included therewith. Consider the case where a mobile station is not currently transmitting to a base station on the uplink, but is receiving speech frames (or other data) on the downlink. Then, the mobile station need not send mode indications on the uplink and can, instead, only send mode requests associated with transmissions to be made to it by the base station on the currently active downlink. Analogously, on the active link codec mode requests for transmissions on the inactive link do not need to be sent until the inactive link becomes active again. Having eliminated the need to transmit mode indications on the inactive link and mode requests on the active link, the bandwidth released thereby can be used in a number of different ways. For example, mode requests can be repeated, e.g., on every sent SID frame, on the inactive link and mode indications can be repeated on the active link, which leads to improved channel error protection. Alternatively, some other type of overhead information can be transmitted during the omitted mode information fields.

In the situation where both links are inactive, transmission of all mode information may be temporarily suspended pending reactivation of one or both links. The corresponding transmission capacity is then free for other uses, e.g., the transmission of other overhead information. Alternatively, mode requests may continue to be transmitted on the inactive link(s) as indicators of the current quality of the channel. Then, when the inactive link becomes active, these mode requests can be used to select an appropriate codec mode for coding the next frame of information to be transmitted.

If mode requests associated with inactive links are not transmitted to use the transmission capacity for other purposes, then, when an inactive link becomes active again, some other technique must be employed to determine which codec mode to use initially until the receiving entity begins to return mode requests in the other link. Several possibilities exist. For example, the transmitting entity can use a predetermined n-th most robust codec mode, where n=1 implies a codec mode having a greatest level of error correction protection. If this solution is used, then no mode indication need be transmitted with this initial frame or frames of information since the receiving entity will know *a priori* which mode is being used for transmission after inactivity.

Another alternative for post-inactivity selection of a codec mode is to use the same codec mode currently being used for the active link. For example, if a mobile station is inactive on the uplink and active on the downlink, once it prepares another frame for transmission on the uplink, it can select the codec mode currently being used to decode received frames on the downlink from the base station. This solution is based on the recognition that there is a certain correlation between the characteristics of the uplink channel and the downlink channel in a duplex pair. As in the previous exemplary embodiment, the receiving entity knows the applied codec mode as it is the same mode that it is employing to transmit frames of information on the other link. A variation on this solution is to employ, instead of the same mode being used on the active link, a mode which is n modes more robust than the mode being used on the active link, e.g, the next most robust mode, assuming that a more robust mode exists. Taking the exemplary modes illustrated in FIG. 3(b), if the active link is currently using a codec mode defined by the combination of source coder 62 and rate C channel coder 70, then (for n=1) the previously inactive link would use the next most robust codec mode provided by source coder 64 and channel coder 72 to transmit its first frame of information.

Yet another alternative for selecting a codec mode after a period of transmission inactivity is to select the mode used to transmit on that link prior to the inactivity. This solution can be useful particularly in situations wherein the radio channel conditions are not rapidly changing. As in the previous exemplary embodiment, this technique can be varied by using, instead of the same previously employed codec mode, a codec mode that is n modes more robust, e.g., the next most robust mode.

Although the invention has been described in detail with reference only to a few exemplary embodiments, those skilled in the art will appreciate that various modifications can be made without departing from the invention. For example, although previously described exemplary embodiments of the present invention alternate transmissions of mode information after decimating the change rates, other transmission patterns may be selected. Thus, the present invention can be implemented by sending a portion of both mode request information and mode indication information in each frame. Accordingly, the invention is defined only by the following claims which are intended to embrace all equivalents thereof.

WHAT IS CLAIMED IS:

1. A method for transmitting information on a first link and receiving information on a second link in a communication system comprising the steps of:

providing at least two different codec modes for processing said information in said system;

transmitting, in at least one first frame on said first link, a mode indication identifying one of said at least two different codec modes which has been used to process said first frame of data; and

transmitting, in at least one second frame on said first link different than said first frame, a mode request identifying one of said at least two different codec modes to be used to process information to be transmitted on said second link.

2. The method of claim 1, wherein each of said at least two codec modes identify both a source coding technique and a channel coding technique.

3. The method of claim 1, wherein said mode request is channel measurement information which can be used by a transceiver to determine an appropriate one of said at least two different codec modes for processing information to be transmitted on said second link.

4. The method of claim 1, wherein said at least one first and second frames are consecutively transmitted.

5. The method of claim 1, wherein said first step of transmitting further comprises the step of:

transmitting said mode indication in said at least one first frame including frames $(n/2+1...n)+k*n$, where k is an incremental frame number and n is an integer.

6. The method of claim 5, wherein said second step of transmitting further comprises the step of:

transmitting said mode request information in said at least one second frame including frames $(1...n/2)+k*n$, where k is an incremental frame number and n is an integer.

7. The method of claim 1, wherein said at least one first and second frames are even and odd frames.

8. The method of claim 7, wherein said at least one first frame comprises two consecutive, evenly numbered frames.

9. The method of claim 7, wherein said at least one second frame comprises two consecutive, oddly numbered frames.

10. The method of claim 1, further comprising the step of:

synchronizing said first and second transmitting steps to a time frame structure of other information transmitted by said communication system.

11. The method of claim 10, wherein said time frame structure is a slow associated control channel (SACCH) structure.

12. A system for transmitting information on a first link and receiving information on a second link in a communication system comprising the steps of:

means for providing at least two different codec modes for processing said information in said system;

means for transmitting, in at least one first frame on said first link, a mode indication identifying one of said at least two different codec modes which has been used to process said first frame of data; and

means for transmitting, in at least one second frame on said first link different than said first frame, a mode request identifying one of said at least two different codec modes to be used to process information to be transmitted on said second link.

13. The system of claim 12, wherein each of said at least two codec modes identify both a source coding technique and a channel coding technique.

14. The system of claim 12, wherein said mode request is channel measurement information which can be used by a transceiver to determine an appropriate one of said at least two different codec modes for processing information to be transmitted on said second link.

15. The system of claim 12, wherein said at least one first and second frames are consecutively transmitted.

16. The system of claim 12, wherein said first means for transmitting further comprises:

means for transmitting said mode indication in said at least one first frame including frames $(n/2+1...n)+k*n$, where k is an incremental frame number and n is an integer.

17. The system of claim 16, wherein said second means for transmitting further comprises:

means for transmitting said mode request information in said at least one second frame including frames $(1...n/2)+k*n$, where k is an incremental frame number and n is an integer.

18. The system of claim 12, wherein said at least one first and second frames are even and odd frames.

19. The system of claim 18, wherein said at least one first frame comprises two consecutive, evenly numbered frames.

20. The system of claim 18, wherein said at least one second frame comprises two consecutive, oddly numbered frames.

21. The system of claim 12, further comprising:

means for synchronizing said first and second transmitting means to a time frame structure of other information transmitted by said communication system.

22. The system of claim 21, wherein said time frame structure is a slow associated control channel (SACCH) structure.

23. A communication station comprising:

a processor for processing payload information and mode indication and request information; and

a transmitter for receiving said payload information, said mode indication information and said mode request information from said processor and for selectively transmitting one of said mode indication information and said mode request information in each frame in addition to said payload information on a first communication link.

24. The communication station of claim 23, further comprising:

a receiver for receiving mode indication information, mode request information and payload information on a second communication link, wherein said mode indication information is used by said processor to decode said payload information and said mode request information is used to determine a coding mode for said payload information transmitted by said transmitter.

25. The communication station of claim 23, wherein said processor selectively adapts transmission of said mode indication information based upon incoming payload information.

26. The method of claim 1, further comprising the steps of:

determining that a data source associated with said first link is inactive; and

halting the transmission of said mode indications in said at least one first frame during a period when said data source is inactive.

27. The method of claim 26, further comprising the step of:

transmitting said mode requests both during said at least one first and second frame during said period of inactivity.

28. The method of claim 26, further comprising the step of:

using a predetermined *n*-th most robust one of said at least two different code modes to process said information for transmission on said first link after said period of inactivity has ended.

29. The method of claim 26, further comprising the step of:

using a codec mode which was used prior to said period of inactivity to process said information for transmission on said first link after said period of inactivity has ended.

30. The method of claim 26, further comprising the step of:

using a codec mode which is *n* modes more robust than a codec mode employed immediately before said period of inactivity to process said information for transmission after said period of inactivity has ended.

31. The system of claim 12, further comprising:

means for determining that a data source associated with said first link is inactive; and

means for halting the transmission of said mode indications in said at least one first frame during a period when said data source is inactive.

32. The system of claim 31, further comprising:

means for transmitting said mode request during both said at least one first and second frames during said period of inactivity.

33. The system of claim 31, further comprising:

means for using a predetermined *n*-th most robust one of said at least two different code modes to process said information for transmission on said first link after said period of inactivity has ended.

34. The system of claim 31, further comprising:

means for using a codec mode which was used prior to said period of inactivity to process said information for transmission on said first link after said period of inactivity has ended.

35. The system of claim 31, further comprising:

means for using a codec mode which is *n* modes more robust than a codec mode employed immediately before said period of inactivity to process said information for transmission after said period of inactivity has ended.

36. A method for receiving information on a first link in a communication system comprising the steps of:

providing at least two different codec modes for processing said information in said system;

receiving, in at least one first frame on said first link, a mode indication identifying one of said at least two different codec modes which has been used to process payload data; and

receiving, in at least one second frame on said first link different than said first frame, a mode request identifying one of said at least two different codec modes to be used to process information to be transmitted on a second link.

37. The method of claim 36, wherein each of said at least two codec modes identify both a source coding technique and a channel coding technique.

38. The method of claim 36, wherein said payload data is contained in a same received frame as said mode indication.

39. The method of claim 36, wherein said payload data is contained in a subsequent received frame different than said at least one first frame including said mode indication.

40. The method of claim 36, further comprising the steps of:

processing said payload data based on said received mode indication; and

during said at least one second frame, continuing to process additional payload data based on a previously received mode indication.

41. The method of claim 1, wherein said first step of transmitting further comprises the step of:

transmitting said mode indication in said at least one first frame including frames $(1...n/2)*2 + k*n$, where k is an incremental frame number and n is an integer.

42. The method of claim 41, wherein said second step of transmitting further comprises the step of:

transmitting said mode request information in said at least one second frame including frames $2*(1...n/2)-1+k*n$, where k is an incremental frame number and n is an integer.

43. The system of claim 12, wherein said first means for transmitting further comprises:

means for transmitting said mode indication in said at least one first frame including frames $(1...n/2)*2 + k*n$, where k is an incremental frame number and n is an integer.

44. The system of claim 43, wherein said second means for transmitting further comprises:

means for transmitting said mode request information in said at least one second frame including frames $2*(1...n/2)-1+k*n$, where k is an incremental frame number and n is an integer.

45. The method of claim 36, further comprising the steps of:

determining that a data source associated with said first link is inactive; and

halting transmission of mode requests on said second link during a period when said data source is inactive.

46. The method of claim 45, further comprising the step of:

transmitting mode indications on said second link both during said at least one first and second frame during said period of inactivity.

47. The method of claim 26, further comprising the step of:

using a codec mode which is *n* modes more robust than a codec mode used on said second link to process said information for transmission after said period of inactivity has ended.

48. The system of claim 26, further comprising:

means for receiving mode indications in every frame on said second link during said period of inactivity on said first link.

49. The system of claim 31, further comprising:

means for using a codec mode which is *n* modes more robust than a codec mode used on said second link to process said information for transmission after said period of inactivity has ended.

50. The method of claim 36, further comprising the steps of:

transmitting information on said second link, which information is processed in accordance with said received mode requests; and

during said at least one first frame, continuing to process said information to be transmitted on said second link based on a previously received mode request.

51. The method of claim 1, wherein said at least one first and second frames are time frames associated with a time division multiple access (TDMA) structure.

52. The system of claim 12, wherein said at least one first and second frames are time frames associated with a time division multiple access (TDMA) structure.

53. The method of claim 26, further comprising the step of:

using a codec mode which is the same as a codec mode used on said second link to process said information for transmission after said period of inactivity has ended.

54. The system of claim 31, further comprising:

means for using a codec mode which is the same as a codec mode used on said second link to process said information for transmission after said period of inactivity has ended.

55. The method of claim 1, wherein said at least one first and second frames are time frames associated with the time frame structure of the employed source and channel coding processing.

56. The system of claim 12, wherein said at least one first and second time frames are time frames associated with the time frame structure of the employed source and channel coding processing.

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FIG. 1

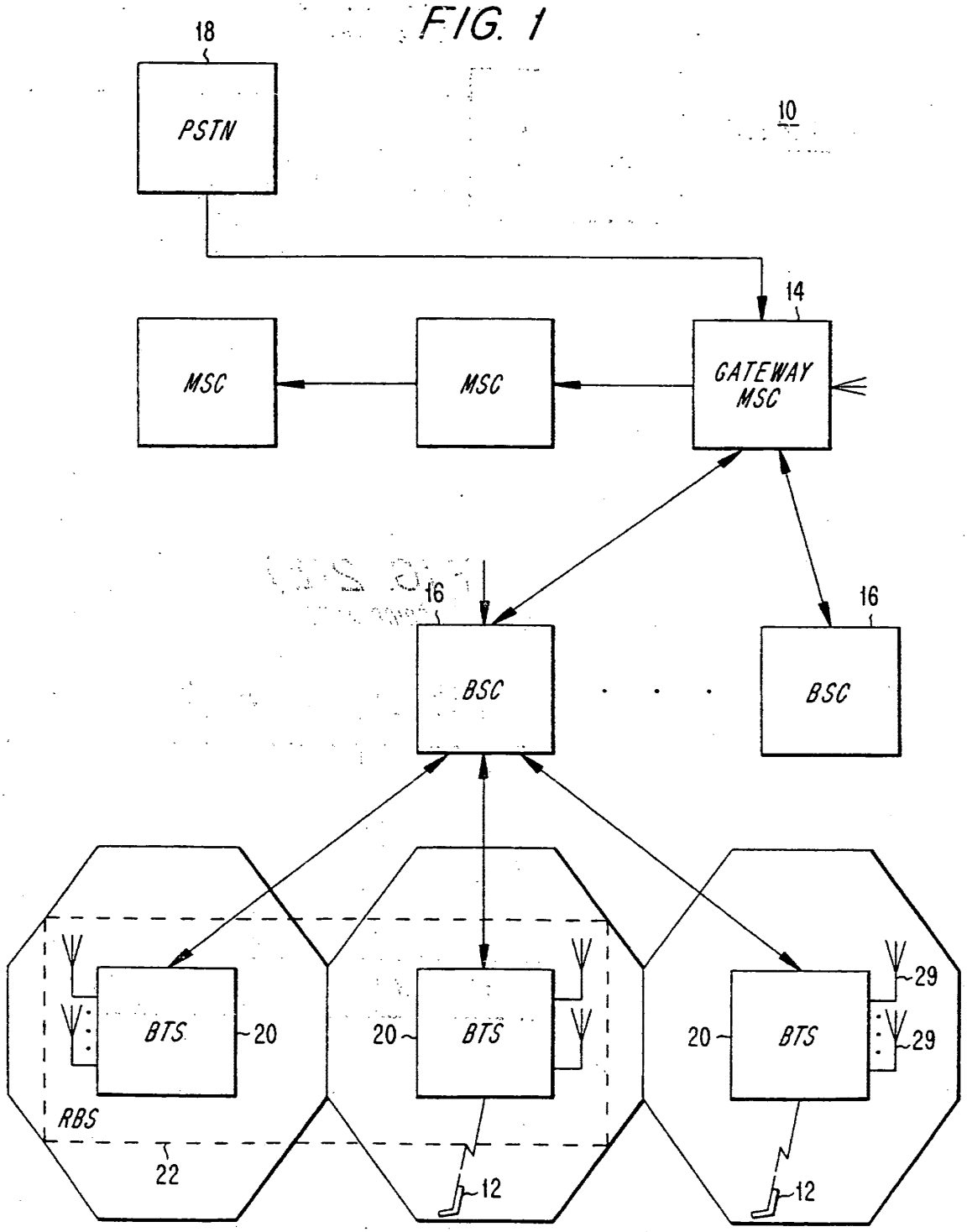

18
PSTN
10
14
MSC
MSC
GATEWAY MSC
16
16
BSC
BSC
BTS
20
20
BTS
20
BTS
29
29
RBS
22
12
12

FIG. 2(a)
(PRIOR ART)

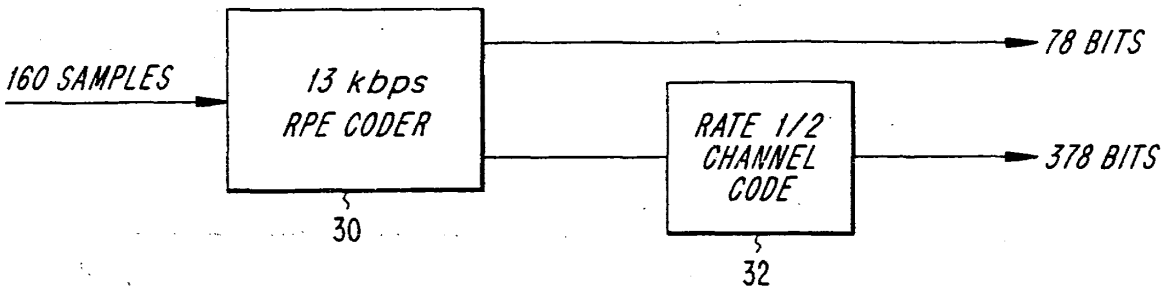
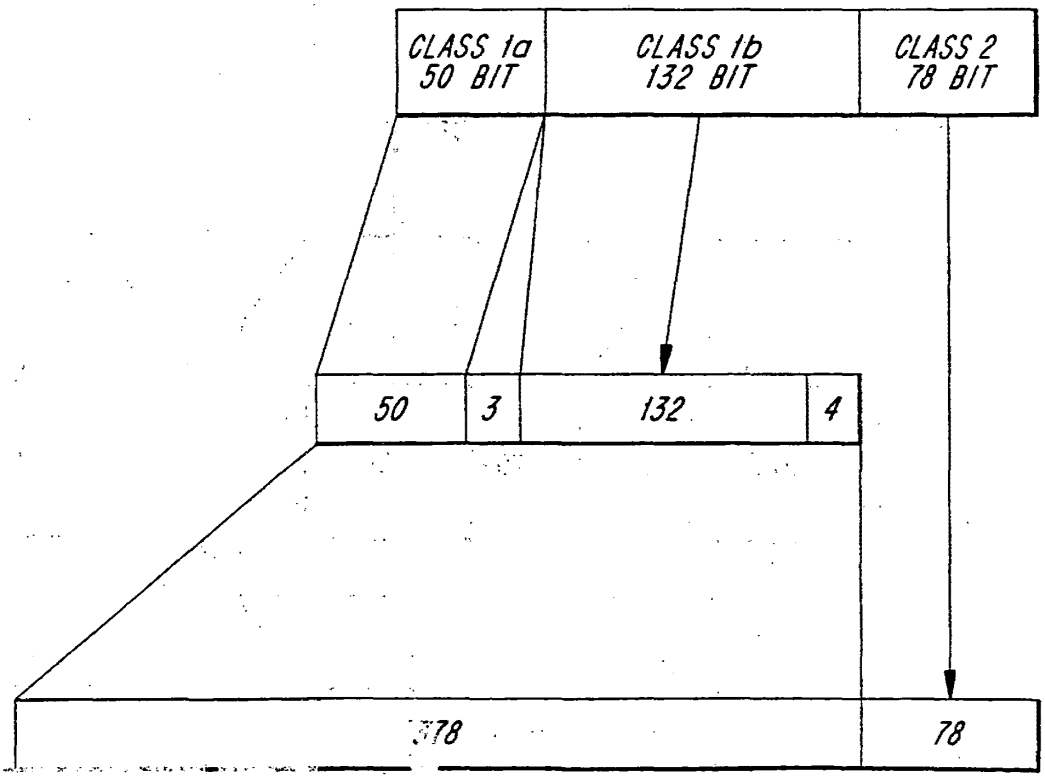


FIG. 2(b)
(PRIOR ART)



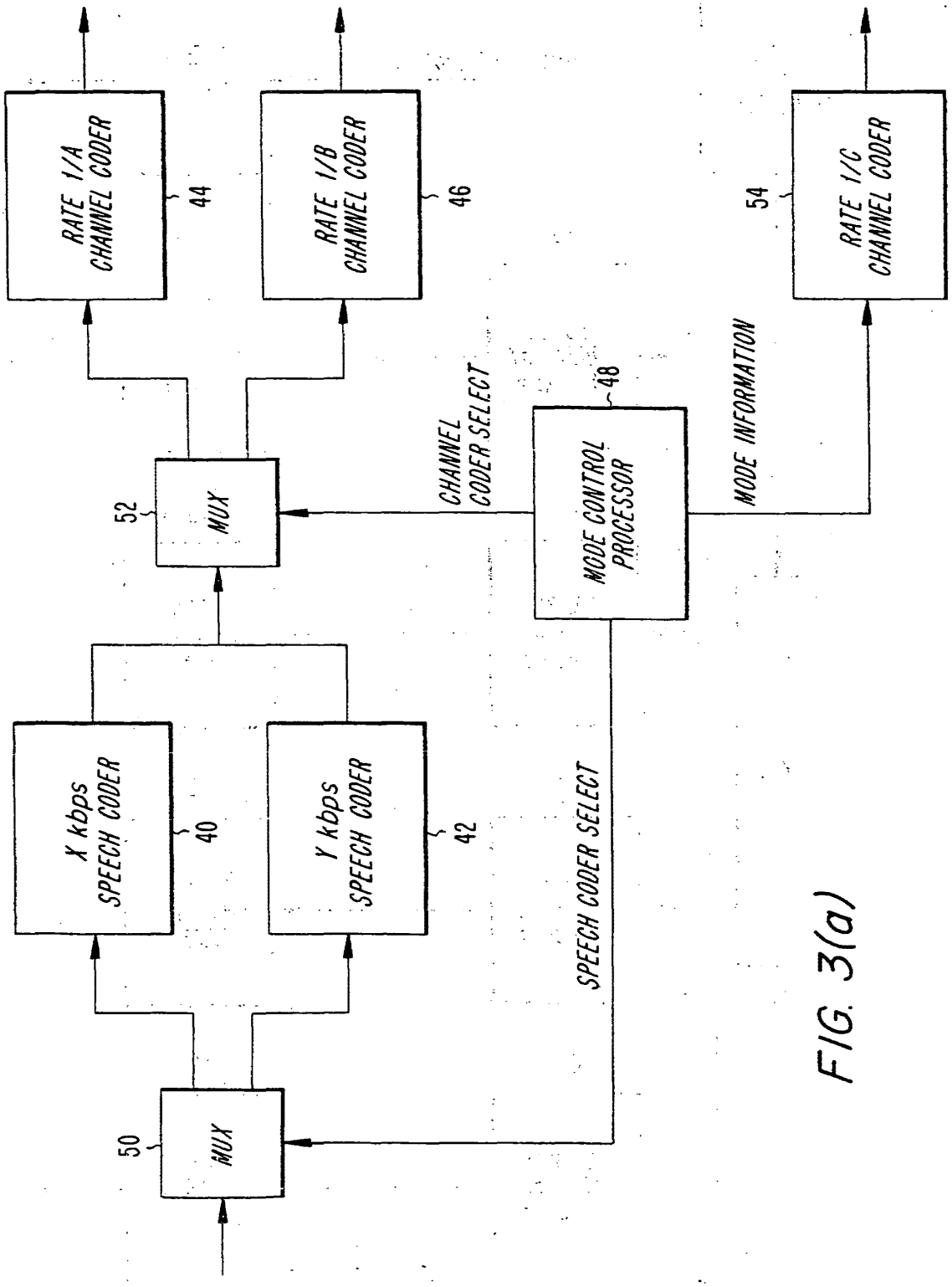
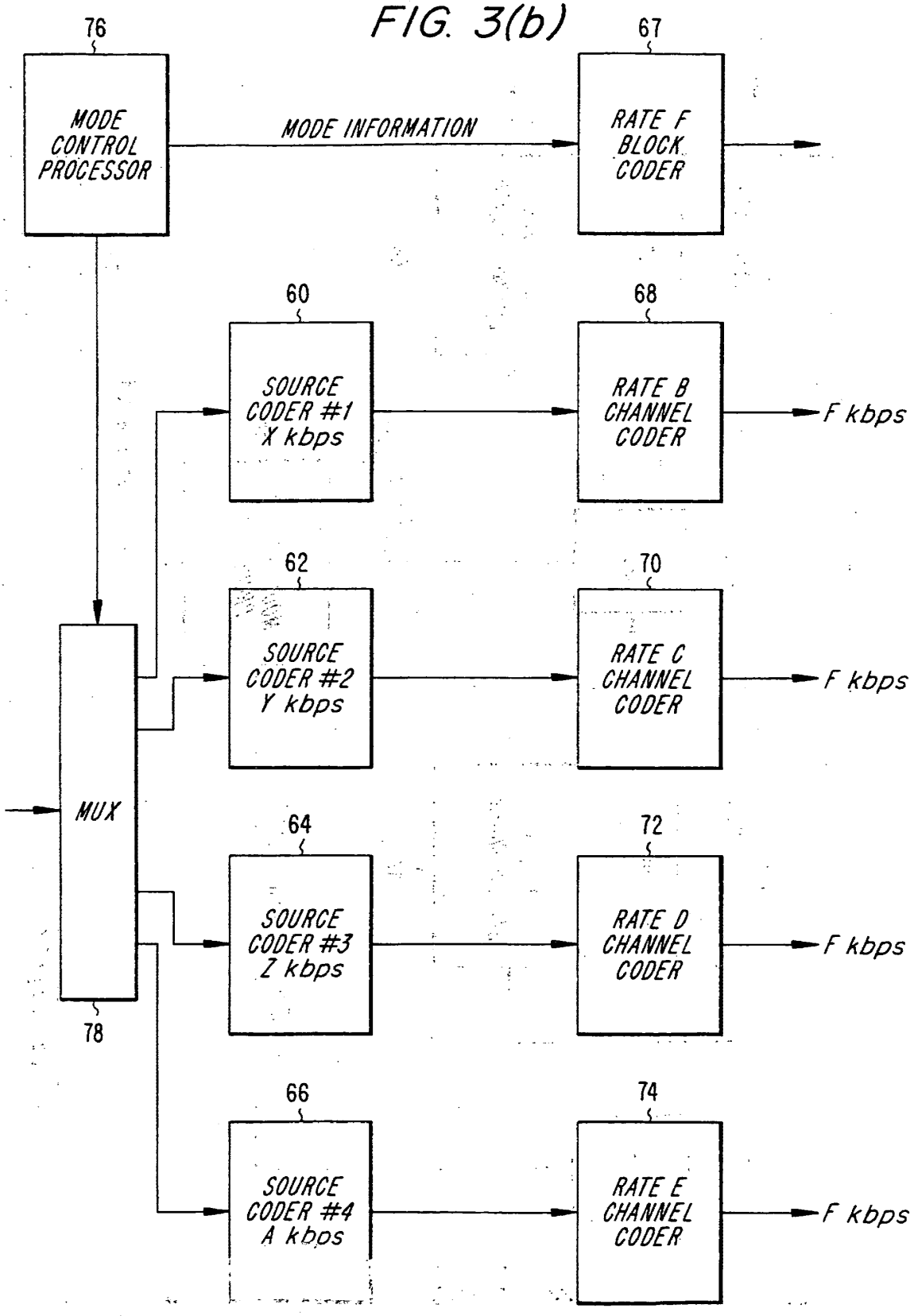

RATE 1/A CHANNEL CODER
44
RATE 1/B CHANNEL CODER
46
RATE 1/C CHANNEL CODER
54
MUX
52
CHANNEL CODER SELECT
MODE CONTROL PROCESSOR
48
MODE INFORMATION
X kbps SPEECH CODER
40
Y kbps SPEECH CODER
42
SPEECH CODER SELECT
MUX
50

FIG. 3(a)

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FIG. 3(b)


76
MODE CONTROL PROCESSOR
MODE INFORMATION
67
RATE F BLOCK CODER
60
SOURCE CODER #1 X kbps
68
RATE B CHANNEL CODER
F kbps
62
SOURCE CODER #2 Y kbps
70
RATE C CHANNEL CODER
F kbps
MUX
64
SOURCE CODER #3 Z kbps
72
RATE D CHANNEL CODER
F kbps
78
66
SOURCE CODER #4 A kbps
74
RATE E CHANNEL CODER
F kbps

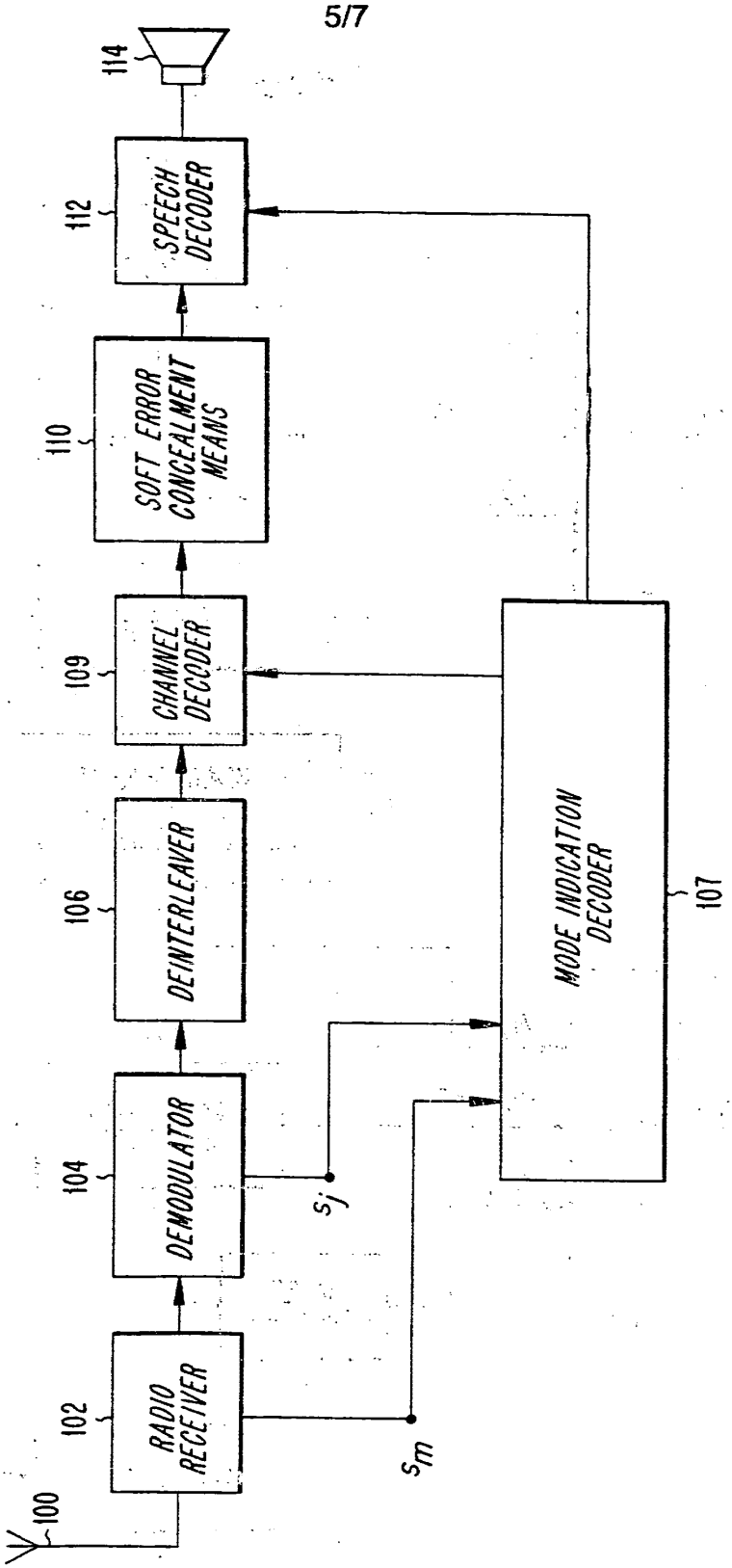

114
SPEECH DECODER
112
SOFT ERROR CONCEALMENT MEANS
110
CHANNEL DECODER
109
DEINTERLEAVER
106
DEMODULATOR
104
RADIO RECEIVER
102
100
MODE INDICATION DECODER
107
Sj
Sm

FIG. 4

FIG. 5

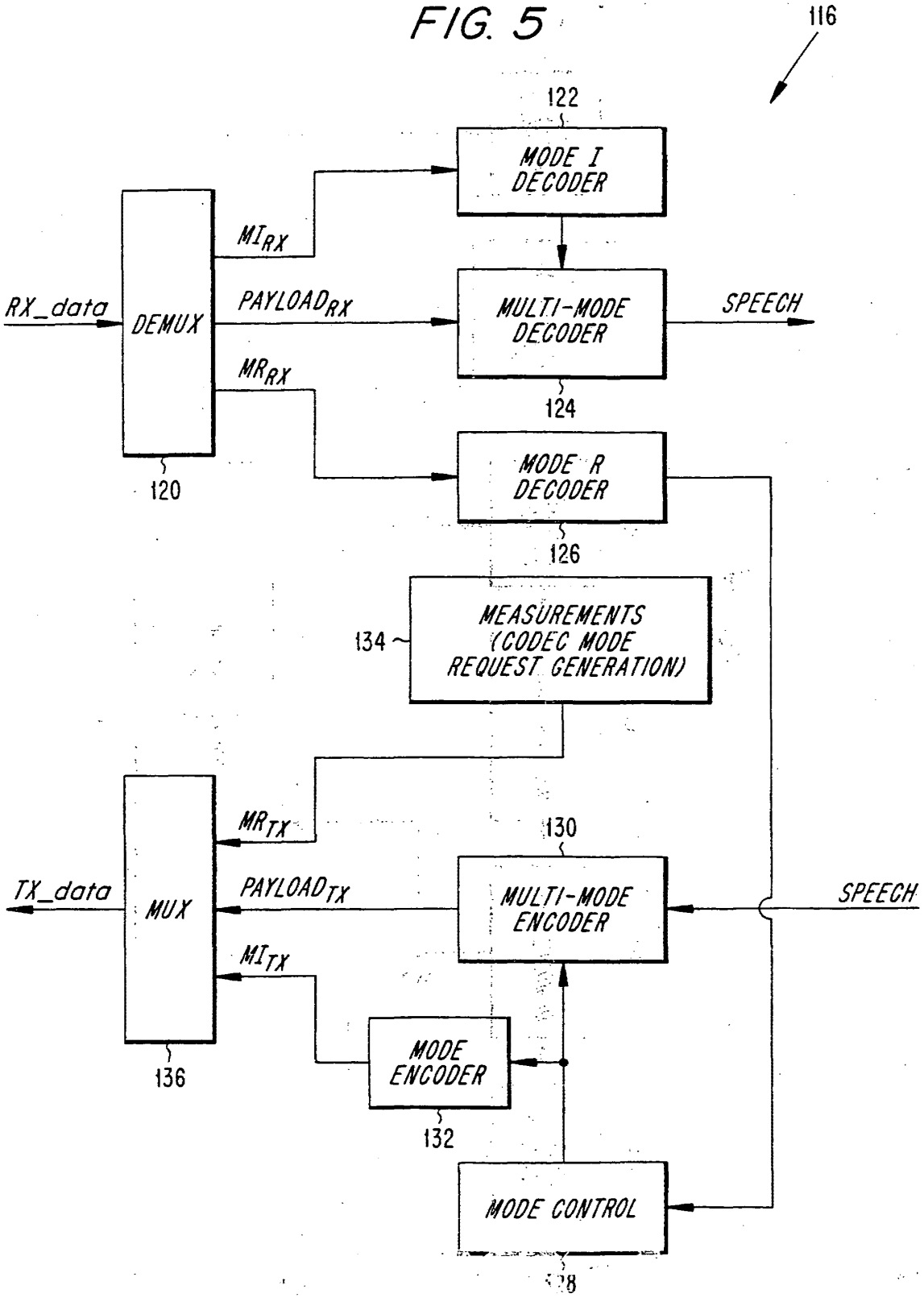
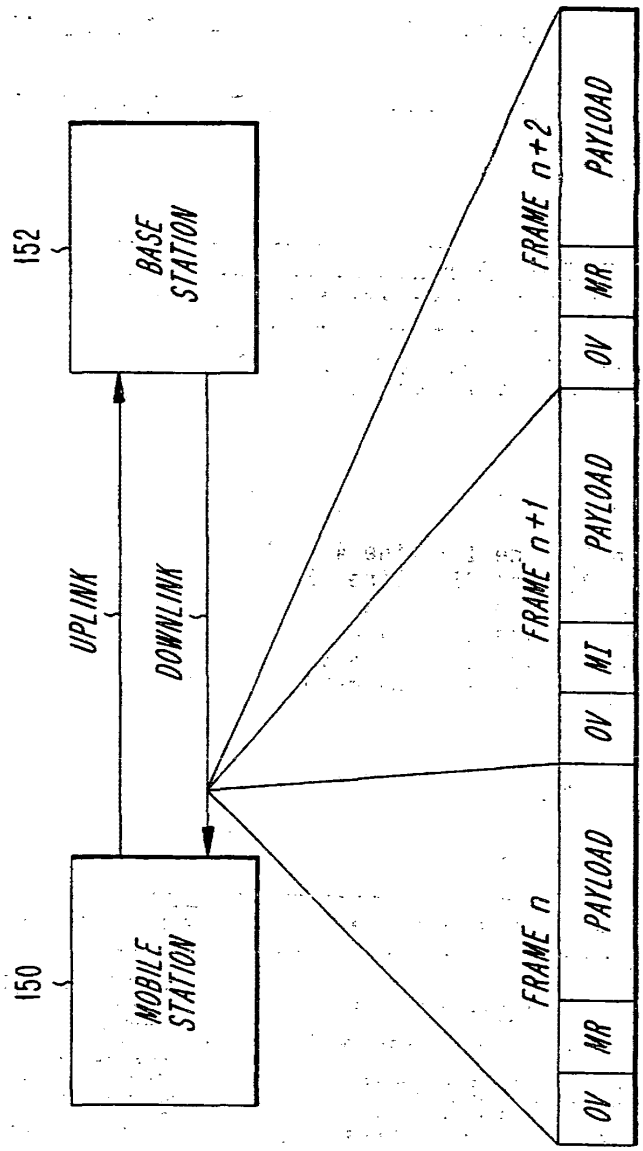

116
122
MODE I DECODER
MI_RX
RX_data
DEMUX
PAYLOAD_RX
MULTI-MODE DECODER
SPEECH
MR_RX
124
120
MODE R DECODER
126
134
MEASUREMENTS (CODEC MODE REQUEST GENERATION)
MR_TX
130
TX_data
MUX
PAYLOAD_TX
MULTI-MODE ENCODER
SPEECH
MI_TX
MODE ENCODER
136
132
MODE CONTROL
128

FIG. 6


BASE STATION
152
MOBILE STATION
150
UPLINK
DOWNLINK
FRAME n
FRAME n+1
FRAME n+2
PAYLOAD
MR
MI
OV

INTERNATIONAL SEARCH REPORT

Inter. nal Application No
PCT/SE 99/01538

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04L1/12 H04L1/00

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

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 863 682 A (OKI ELECTRIC IND CO LTD) 9 September 1998 (1998-09-09)	1,3,10, 12,14, 21, 23-25, 36,51,52
A	abstract column 2, line 1 - line 4 column 2, line 23 - line 43 column 4, line 2 - line 11 column 8, line 24 - line 32 column 8, line 50 - line 52 column 8, line 53 -column 9, line 45	2,4,11, 13,37-39

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
7 December 1999	14/12/1999

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INTERNATIONAL SEARCH REPORT

Interr ..al Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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A	abstract	2,4-11, 13, 15-22, 37-44
	column 1, line 1 -column 2, line 42 claim 1 figure 1	

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A	abstract page 2, line 50 -page 3, line 8 page 3, line 29 - line 30 page 3, line 50 - line 53 page 4, line 2 - line 7 table 2 page 9, line 51 - line 55 page 10, line 2 - line 5 page 11, line 5 - line 9 figures 1,10,11	24,25

A	WO 97 41549 A (ERICSSON TELEFON AB L M) 6 November 1997 (1997-11-06)	1-3, 12-14, 23-25, 36-40, 51,52
	abstract page 6, line 6 - line 12 page 9, line 5 - line 28 figures 9,16	

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	abstract page 5, line 26 -page 6, line 4 page 6, line 27 -page 7, line 10 page 23, line 29 -page 25, line 4 claims 15,20,21 figures 2,3,7,10	

A	EP 0 827 312 A (BOSCH GMBH ROBERT) 4 March 1998 (1998-03-04)	1,3-10, 12, 14-21, 23,36, 41-44
	abstract column 1, line 44 -column 2, line 15 column 3, line 37 - line 44 column 3, line 55 -column 4, line 24 figures 2,3	

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/SE 99/01538

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 790 713 A (LUCENT TECHNOLOGIES INC) 20 August 1997 (1997-08-20) abstract page 5, line 7 - line 12	1,3,12, 14, 23-25,36
A	US 5 007 047 A (PAYTON JOHN L ET AL) 9 April 1991 (1991-04-09) abstract column 2, line 48 -column 3, line 10 column 12, line 53 -column 13, line 2 column 17, line 9 - line 20 figure 2	1,12,23, 37

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(72) Inventors; and

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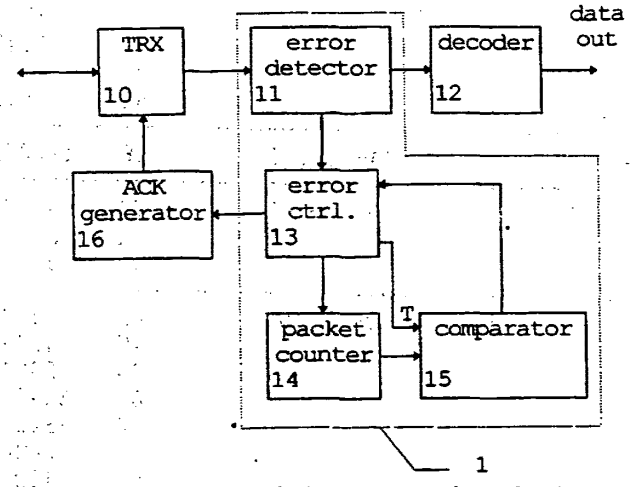
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(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent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

Published:
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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: ERROR CONTROL METHOD AND APPARATUS



(57) Abstract: The invention relates to an error control method and apparatus for performing a control so as to allow a transmission of data units via a transmission channel independence on the sequence number of a preceding data unit not yet acknowledged, wherein the transmission rate of acknowledgment messages is changed in response to an estimated transmission quality of the transmission channel. Thereby, the retransmission protocol is made faster in poor channel conditions, whereas the amount of resources used for the acknowledgment message is lowered for better channel conditions. The error control may be performed at the transmitter side, wherein the transmitter commands or polls the receiver to send an acknowledgment message. The channel quality may be determined by detecting a retransmission of negatively acknowledged data unit. Alternatively, the error control can be performed at the receiver side, wherein the receiver decides when an acknowledgment shall be sent and is able to count the data units lost or erased during the transmission to thereby estimate or detect the channel quality.

WO 01/22645 A1

Error control method and apparatus

FIELD OF THE INVENTION

The present invention relates to an error control method and apparatus for performing a control so as to allow a transmission of data packets via a transmission channel in dependence on the sequence number of a preceding data packet not yet acknowledged, i.e. an earlier data packet which has been transmitted but not yet acknowledged as a properly received data packet. The transmission channel may be provided in a cellular network such as a GSM (Global System for Mobile communications) or a GPRS (General Packet Radio Services) network.

BACKGROUND OF THE INVENTION

In a digital transmission system, transmission errors occur due to noise and distortion. There are two types of transmission errors: random errors and burst errors. Random errors may be caused by thermal noise. Burst errors are generated during a fade in the transmission channel. Transmission errors can be detected by adding a redundant signal (check bits) to the information signal.

Upon detecting a transmission error, there are two ways to control the error. One is called ARQ (Automatic Repeat Request) and uses a feedback control to request a retransmission of the corrupted data. The other called FEC (Feed-forward Error Correction) uses a feed-forward control to control the errors.

In packet data networks, different transmission protocols are used to convey data via a transmission

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channel from a source (transmitter) to a destination (receiver). Transmission protocols are typically arranged in such a manner that data to be transferred is segmented into a sequence of data packets, called Packet Data Units (PDUs) which are then individually transferred to the destination where they are finally reassembled by the transmission protocol.

Each PDU has a header and a data part. The former contains information essential for the transmission protocol, such as an element defining the destination and/or the sequence number by which the PDU can be identified, whereas the latter contains a piece of the actual data packet being transferred.

To achieve a reliable data transmission, the transmission protocol has to assure that all transmitted PDUs are received correctly by the receiver. For this purpose, the receiver sends acknowledgments to the transmitter which in turn retransmits the unacknowledged or negatively acknowledged PDUs according to a specified ARQ scheme. A widely used ARQ scheme is the so-called Go-Back-N method where the receiver acknowledges all the PDUs up to a certain sequence number N. In particular, the receiver sends the sequence number N up to which it has received all PDUs properly ad in order. After receiving such an acknowledgment, the transmitter continues the transmission starting from the specified sequence number N. During the so-called round-trip delay, the receiver may have already transmitted PDUs with sequence numbers larger than N. Nevertheless, the transmitter continues transmission by (re)transmitting the PDUs with sequence numbers N, N+1, N+2,..., when receiving such an acknowledgement.

In the so-called Selective Retransmission ARQ scheme, the receiver sends acknowledgments where the successfully received PDUs are specified based on their sequence numbers. When receiving such an acknowledgment, the transmitter has to retransmit only the lost or erased PDUs, whereby transmission resources are saved. Thus, this scheme has the highest efficiency. The Selective Retransmission ARQ scheme is commonly used together with the so-called Sliding Window method. According to this method the transmitter is allowed to transmit or retransmit only those PDUs having sequence numbers within a specified transmit window. The transmit window starts at the first PDU which has not been acknowledged and spreads over K PDUs, wherein K denotes the size of the window. The receiver has a corresponding receive window and accepts only those PDUs having sequence numbers within the receive window. The receive window starts at the first PDU which has not been received and spreads over K PDUs. It can be shown that with a window size of K the transmitted PDUs can be uniquely identified for sequence numbers ranging from 0 to (2K - 1).

In the acknowledgment messages, the successfully received PDUs are specified. When the first unacknowledged PDU in the beginning of the transmit window is acknowledged the transmitter can move its transmit window forward until the next unacknowledged PDU is found. Thereby, the transmission is slid over new PDUs which can then be transmitted.

However, in case a transmitter using the Selective Retransmission ARQ scheme with the Sliding Window method is able to transmit a considerable amount of PDUs within the transmit window during a round-trip delay of the transmission channel, i.e. a delay between the transmission

of a PDU and the receipt of the corresponding acknowledgment message, the transmit window may be stalled during the transmission resulting in a reduced throughput. In such a case, all PDUs within the transmit window have been transmitted at least once and the transmitter has to wait until the transmit window can be slid further. The probability of a stalled transmit window rises with the rate of erased PDUs within all transmitted PDUs (Packet Erasure Rate, PER).

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an error control method and apparatus by means of which the transmission throughput can be increased in the Sliding Window method.

This object is achieved by an error control method for a transmission channel, wherein a transmission of data units via the transmission channel is controlled in dependence on the sequence number of a preceding data unit not yet acknowledged, the error control method comprising the steps of:

defining a transmit window based on the sequence number of the preceding data unit not yet acknowledged;

allowing the transmission of a data unit only if the sequence number of the data unit lies within the transmit window;

estimating a transmission quality of the transmission channel; and

changing the transmission rate of acknowledgment messages in response to the estimated transmission quality of the transmission channel.

Additionally, the above object is achieved by an error control apparatus for performing a control so as to allow a transmission of data units via a transmission channel in dependence on the sequence number of a preceding data unit not yet acknowledged, the error control apparatus comprising:

detecting means for detecting a transmission quality of the transmission channel; and

control means for changing the transmission rate of acknowledgment messages in response to the transmission quality detected by the detecting means.

Accordingly, the retransmission protocol is made faster in poor channel conditions, whereas the amount of resources used for acknowledgment messages is lower for better channel conditions. Thereby, the retransmission delay and the amount of resources required for the acknowledgment messages are adapted to the channel conditions, to thereby optimize the ARQ scheme. The acknowledgment strategy for the Selective Retransmission ARQ scheme with the Sliding Window method can thus be adapted to different and possibly changing PER values and provides a good throughput without an excessive amount of transmitted acknowledgment messages. Acknowledgment messages are generated more frequently, when the PER is high, whereas the acknowledgment rate is reduced in cases of lower PER values. Thereby, transmission resources and processing power can be saved without reducing the throughput of the primary transmission.

The transmission rate of the acknowledgment messages may be changed in response to a data unit erasure or loss detected at the receiving end of the transmission channel. In this case, the number of data units which have been successfully received may be counted, the count value may

be increased by the predetermined value when a packet erasure or loss has been detected, and an acknowledgment message may be transmitted when the counter value exceeds a predetermined threshold value. Alternatively, instead of increasing the count value by the predetermined value, the predetermined threshold value may be decreased when a data unit erasure or loss has been detected.

Thus, the receiver decides on the transmission timing of acknowledgments and is able to count the data units lost or erased during the transmission.

Alternatively, the transmission rate of the acknowledgment messages may be changed in dependence on a retransmission of a negatively acknowledged data unit. In this case, the number of unacknowledged data units transmitted via the transmission channel may be counted, the counter value may be increased be a predetermined value when a negatively acknowledged data unit has been retransmitted, and a transmission of an acknowledgment message may be polled, when the counter value exceeds a predetermined threshold value. Alternatively, instead of increasing the count value by the predetermined value, the predetermined threshold value may be decreased when a negatively acknowledged data unit has been retransmitted.

Thus, the transmitter commands or polls the receiver to send an acknowledgment message. This can be done for instance by setting a predefined polling bit provided or defined in the header of a transmitted data unit.

In the transmitter side error control as well as the receiver side error control, a simple algorithm easy to implement is thus provided.

Preferably, the predetermined value and/or the predetermined threshold value are adjusted based on a transmission rate of data units, a size of the transmit window and/or a round-trip delay of the transmission channel. Thereby, the error control can be optimized with respect to the characteristics of the transmission channel.

The detecting means may be arranged to detect a data unit erasure or loss at a receiving end of the transmission channel, or may be arranged to detect a negative acknowledgment message received at a transmission end of the transmission channel.

In case of the receiver side control, counting means for counting the number of data units which have been received successfully, and comparing means for comparing the count value obtained from the counting means with the predetermined threshold value may be provided, wherein the control means may be arranged to increase the count value of the counting means by a predetermined value or to decrease the predetermined threshold value, when a data unit erasure or loss has been detected by the detecting means, and to initiate a transmission of an acknowledgment message when the comparing result of the comparing means indicates that the count value has exceeded the predetermined threshold value.

In the transmitter side control, counting means for counting the number of unacknowledged data units transmitted via the transmission channel and comparing means for comparing the count value of the counting means with a predetermined threshold value may be provided, wherein the control means may be arranged to increase the

count value by a predetermined value, or to decrease the predetermined threshold value, when a negatively acknowledged data unit is retransmitted, and to poll for a transmission of an acknowledgment message when the comparing result of the comparing means indicates that the count value has exceeded the predetermined threshold value.

Preferably, the control means is arranged to adjust the predetermined value and/or the predetermined threshold value based on a transmission rate of the data units, a size of the transmit window and/or a round-trip delay of the transmission channel.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following, the invention will be described in greater detail on the basis of a preferred embodiment with reference to the accompanying drawings, wherein

Fig. 1 shows a basic block diagram of an error control apparatus according to the preferred embodiment arranged at the receiving side of the transmission channel,

Fig. 2 shows a flow diagram of the receiver side error control according to the preferred embodiment of the present invention,

Fig. 3 shows a basic block diagram of an error control apparatus according to the preferred embodiment arranged at the transmitting side of the transmission channel; and

Fig. 4 shows a flow diagram of a transmitter side error control according to the preferred embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The preferred embodiment of the present invention will now be described on the basis of an RLC (Radio Link Control) connection provided in a GPRS network.

An RLC connection is comprised of two peer entities. Each RLC endpoint has a receiver which receives RLC data blocks. Each RLC endpoint also has a transmitter which transmits RLC data blocks. Each endpoint's receiver has a receive window. In an RLC acknowledged mode, the receive window is defined in such a manner that the difference between the sequence number of the oldest data packet, i.e. RLC data block, not received and the sequence number of the next data block expected to be received is less or equal than a predefined window size. All received data blocks which meet this criteria are valid within the receive window.

Furthermore, each endpoint's transmitter has a transmit window. In the RLC acknowledged mode, the transmit window is defined such that the difference between the sequence number of the oldest data block not positively acknowledged and the sequence number of the next data block to be transmitted is less or equal to the predefined window size. All data blocks which meet this criteria are valid within the transmit window.

In the present GPRS network, one connection endpoint may be a mobile station and the other endpoint may be a network element such as a PCU (Packet Control Unit).

Each RLC endpoint transmitter has an associated acknowledge state array indicating the acknowledgment status of the previous RLC data blocks within the transmit window. The array is indexed relative to the oldest data block not positively acknowledged (unacknowledged data block) or relative to the starting sequence number. The sequence number of the next data block to be transmitted is updated based on the content of a received packet acknowledgment message. If a received packet acknowledgement message has indicated that some of the data blocks have to be retransmitted, then the RLC endpoint transmitter retransmits negatively acknowledged data blocks at first, starting from the oldest one, and then returns to the original transmission order. If the transmit window is stalled, then the RLC endpoint transmitter may retransmit the unacknowledged data blocks starting from the oldest one until the window can be slid further.

In the uplink direction, a packet uplink acknowledgment message is sent by the GPRS network to the mobile station in order to indicate the status of the received RLC data blocks. This message may also update the timing advance and power control parameters. In the downlink direction, a packet downlink acknowledgment message is sent from the mobile station to the network to indicate the status of downlink RLC data blocks received and to report the channel quality of the downlink channel.

Each RLC endpoint receiver has an associated sequence number of the oldest data block not received. This sequence number may be set to the value 0 at the beginning of each transmission in which the RLC endpoint is the receiver. The sequence number of the oldest data block not received is set to the sequence number of the next data block expected

to be received, if all RLC data blocks within the receive window have been received properly.

Each RLC endpoint receiver has an associated receive state array indicating the receive status of previous RLC data blocks within the receive window. The array is indexed relative to the sequence number of the next data block expected to be received. When an RLC data block having a sequence number within the receive window is received, the corresponding element of the receive state array is set to the value RECEIVED. When an element falls outside the active receive window, the corresponding element is set to the value INVALID. Thereby, the receive window is moved forward during the transmission.

According to the preferred embodiment, a strategy for generating acknowledgment messages is implemented, wherein the rate of transmitting acknowledgment messages is changed on the basis of the transmission quality of the transmission channel, e.g. the RLC connection. In particular, acknowledgment messages are generated more frequently when the PER is high, and the acknowledgment rate is reduced when the PER is low.

In the following two alternative examples for implementing the above strategy are described.

According to the first example, a receiver side error control is performed, wherein the RLC endpoint receiver decides when an acknowledgment shall be send and is able to count the data blocks lost or erased during the transmission. This means that the receiver has to have knowledge of the data blocks to be received or has to be able to detect the data blocks which have been transmitted

to it, even if the data blocks may have been corrupted during the transmission.

Fig. 1 shows a block diagram of a receiver at an endpoint of an RLC connection. It is to be noted that only those blocks of the receiver which are essential to the present invention are shown in Fig. 1.

According to Fig. 1, the receiver comprises a transceiver (TRX) 10 for receiving data blocks transmitted via the RLC connection and for transmitting acknowledgment messages generated by an acknowledgment message generator 16. The received data blocks are supplied to an error detector 11 arranged for detecting a lost or erased data block. This may be achieved on the basis of the sequence numbers of received data blocks, the reception timing of received data blocks, the receive state array, or the like. The received data blocks are then supplied to a decoder 12 for decoding the data blocks according to a (higher level) protocol used for supplying the data to a data sink.

Furthermore, the receiver comprises a packet counter 14 which is initialized at the beginning of a transmission. An error control unit 13 controls the packet counter 14 so as to be incremented by one whenever an information indicating a successful receipt of a data block has been supplied from the error detector 11 to the error control unit 13. The control of the packet counter 14 may be performed by supplying count pulses or the like thereto. Whenever a lost or erased data block is detected by the error detector 11, a corresponding information is applied to the error control unit 13 which subsequently controls the packet counter 14 so as to be increased by (1 + W), where W denotes a weighting parameter larger than 0.

Furthermore, a comparator 15 is provided to which the count value of the packet counter 14 is supplied and which compares the count value with a predetermined threshold value T supplied from the error control unit 13. The comparison result is supplied to the error control unit 13.

According to the above arrangement, an error processing unit 1 consisting of the blocks 11, 13, 14 and 15 is provided, which detects lost or erased data blocks and which controls the acknowledgment message generator 16 so as to generate an acknowledgment message when the count value of the packet counter 14 exceeds the predetermined threshold value T. To achieve this, the error control unit 13 is connected to the acknowledgment message generator 16 in order to supply a control signal for initiating the generation of an acknowledgment message.

The parameters W and T may be adjusted separately for various systems based on their transmission rates, window sizes and round-trip delays. This may be performed by the error control unit 13 based on a corresponding external information or an initial programming of the error control unit 13.

In the following, the error control operation according to the first example of the preferred embodiment will be described on the basis of a flow diagram shown in Fig. 2.

At the beginning of a transmission, the packet counter 14 is initialized (S100), then the transmission is started in step S101. Thereafter, the error control unit 13 determines in step S102, whether the error detector 11 has indicated the successful receipt of a data block. If so,

the error control unit 13 supplies a control signal to the packet counter 14 so as to increment the count value (S103). If the error detector 11 has detected a lost or erased data block, i.e. the control unit 13 determines in step S102 that the data block has not been received successfully, it controls the packet counter 14 by a corresponding control signal so as to increase the count value by the value 1 + W.

Thereafter, the error control unit 13 checks in step S105 whether the comparator 15 indicates that the threshold value T has been exceeded, or not. If so, the control unit 13 initiates the transmission of an acknowledgment message by the acknowledgment message generator 16 (S106) and resets the counter 14 (S107). If not the control flow proceeds to step S108, where it is checked whether the transmission end has been reached or not. If the transmission is not yet finished, the control flow returns to step S102 in order to check for the successful receipt of a new data block. Otherwise, the control procedure is terminated.

According to a second example of the preferred embodiment, the error control may be performed at the transmitting end of the RLC connection, wherein the transmitter polls the receiver to send an acknowledgment message.

Fig. 3 shows a basic block diagram of a transmitter at an endpoint of an RLC connection. It is to be noted that only those blocks of the transmitter, which are essential to the present invention are shown in Fig. 3.

According to Fig. 3, the transmitter comprises a transceiver (TRX) 20 arranged to transmit data blocks supplied from an encoder 22 to the RLC connection, and to receive acknowledgment messages from a receiver arranged at the other end of the RLC connection. The encoder 22 is arranged to generate RLC data packets from supplied input data, e.g. PDUs of a higher transmission protocol. The received acknowledgment messages are supplied to an error detector 21 arranged for detecting negatively acknowledged data packets to be retransmitted. The detection may be performed on the basis of the status information included in the received acknowledgment message, the acknowledge state array, or the like. The error detector 21 supplies a corresponding detection information to an error control unit 23 arranged for controlling a packet counter 24 by supplying a corresponding control information, e.g. control pulses, based on the detection result. Furthermore, the error control unit 23 is connected to the encoder 22 in order to receive an information indicating the transmission of a new, i.e. unacknowledged, data packet.

In particular, the error control unit 23 performs an error control in such a manner that the packet counter 24 is incremented by one whenever an unacknowledged new data packet is transmitted by the TRX 20. However, whenever the error detector 21 detects a negative acknowledgment message, and the negatively acknowledged data block is retransmitted, the error control unit 23 controls the packet counter 24 so as to increase the count value by (1 + W). Additionally, a comparator 25 is provided to which the count value of the packet counter 24 is supplied and which compares the count value with a predetermined threshold value T supplied from the error control unit 23. The comparison result is supplied to the error control unit 23

which controls the encoder 22 so as to poll an acknowledgment message from the receiver at the other connection end, when the count value of the packet counter 24 exceeds the given threshold value T. Furthermore, the error control unit 23 is arranged to reset the packet counter 24 after each polling operation. The polling may be performed by controlling the encoder 22 so as to set a predetermined polling bit defined in the header of a transmitted data block.

Thus, an error processing unit 1 comprising the blocks 21, 23, 24 and 25 is provided, which changes the transmission rate of acknowledgment messages from the receiver at the other connection end by commanding or polling the receiver based on the received acknowledgment messages.

As an alternative, the error detection function may be privided in a kind of scheduler which supplies the data blocks to the encoder 22 according to the above described selective transmission scheme. In this case, the scheduler knows whether the actual transmission is a retransmission of a negatively acknowledged data block or a transmission of a new unacknowledged data block. This information may be fed to the error control unit 23 whenever a data block is transmitted.

In the following, the error control operation according to the second example is described on the basis of a flow diagram shown in Fig. 4.

According to Fig. 4, the packet counter is initialized in step S200 at the beginning of a transmission. Then, the transmission is started in step S201.

In step S202, the error control unit 23 checks whether a negatively acknowledged data packet is retransmitted, based on the information supplied from the error detector 21 and the encoder 22. If not, i.e. in case an unacknowledged data packet is transmitted, the packet counter 24 is incremented by one in step S203. Otherwise, in case of a retransmission of a negatively acknowledged data packet, the error control unit 23 controls the packet counter 24 so as to increase the count value by (1 + W).

Then, in step S205, the error control unit 23 checks whether the predetermined threshold T has been exceeded by the count value. If so, the error control unit 23 controls the encoder 22 so as to poll the receiver to send an acknowledgment message (S206). Then, the error control unit 23 controls the packet counter 24 so as to reset its count value (S207).

If the threshold value T is not exceeded in step S205, the flow advances to step S208 where the transmission end is checked. If the transmission has not yet terminated, the flow returns to step S202 where the retransmission of a negatively acknowledged packet is checked again. Otherwise, the control procedure is terminated.

Also in the second example, the parameters W and T may be adjusted separately or in combination by the error control unit 23 for various systems, based on their transmission rates, window sizes and/or round-trip delays. A corresponding system information may be externally supplied to or programmed into the error control unit 23.

As an alternative to the above described error control performed in the first and the second example, the control units 13 and 23 may be arranged to decrease the predetermined threshold value T by a predetermined amount, whenever a lost or erased data packet is detected, or, respectively, whenever a negatively acknowledged data packet is retransmitted. In this case, the packet counters 14 or 24 not necessarily have to be increased by (1 + W).

Accordingly, the number of frames transmitted between successive acknowledgment messages is made dependent on the channel quality. When the channel quality is poor, the acknowledgment messages are transmitted more frequently, whereas the transmission rate of the acknowledgment messages is decreased when the channel quality is higher.

It is to be noted that the error control functions performed by the respective blocks of the error processing unit 1 depicted in Figs. 1 and 3 may as well be implemented by corresponding software routines stored in a program memory and executed by respective mikroprocessors (CPUs) arranged in the transmitter and receiver.

In summary, the invention relates to an error control method and apparatus for performing a control so as to allow a transmission of data units via a transmission channel independence on the sequence number of a preceding data unit not yet acknowledged, wherein the transmission rate of acknowledgment messages is changed in response to an estimated transmission quality of the transmission channel. Thereby, the retransmission protocol is made faster in poor channel conditions, whereas the amount of resources used for the acknowledgment message is lowered for better channel conditions. The error control may be

performed at the transmitter side, wherein the transmitter commands or polls the receiver to send an acknowledgment message. The channel quality may be determined by detecting a retransmission of negatively acknowledged data unit. Alternatively, the error control can be performed at the receiver side, wherein the receiver decides when an acknowledgment shall be sent and is able to count the data units lost or erased during the transmission to thereby estimate or detect the channel quality.

It should be understood that the above description and the accompanying figures are only intended to illustrate the present invention. Thus, the error control method and apparatus according to the present invention may also be used in other cellular or non-cellular data networks. Furthermore, the estimation of the channel or transmission quality may be performed on the basis of other parameters, such as an SIR (Signal Interference Rate), an E_b/N_0 rate, or a corresponding information derived from the received data units. Moreover, the data unit may be any data packet, frame, cell, octett or part of data packet (e.g. TCP data unit) which can be acknowledged. The present invention may thus vary within the scope of the attached claims.

Claims

1. An error control method for a transmission channel, wherein a transmission of data units via said transmission channel is controlled in dependence on the sequence number of a preceding data unit not yet acknowledged, said error control method comprising the steps of:

a) defining a transmit window based on said sequence number of said unacknowledged preceding data unit,

b) allowing the transmission of a data unit only if the sequence number of said data unit lies within said transmit window;

c) estimating a transmission quality of said transmission channel; and

d) changing the transmission rate of acknowledgment messages in response to said estimated transmission quality of said transmission channel.

2. A method according to claim 1, wherein said transmission rate of said acknowledgment messages is changed in response to a data unit erasure or loss detected at the receiving end of said transmission channel.

3. A method according to claim 2, further comprising the steps of counting the number of data units which have been successfully received; increasing the count value by a predetermined value when a data unit erasure or loss has been detected; and transmitting an acknowledgment message when said count value exceeds a predetermined threshold value.

4. A method according to claim 2, further comprising the steps of counting the number of data units which have been successfully received; transmitting said acknowledgment

message when the count value exceeds a predetermined threshold value; and decreasing said predetermined threshold value when a data unit erasure or loss has been detected.

5. A method according to claim 1, wherein said transmission rate of said acknowledgment messages is changed in dependence on a retransmission of a negatively acknowledged data unit.

6. A method according to claim 5, further comprising the steps of counting the number of unacknowledged data units transmitted via said transmission channel; increasing the count value by a predetermined value when a negatively acknowledged data unit has been retransmitted; and polling for a transmission of an acknowledgment message when said count value exceeds a predetermined threshold value.

7. A method according to claim 5, further comprising the steps of counting the number of unacknowledged data units transmitted via said transmission channel; polling for a transmission of an acknowledgment message when the count value exceeds a predetermined threshold value; and decreasing said predetermined threshold value when a negatively acknowledged data unit has been retransmitted.

8. A method according to claim 3 or 6, wherein said predetermined value is adjusted on the basis of a transmission rate of said data units, a size of said transmit window and/or a round-trip delay of said transmission channel.

9. A method according to any one of claims 3 to 8, wherein said predetermined threshold value is adjusted on

the basis of a transmission rate of said data units, a size of said transmit window and/or a round-trip delay of said transmission channel.

10. A method according to any one of the preceding claims, wherein said transmission channel is an RLC connection for transmitting RLC data blocks in an uplink or downlink direction of a GPRS network.

11. An error control apparatus for performing a control so as to allow a transmission of data units via a transmission channel in dependence on the sequence number of a preceding data unit not yet acknowledged, said error control apparatus comprising:

a) detecting means **(11; 21)** for detecting a transmission quality of said transmission channel; and

b) control means **(13; 23)** for changing the transmission rate of acknowledgment messages in response to the transmission quality detected by said detecting means.

12. An apparatus according to claim 11, wherein said detecting means **(11)** is arranged to detect a data unit erasure or loss at a receiving end of said transmission channel.

13. An apparatus according to claim 11, further comprising counting means **(14)** for counting the number of data units which have been received successfully, and comparing means **(15)** for comparing the count value obtained from said counting means **(14)** with a predetermined threshold value, wherein said control means **(13)** is arranged to increase the count value of said counting means **(14)** by a predetermined value when a data unit erasure or loss has been detected by

said detecting means **(11)** and to initiate a transmission of an acknowledgment message when the comparing result of said comparing means **(15)** indicates that the count value has exceeded said predetermined threshold value.

14. An apparatus according to claim 12, further comprising counting means **(14)** for counting the number of data units which have been received successfully, and comparing means **(15)** for comparing the count value obtained from said counting means **(14)** with a predetermined threshold value, wherein said control means **(13)** is arranged to decrease said predetermined threshold value when a data unit erasure or loss has been detected by said detecting means **(11)** and to initiate a transmission of an acknowledgment message when the comparing result of said comparing means **(15)** indicates that the count value has exceeded said predetermined threshold value.

15. An apparatus according to claim 11, wherein said detecting means **(21)** is arranged to detect a negative acknowledgment message received at a transmission end of said transmission channel.

16. An apparatus according to claim 15, further comprising counting means **(24)** for counting the number of unacknowleged data units transmitted via said transmission channel; and comparing means **(25)** for comparing the count value of said counting means **(24)** with a predetermined threshold value, wherein said control means **(23)** is arranged to increase the count value by a predetermined value when a negatively acknowledged data unit is retransmitted, and to poll for a transmission of an acknowledgment message when the comparing result of said

comparing means **(25)** indicates that the count value has exceeded said predetermined threshold value.

17. An apparatus according to claim 15, further comprising counting means **(24)** for counting the number of unacknowledged data units transmitted via said transmission channel; and comparing means **(25)** for comparing the count value of said counting means **(24)** with a predetermined threshold value, wherein said control means **(23)** is arranged to decrease said predetermined threshold value when a negative acknowledgment message has been detected by said detecting means **(21)**, and to poll for a transmission of an acknowledgment message when the comparing result of said comparing means **(25)** indicates that the count value has exceeded said predetermined threshold value.

18. A apparatus according to claim 13 or 16, wherein said control means **(13; 23)** is arranged to adjust said predetermined value based on a transmission rate of said data units, a size of said transmit window and/or a round-trip delay of said transmission channel.

19. An apparatus according to any one of claims 13 to 18, wherein said control means **(13; 23)** is arranged to adjust said predetermined threshold value based on a transmission rate of said data units, a size of said transmit window and/or a round trip delay of said transmission channel.

20. An apparatus according to claim 16 or 27, wherein said control means **(23)** is arranged to perform a control such that a polling bit is set in the header of a data unit to be transmitted.

21. An apparatus according to any one of claims 11 to 20, wherein said error control apparatus is arranged in a mobile station and/or a network element of a GPRS network.

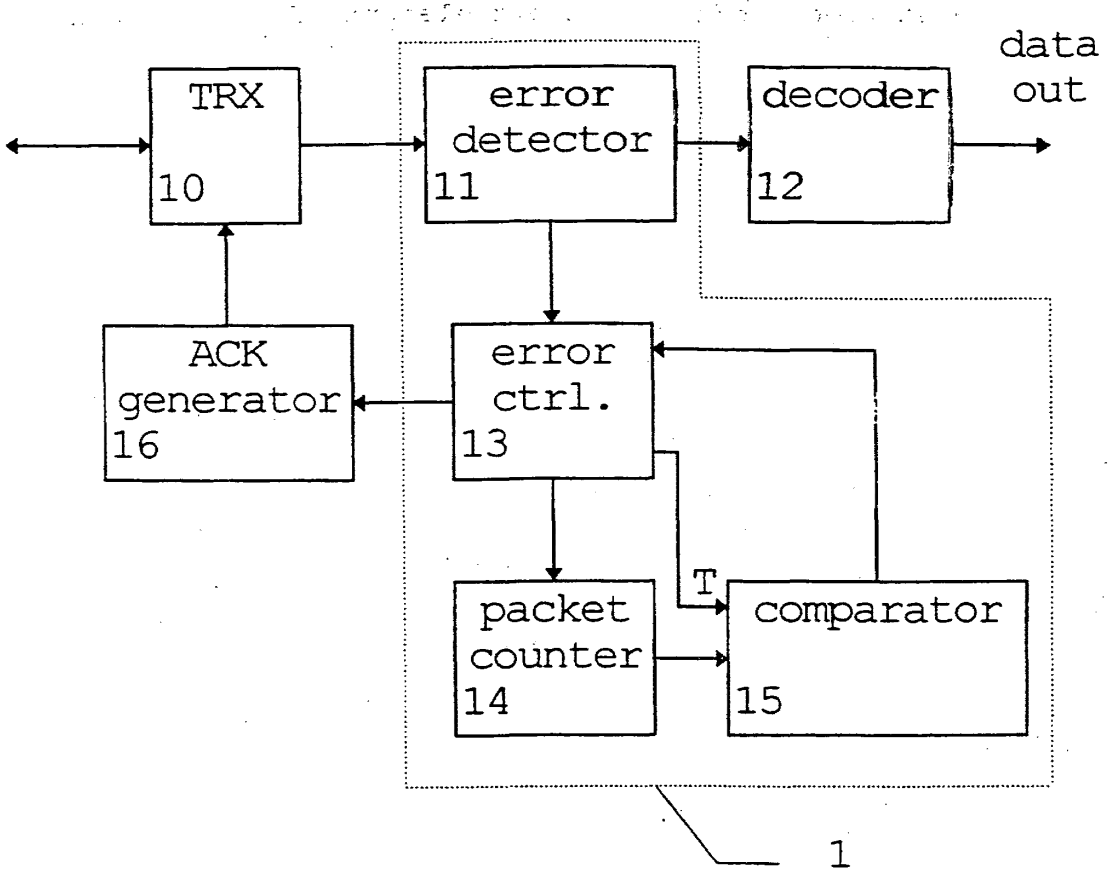

TRX
10
error
detector
11
decoder
12
data
out
ACK
generator
16
error
ctrl.
13
packet
counter
14
T
comparator
15
1

Fig. 1

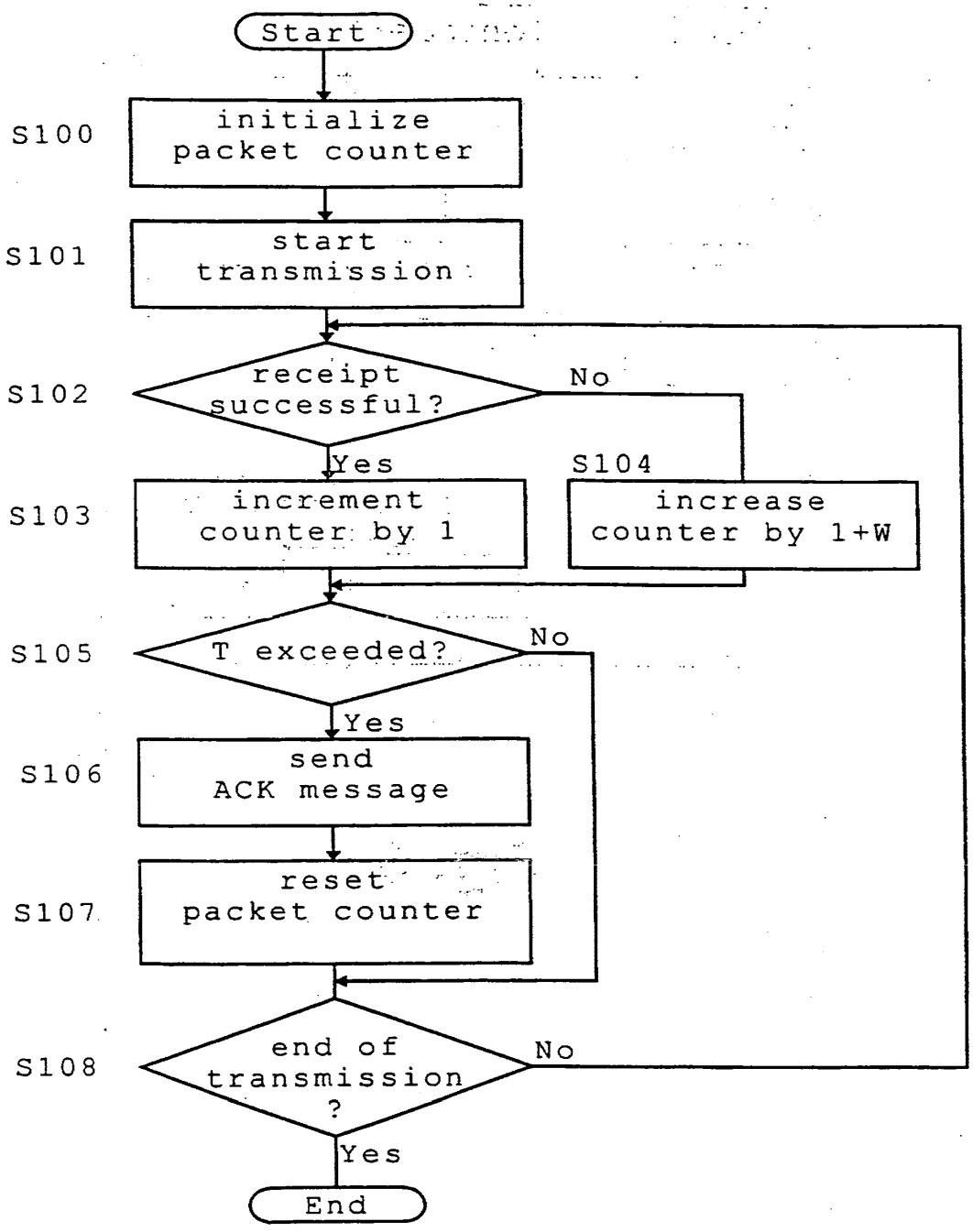

Start
S100
initialize packet counter
S101
start transmission
S102
receipt successful?
No
Yes
S104
increase counter by 1+W
S103
increment counter by 1
S105
T exceeded?
No
Yes
S106
send ACK message
S107
reset packet counter
S108
end of transmission ?
No
Yes
End

Fig. 2

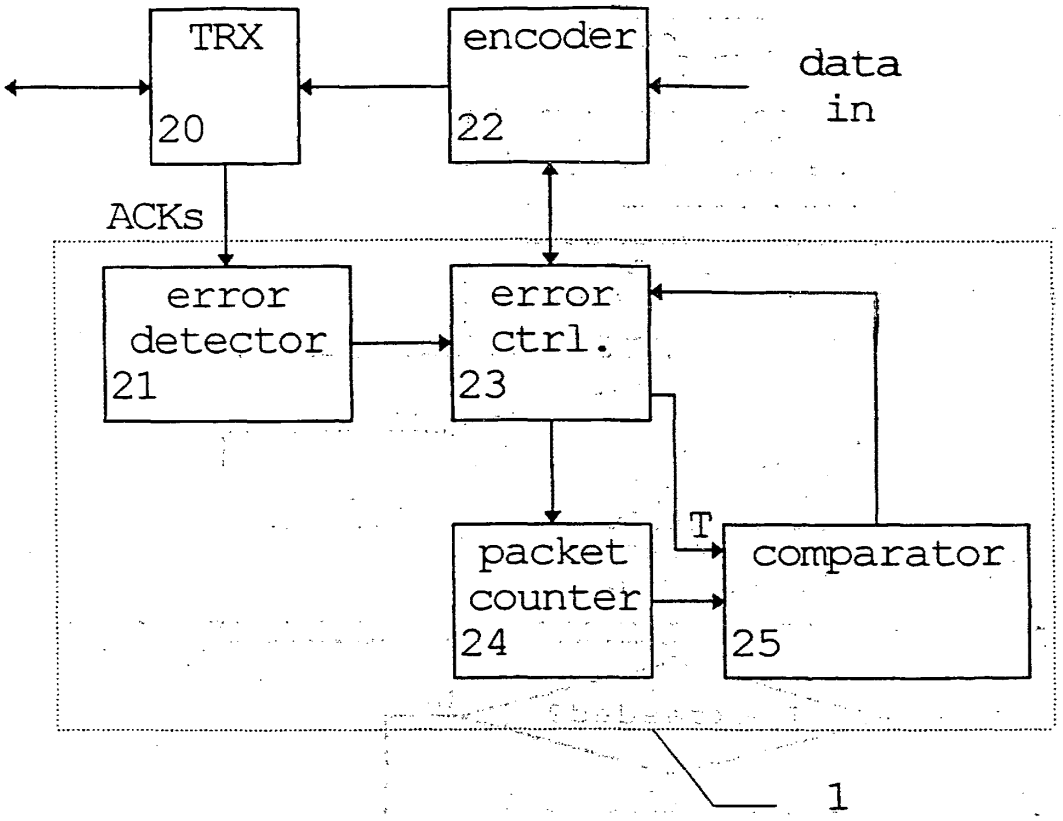

TRX
20
encoder
22
data
in
ACKs
error
detector
21
error
ctrl.
23
packet
counter
24
T
comparator
25
1

Fig. 3

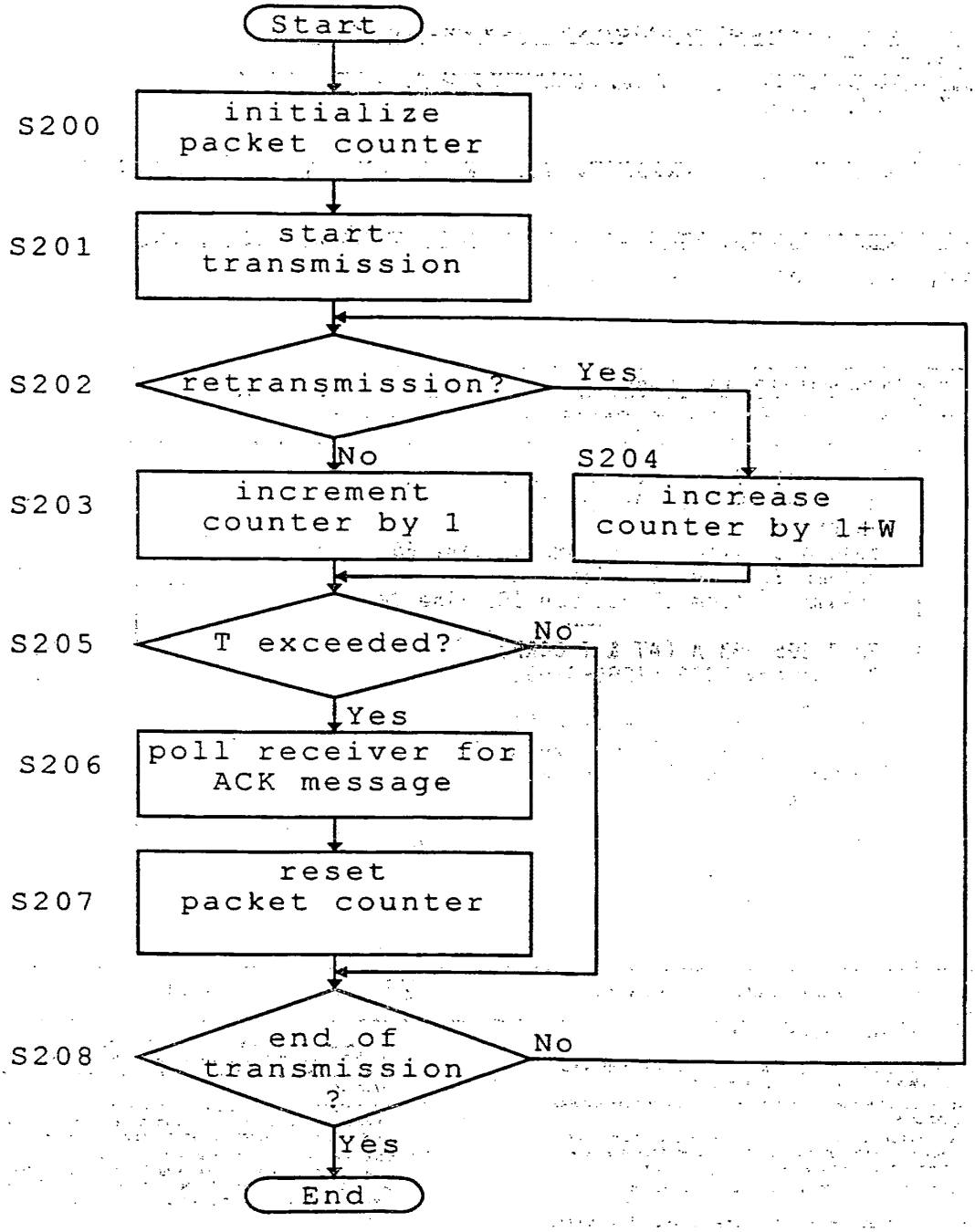

Start
S200
initialize packet counter
S201
start transmission
S202
retransmission?
Yes
No
S204
S203
increment counter by 1
increase counter by 1+W
S205
T exceeded?
No
Yes
S206
poll receiver for ACK message
S207
reset packet counter
S208
end of transmission ?
No
Yes
End

Fig. 4

INTERNATIONAL SEARCH REPORT

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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EPO-Internal, WPI Data, PAJ, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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INTERNATIONAL SEARCH REPORT

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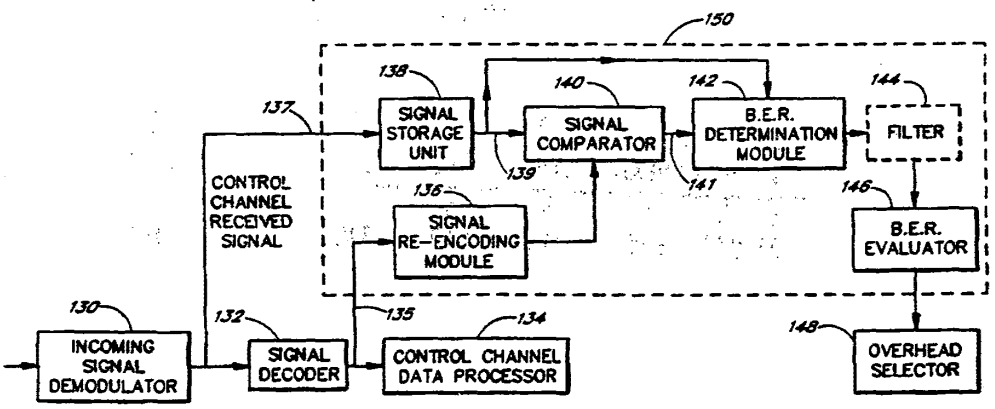
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(54) Title: TRAFFIC CHANNEL QUALITY ESTIMATION DERIVED FROM A DIGITAL CONTROL CHANNEL



(57) Abstract

The present invention provides a method and apparatus for more effectively monitoring the quality of a traffic channel in a communication system, and in response, modifying transmission coding or data transmission rates, or both. This permits improving communication quality and increasing data transfer rates in digital wireless communication systems. The present invention provides a channel quality estimator to determine and evaluate the bit error rate (BER) of a signal on a control channel. An estimation of the quality of the traffic channel is made based on the quality of the control channel signal. Accordingly the processing and control circuitry of either of a mobile station or a base station adjusts the error correction applied to traffic channel transmissions. The traffic channel data transmission rate may also be modified based on the control channel signal quality.

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TRAFFIC CHANNEL QUALITY ESTIMATION DERIVED FROM A DIGITAL CONTROL CHANNEL

Background of the Invention

Field of the Invention

The present invention relates to the field of communications. In particular, the present invention provides an improved apparatus and method for determining channel quality based on evaluation of a control channel.

Background of the Invention

Wireless communication systems continue to experience rapid growth to meet the needs of cellular telephone users. The demand for wireless communication has increased the number of users attempting to gain access to the system and has placed higher expectations on the clarity provided by wireless communication systems. For example, users prefer the audio quality of their wireless service to meet that of a wired connection, and expect wireless service to consistently place a call. Furthermore, users expect the number of "dropped" calls to be at a minimum.

The expanding wireless systems places a premium on existing cellular sites, and in particular, the available bandwidth or bit rate capacity of each base station. The limited number of suitable locations at which cellular sites may be placed increases the demands on existing cellular base station capacity thereby placing an even greater premium on the bandwidth or bit rates of existing base stations.

In general, each cellular site operating in current digital wireless communication systems, such as for example, GSM (Global System for Mobile Communications) use at least two channels over which communication between a mobile station and a base station (cellular site) may occur--at least one data or traffic channel and of at least one control channel. The data or traffic channel shoulders the majority of the exchange by carrying the encoded voice or data transmitted between mobile and base stations of the wireless system.

The control channel provides a communication link between the mobile station and the base station for mobile management tasks. Examples of data exchanged over the one or more control channels include mobile station location, in-coming call traffic control, billing information, and security verifications. Similarly, control channels often provide paging or broadcast services. The amount of data exchanged over the control channel is relatively insignificant compared to the amount of data exchanged over the traffic channel. However, the control channel is very robust because of the importance of the control channel. Although not the focus of the present invention, these safeguards may include extensive redundancy in the form of block-coding and convolutional coding. The extensive redundancy associated with the control channel provides robust error detection and correction.

Summary of the Invention

A mobile station is typically configured with a fixed bandwidth or bit rate. The communication system assigns the total bit rate based on a system standard. This total bit rate does not change regardless of channel quality, and is typically selected for worst case or near-worst-case channel conditions. Accordingly, the maximum number of users per base station is also fixed.

Various methods exist for determining the quality of the traffic channel. The typical methods include traffic channel frame success rate, signal strength, bit error rate on the traffic channel, and the frame ratio. However, the

traffic channel provides an unreliable channel quality indicator due to its high incidence of noise. For example, noise or static over the traffic channel almost always exists. Likewise, a plurality of interference generating sources exist, such as a passing truck, an underpass, or other electromagnetic interference which are inherent in wireless communication. The high incidence of interference on the traffic channel coupled with a generally small degree of error correction (redundancy) on the traffic channel hinders its employ as a reliable channel quality indicator.

The inventors recognized the need for a more reliable and accurate method of evaluating the quality of the traffic channel to allow more flexibility in the system, such as enabling modifying the channel coding and/or permitting a higher bit or lower bit rate.

The present invention provides a method and apparatus for use in a digital communication systems, such as GSM, to more accurately evaluate the traffic channel quality, and in response, modify the channel coding used during the transmission of speech data or modify the channel coding and/or the effective bit rate on a traffic channel.

The present invention provides an improved method and apparatus for evaluating the traffic channel quality. An associated control channel is present during an active speech call or active data transmission. Because the control channel is very robust, the control channel quality is very predictive of the actual channel quality of the traffic channel where the traffic channel and the control channel are related, such as by frequency, or otherwise experiencing similar interference and fading. In other words, the efficacy of a channel quality determination based on the control channel is reliable because on the control channel spurious noise is less likely to provide a non-reliable indicator of steady-state changing channel quality. During an active voice or data call, the associated control channel, such as the Slow Associated Control Channel in a GSM communication system, is monitored to obtain an estimation of gross bit error rate (BER). The BER of the control channel is calculated by re-encoding the successfully decoded information bits and comparing them to the received bits. In a preferred embodiment, BER rate is only calculated if a PASS result from block decoding. The estimated BER, which may be filtered, is then used to determine the control channel quality. The quality of the control channel can then be applied to the traffic channel and used to select channel coding for the traffic channel which maximizes the efficient use of system bit rates without significantly degrading the speech quality. The determination of the traffic channel quality from the control channel estimated BER can be made by preset thresholds or variable thresholds. Where the control channel and traffic channel are related such that the control channel experiences similar interference to the traffic channel, as in most cases, the control channel signal quality is predictive of the traffic channel quality.

In one embodiment, the invention comprises a method for estimating the quality of a traffic channel in a wireless communication system having at least one control channel and at least one associated traffic channel. In particular, the method involves receiving a coded version of a control channel signal, decoding and re-encoding the control channel signal, and comparing the received coded version of the control channel signal with the decoded (corrected) and re-encoded control channel signal to determine the difference between the two. The difference represents errors in the control channel signal, and is used to calculate the bit error rate. Based on the difference, a similar signal quality is assumed for the traffic channel.

In another embodiment, the channel quality estimator comprises a signal decoder configured to decode an encoded control channel signal and a signal storage device configured to store the received control channel signal while the estimator re-encodes the decoded control channel signal. A comparator coupled to the re-encoder and the signal storage device determines the number of bits which differ between the two. The difference, or bit error rate, enters an evaluation module which estimates the quality of the channel based on the bit error rate.

In yet another embodiment, the invention comprises an error correction controller configured to select the error correction overhead (channel coding) to apply to signals on a traffic channel. The controller comprises a signal decoder configured to decode an encoded control channel signal. A re-encoding module re-encodes the decoded (corrected) signal, and a comparator configured to receive both of the re-encoded signal from the signal decoder and a stored signal from a signal storage device (containing the received signal) compares the two signals. An error correction selector receives information from the comparator and evaluates the control channel signal quality. Based on the control channel signal quality, the selector selects appropriate overhead (error detection and correction coding) to apply to outgoing data transmissions on the traffic channel.

In one embodiment, the frame error rate can be used rather than the bit error rate. As with the bit error rate, preferably, the decoded control channel signal is only re-encoded and the frame error rate calculated if a PASS results from block decoding.

Brief Description of the Drawings

Figure 1 illustrates basic components of a wireless communication system.

Figure 2 is a block diagram illustrating a channel quality estimator.

Figure 3 is a flow chart of a bit error rate evaluator.

Figure 4 is a block diagram of a base station having a channel quality estimator in accordance with the present invention.

Figure 5 is a block diagram of a mobile station having a channel quality estimator in accordance with the present invention.

Figure 6 illustrates varying voice frames resulting from varying the use of overhead in accordance with the present invention.

Figure 7 illustrates varying data packets based upon channel quality estimation in accordance with the present invention.

Figure 8 illustrates varying both the amount of data and the amount of error correction in accordance with one aspect of the present invention.

Detailed Description of the Preferred Embodiment

As used in this application, "total bit rate" is the bit rate of all bits including redundancy. "Effective bit rate" refers to the bit rate of data bits without encoding redundancy.

Figure 1 illustrates the basic components of a wireless communication system, as embodied in a cellular telephone communication network. Modern cellular communication systems generally comprise a plurality of base

stations 100 (cellular sites) and mobile stations 102. Each base station 100 generally comprises a base station antenna 104 and base station architecture 106.

Each mobile station 102 generally includes an antenna 108 and is often located in a hand held unit, an automobile or other mobile vessel. The mobile stations 102, movable within the network, operate to transmit data to the base stations 106. The base stations 106 are similarly equipped to transmit data to the mobile station 102.

In many modern digital communication systems, such as GSM, the base station 106 and the mobile station 102 communicate over at least two separate channels, each channel possessing a separate frequency or coding scheme, or occupying a separate time frame on the same frequency with the same or different coding scheme. The first channel, a traffic channel generally carries the majority of the data, either voice or other digital data, which a user desires to transmit. The control channel provides a communication link between the mobile station and the base station for mobile management tasks, such as mobile location, in-coming call traffic control, billing information, security verifications, paging or broadcast services.

Transmission over a wireless network often introduces errors into the digital data stream. To detect and correct these errors, the traffic channel data is typically coded with block and convolutional encoding (generally referred to in this description as error correction overhead and/or redundancy). The encoding (error correction overhead) permits the receiving station to correct some errors in the signal which occur during transmission from station to station. Examples of the type of encoding methods include block coding, convolutional coding and others. Using these types of encoding patterns, the receiving station can more accurately reproduce the original speech or data transmission. However, the error correction overhead on the traffic channel is fixed, and is generally minimal.

The number of errors which are introduced during transmission is often referred to as the bit error rate or BER. The BER is simply a ratio of the number of bits in error to the number of total bits received. A high BER indicates a high rate of error which is generally caused by a poor channel.

In the prior art, the overhead, often referred to as forward error correction encoding algorithm or channel coding, is constant, regardless of the actual need for the particular channel coding. Likewise, if the traffic channel is configured to carry digital data, the data rate is held constant, regardless of the capability of the channel to support an increased data rate. This is a significant drawback because it restricts communication systems from adjusting to changing channel conditions and most efficiently using system bandwidth.

As mentioned previously, one or more additional channels, known as control channels, are maintained between the base station 106 and mobile station 102. The control channels have a slow effective bit rate and carry extensive error correction overhead. The control channel carries extensive channel coding because the accurate exchange of information over the control channel is essential for proper system operation. The extensive error correction capability enhances the robust reconstruction of the signal transmitted. Examples of the type of data exchanged over the control channel(s) include, but are not limited to, base station selection, mobile station location, billing information and paging information.

Conventional base stations are limited in the number of mobile stations simultaneously supported because of the constant total bit rate capacity. In addition, in times of poor channel quality, current systems do not provide

any flexibility to increase channel coding and reduce the maximum number of users. The present invention provides flexibility and increases the efficient use of available bandwidth. In the present invention, each base station 106 has a maximum bit rate or a maximum number of bits which it may process per second from all mobile stations combined. The base station 106 is not capable of processing a greater number of bits per second than its maximum bit rate. This bit rate is determined by the general configuration of the base station electronics and the network. Accordingly, this maximum bit rate establishes an absolute maximum. Thus, a base station 106 always has a maximum number of mobile stations 102 it can support with no encoding.

Reducing the error correction overhead reduces the total bit rate for one the traffic channel for a particular mobile station having a constant effective bit rate. Therefore, reducing the total bit rate exchanged between each mobile station 102 and base station 106 increases the number of mobile stations which a base station may support. Lowering the amount of error correction overhead reduces the total bit rate of the traffic channel on a per mobile basis (leaving the effective bit rate constant) and consequently allows each base station 106 to support additional mobile stations 102 within its maximum bit rate constraint (total bandwidth). Increasing the number of mobile stations 102 which a base station 106 may service advantageously increases the number of users serviceable on a network and further reduces the need for additional base stations (cellular sites).

However, when the quality of the traffic channel is poor, minimal error correction algorithms or schemes do not provide the receiving station with adequate information to recreate an accurate signal. Thus, calls may be dropped or the receiving station (base or mobile) may inaccurately recreate the transmitted signals. Increasing the error correction overhead provides additional error correction capability, but this undesirably increases the total bit rate for the particular mobile station, and consumes valuable base station bandwidth. In short, under poor channel conditions, increasing error correction capability is desirable, while during periods of robust channel conditions, a high degree of its error correction overhead is undesirable because it wastes base station bandwidth with more redundancy than necessary.

In an effort to increase the number of mobile stations 102 a base station 106 may support, and more reliably transmit data in accordance with changing signal quality, a wireless communication system in accordance with one aspect of the present invention preferably utilizes the control channel to ascertain the quality of the traffic channel and, based on the quality of the control channel, adjusts the amount of error correction overhead (selects different channel coding) included on the traffic channel. Thus, only the degree of error correction necessary for existing channel conditions is used.

The traffic channel, existing simultaneous in time and route with the control channel, experiences interference which closely matches that of the traffic channel. The traffic channel provides, therefore, an accurate inference that the quality of the traffic channel mirrors the quality of the control channel.

Determining the quality of the traffic channel based on the quality of the control channel has many advantages. One advantage over prior systems is that data on the control channel provides a better indication of the true channel quality because the high degree of error correction included on the control channel allows the receiving station to create an exact replication of the transmitted signal, which may be compared to the possibly

corrupted signal which was actually received. Thus, a more accurate portrayal of true channel conditions is available using the control channel. Using the traffic channel to monitor signal quality is less desirable because the traffic channel redundancy is much lower and errors are common even with the reasonable channel quality. However, the traffic channel could also be used in monitoring signal quality and adjusting channel coding and/or bit rates.

Control Channel Quality Estimation

Figure 2 provides a block diagram which illustrates the channel quality estimation of the present invention. An antenna 108, 104 (Figure 1) or other reception means obtains an incoming control channel signal which enters a demodulator 130, which demodulates the signal as well known in the art. The resulting signal is reverse coded (e.g., reverse convolutional encoded and reverse block coded) with the signal decoder 132, as well understood in the art. The decoded control channel signal is provided to the conventional control channel processing module 134.

In addition, the signal arriving over the control channel is provided to a channel quality estimator 150 from the demodulator 130 and from the decoder 132. The channel quality estimator 150 evaluates the bit error rate (BER) of the signal arriving over the control channel. The system may infer the quality of the traffic channel based on the output of the channel quality estimator 150 because the control channel and the traffic channel are generally subject to the same distorting effects.

The channel quality estimator 150 has a signal storage unit 138, a signal re-encoding module 136, a signal comparator 140, a bit error rate determination module 142, an optional filter 144 and bit error rate evaluation module 146. An overhead selector 148 receives the output of the estimator 150.

The demodulated control channel signal enters the signal storage unit 138 from an input 137 to the estimator 150. The signal storage unit 138 stores the signal for later analysis. Another input 135 to the estimator 150 provides the decoded control channel signal to the signal re-encoding module 136. As explained above, the decoded signal has undergone reverse encoding techniques (such as reverse convolutional (e.g., Viterbi) and reverse block coding) well understood in the art, so that the decoded signal is an error-free reconstruction of the transmitted data bits. Indeed, for the control channel, the reverse block decoding or cyclical redundancy check (CRC) is very robust, and a very high confidence is required to obtain a PASS for the decoded control channel signal. The re-encoding module 136 re-encodes the decoded signal. Preferably, the re-encoding is only completed if PASS was obtained with the reverse block decoding. The signal is re-encoded so that the received signal and the re-encoded signal may be compared for differences on a bit-by-bit basis.

A signal comparator 140 coupled to both the signal storage unit 138 and the signal re-encoding module 136 compares the received signal with the re-encoded signal on a bit-by-bit basis to determine the number of bits which are different between the two signals. Based on this evaluation, the bit-error-rate determination module 142 calculates at a bit error rate (BER), for the incoming control channel signal. The BER determination module of the current embodiment obtains information about the total number of bits by monitoring the signal storage unit output 139. The BER determination module 142 is also coupled to via a signal line 141 to the signal comparator 140. The BER is the number of incoming bits which are in error or corrupted as compare to the total number of incoming bits. A low BER indicates a high quality channel whereas a high BER indicates poor channel quality.

It should be understood that the BER determination module is an exemplary method of determining the quality of the control channel. The "frame error rate," also well understood in the art, could also be used in place of or in addition to the BER.

In one embodiment, the BER signal enters an optional filter 144 to provide a more useful representation of the actual BER over time and thereby eliminating minute fluctuations of the BER in time. Filtering the BER reveals more consistent trends which thereby provide a more accurate representation of the true quality of the channel through averaging or smoothing. For example, the control channel may degrade for a moment while a large vehicle passes. Decisions, such as switching to a different base station or modifying the redundancy of the traffic channel should not be based on such transient occurrences.

Finally, a BER evaluator 146 analyses the BER. Based on an evaluation of the BER, either of the base station transmitter or mobile station transmitter may adjust the error correction encoding used for the outgoing signal on the traffic channel. The overhead is selected with an overhead selector 148. The overhead selector 148 may be embodied in many ways, such as program executing on the processor for the mobile or base station, or both, or as firmware or as a separate circuit. Typically, the monitoring and/or adjustment would take place at the base station 106 because of the potential for higher processing capabilities at the base station. However, with a bit error rate determination module in the mobile station, such decisions can also be made at the mobile station. The station selecting the encoding transmits the selected encoding process to the receiving station to enable proper decoding.

As discussed previously, adjusting the overhead included on the traffic channel with the voice data affects the total bit rate between mobile station 102 and the base station 106. Reducing the redundancy allows additional mobile stations 102 to gain access to the base station 106. Alterations to redundancy may be to alter block coding (e.g, parity) redundancy and/or alter the convolutional encoding algorithm or complexity.

Bit Error Rate Evaluator

Figure 3 illustrates a flow chart for one example of the operation of the BER evaluator 146 of Figure 2. A wireless communication system in accordance with the present invention may be capable of using a number of different encoding schemes. These encoding schemes may involve different levels of redundancy for varying channel quality. Accordingly, each scheme would preferably utilize a different amount of overhead. Error correction schemes having a high amount of overhead would provide the greatest amount of error correction capability and are best suited for poor channel conditions. Conversely, error correction schemes having minimal overhead would provide little error correction capability and are best suited for ideal channel conditions. In exceptionally high channel quality (rarely present), encoding may be dropped entirely, or only parity may be calculated.

In the exemplary embodiment described herein, the communication system includes three error correction schemes or algorithms, each being selectively implemented based on an evaluation of the BER of the control channel, and each providing a different degree of error correction overhead with the signal on the traffic channel. Further, the present embodiment also includes three BER thresholds, each BER threshold causing either the system to transfer communication with the mobile station 102 to a new base station 106 or the adoption of a different error correction scheme. In particular, a BER threshold defines a range of BER values which define a set mode of operation. When

the BER crosses one of the threshold values, it is at a level which the system should take action based on the quality of the control channel. However, of course, any number of schemes could be implemented, and two or more provide an improvement over existing systems which have no flexibility.

After the channel quality estimator 150 determines the BER, the overhead scheme selector 148 (Figure 2) selectively adjusts the amount of error correction overhead applied for the data on the traffic channel. In the exemplary embodiment described herein, the BER is tested for plurality of the thresholds. The first threshold (block 180) is set to a BER value representing the lower channel quality limit. If the BER rises above this limit, the number of bits which arrive corrupted is too great to maintain an acceptable traffic channel communication link between the base station 106 and the mobile station 102 over the existing channel with the available encoding schemes. Consequently, if the BER is greater than or equal to the first threshold, the communication network may switch to another physical channel, another frequency, another frame combination (e.g., half rate to full rate channel) or transfers responsibility for communication to a different base station (block 182).

If the BER is less then the first threshold, the BER is compared to a second threshold (block 184). A BER value between the first and second thresholds represents high error rates in the system, which are appropriately afforded the greatest degree of error correction. If the value of the BER is between the first and second threshold, the overhead selector 148 causes the transmitting circuitry in either or both of the base station 106 and the mobile station 102 to assume a first overhead (encoding) scheme (block 186). The first overhead scheme incorporates a high degree of error detection and correction to compensate for the generally high BER.

Increasing the amount of error correction overhead when the BER is high (i.e., when the signal is encountering a large amount of corruption), advantageously ensures that the receiving station obtains adequate encoding permit accurate reconstruction of the transmitted data. Systems of the prior art undesirably hold the encoding scheme constant, even during poor channel conditions and thus pass static, garbled sounds and corrupt data to a user or subject a user to "dropped" calls.

If the BER is less than the second threshold, the BER is compared to a third threshold (block 188). If the BER is less than or equal to the second threshold but greater than the third threshold, a second encoding scheme is selected (block 190). The second encoding scheme incorporates less overhead than the first overhead scheme because the lower BER indicates a better channel quality, requiring less error correction. Most wireless communication systems in operation today fix a level of error correction overhead equivalent to the second error correction scheme. This inflexibility undesirably prevents the wireless network from adjusting the bit rate on the traffic channel to account for the changing channel conditions encountered by each of a plurality of mobile stations. This results in less efficient use of the base station bandwidth.

If the BER does not fall within the limits of the second and third threshold, a third overhead scheme is selected (block 192). When the BER is below the third threshold, the overhead scheme selector selects the third encoding scheme. The third encoding scheme incorporates the least amount of redundancy because the low BER indicates a robust channel which does not introduce corruption on the traffic channel, and hence does not require extensive error correction overhead. Of course, additional levels of encoding complexity could be used, but the more

levels that are provided, the more complex the processing required of the systems, which adds cost. Advantageously, reducing the amount of overhead included with the data packets or voice frames transmitted on the traffic channel reduces the total bit rate of each mobile station 102 without decreasing the effective bit rate (i.e., the number of bits to represent (effective bit rate) the voice transmission remains the same while the total bit rate decreases). Maintaining the effective (data) bit rate maintains the requisite amount of information to ensure accurate and clear voice or data reproduction. Each base station 106 in the network is able to support additional mobile stations 102 because each mobile station consumes a smaller portion of a base station's bandwidth.

Figure 4 illustrates a block diagram of one embodiment of a base station 106 incorporating the above-described channel quality estimator 150 and overhead scheme selector 148 (operating within the processing and control circuits 206). One embodiment of the base station 106 includes an antenna 104 for receiving radio waves and transforming the radio waves into electrical signals. The antenna 104 functions in cooperation with a transmitter 210 and receiver 202. Processing and control circuitry 206 oversees operation of the base station 106 and provides the overhead selector 148. The processing and control circuitry 206 coordinates operation of the receiver 202, a decoder 132, a channel quality estimator 150 and the transmitter 210.

The receiver 202 obtains the incoming signals from the antenna 104 and performs various functions on the incoming signal, including, but not limited to demodulation, channel separation and signal strength adjustment. Preferably, the receiver 202 separates the traffic channel and the control channel, as shown, and routes both to the decoder 132. In addition, the receiver 202 is in communication with the processing control circuit 206 which receives the demodulated control channel signal from the receiver 202.

The decoder 132 performs reverse encoding operations, and applies various error correction algorithms to the incoming signals. An output of the decoder 132 forwards the traffic channel information to the output circuitry 204. The decoder 132 also provides the decoded control channel signal to the processing and control circuitry 206 for communication link management in a conventional manner. The control circuitry also provides the control channel (prior to and subsequent to decoding) to the channel quality estimator 150. Alternatively, the control channel signal can be provided directly from the receiver 202 to the channel quality estimator 150, and directly from the decoder 132 to the estimator 150. The channel quality estimator 150 evaluates the quality of the control channel in the manner described above with reference to Figures 2 and 3. The quality of traffic channel is generally similar to the quality of the control channel. The channel quality estimator 150 reports the BER to the processing and control circuitry which in conjunction alters the error correction scheme (encoding) for the outgoing data on the traffic channel. The transmitter 210 performs the selected encoding (error overhead) and modulation and transfers the data to the antenna 104 for transmission.

Other arrangements, either in hardware and/or software are available as a substitute to the above described configuration which do not depart from the scope of the present invention.

Figure 5 illustrates a block diagram of one embodiment of a mobile station 102 incorporating the above described channel quality estimator and overhead scheme selector 148. As shown, the components and operation of the mobile station 102 are generally similar to the components and operation of the base station 106.

Accordingly, a detailed description of the components and operation of the mobile station 102 is not repeated. However, if the data on the traffic channel is voice information, the output circuitry 204 includes means to convert the digital data to an analog signal and amplification means to provide an audible signal to a speaker (not shown). Because the quality of the channel from the mobile station 102 to the base station 106 often differs from the channel quality from the base station to the mobile station, both the mobile station and the base station may incorporate the channel quality estimator 150 and overhead scheme selector 148 in a preferred embodiment. Incorporating the channel quality estimator and overhead selector on both the mobile station 102 and base station 102 advantageously provides means on each station to accurately evaluate the channel quality and adjust the amount of associated error correction overhead. In another embodiment, each station may exchange BER information regarding the incoming control channel signal so that each station may adjust the amount of error correction overhead in direct relation to the quality of the channel over which that station must transmit data. The particular overhead scheme selected is transmitted from the appropriate station so that the proper decoding scheme is selected at the receiving station. The selected scheme can be transmitted with one or more bits in each packet or frame, each time a change is made, or on a scheduled, periodic basis.

Figure 6 provides a visual illustration of the overhead adjustments made to data transmissions over the traffic channel in response to control channel quality. Transmissions over digital wireless systems comprise a plurality of bits. These bits comprise effective data 250 and a certain amount of error correction overhead 252, 253, 264, both of which are combined into a voice frame 254, 256, 262. Of course, as is understood in the art, the overhead is generally not one block of bits. With convolutional encoding and other encoding techniques, the redundancy is encoded such that the actual data bits no longer exist as separate, identifiable bits. Accordingly, Figure 6 is merely illustrative of changing the level of overhead. In addition, the proportions of the data and overhead are not intended to indicate a precise scale. A transmitter in either of base station 106 or mobile station 102 transmit the frames 254, 256, 262. Since each frame 254, 256, 262 is comprised of a number of bits, the transmitter outputs the data at a certain bit rate. As mentioned previously, for systems of the prior art, the bit rate, or bits transmitted per second, is generally held constant during the duration of the communication link, regardless of channel quality. Holding the bit rate constant undesirably limits the maximum number of mobile stations 102 which a base station 106 may support.

Using the principles of the present invention, however, the transmitting station, the base station 106 and/or mobile station 102, alters the overhead depending on the quality of the control channel. For example, assuming each frame of Figure 6 is transmitted in the same amount of time, the second frame 256 includes minimal overhead 253, yet maintains the same effective data rate for the effective data 250 (voice or data information). Thus, the total bit rate for the second frame 256 is lower than for the first frame 254. The overhead selector 148 reduces the overhead in response to a low BER as determined by the channel quality estimator 150 (Figure 2). Accordingly, the reduced overhead 253 results in a reduced number of bits to send. Reducing the bit rate of a plurality of mobile stations 102 frees bandwidth of the base station 106, thereby allowing the base station to support additional mobile stations.

Conversely, if the channel quality estimator 150 indicates a high BER, the overhead scheme selector 148 increases the overhead. The third frame 262 illustrates an increase in the amount of overhead 264 to provide additional error correction capability in response to the high BER value. As shown however, the system maintains the effective bit rate of the voice data 250 to ensure a high quality signal. But, the overhead 264 increases as does the total bit rate of the outgoing frame 262, which in turn consumes a greater percentage of a base station's bit rate allocation. The increased error correction overhead 264 desirably ensures voice clarity and reduces incidence of dropped calls.

Figure 7 provides a similar illustration of the advantages of the present invention when utilized in conjunction with digital data transmission for both voice or digital data other than voice. Digital wireless communication systems generally maintain a constant sampling rate of the analog voice signals causing the rate of digital data generated for voice communication to be generally constant. Figure 6 illustrates the generally constant size of the voice data information 250. However, in another embodiment, for instance when wireless communication systems transmits non-voice digital data or voice data, the effective data rate need not be held constant, and hence the rate of data transmission may increase in response to ideal channel conditions. Examples of digital data transmission shown in Figure 7 comprise transmission of e-mail, facsimile, file download, Internet access, or voice transmission with changes to voice encoding. While systems of the prior art undesirably hold the data transmission rate or effective bit rate constant during the entire communication link even though the channel may support a higher effective bit rate, systems adopting the principles of the present invention benefit from the channel quality estimator 150 (Figure 2) to alter the effective bit rate.

As shown in Figure 7, the first data packet 300 is exemplary of a first data/overhead percentage. As shown, the data 302 comprises the majority of the data packet and the overhead 304 comprises a generally smaller portion of the signal packet 300. If the channel quality is too poor to support the standard bit rate, the overhead may be adjusted.

The second data packet 310 illustrates a situation when the channel quality estimator 150 (Figure 2) determines a high BER on the control channel. Inferring that the traffic channel is also encountering corruption, the overhead selector 148 reduces the effective data rate and increases overhead thereby sending less data 312. Lowering the effective bit rate maintains the data link and continues data transmission, albeit at a slower rate. Hence, the likelihood of a dropped data link is significantly reduced.

The third data packet 320 illustrates an example of the channel quality estimator 150 (Figure 2) reporting a low BER, a sign of a robust traffic channel. The communication system takes advantage of the traffic channel's ability to support an elevated effective bit rate and accordingly increases the amount of data 322 (bits for voice or bits or data), while decreasing the amount of overhead 324. Increasing the effective data rate effectively decreases the time required to download a set amount of data or increases the voice quality. In the case of non-voice data, this in turn reduces the time that a communication system must maintain the communication link. Advantageously, this more rapidly frees system resources so that the base station 106 may support other mobile data links.

Figure 8 illustrates yet another application of the channel quality estimation of the present invention. As depicted in Figure 8, the number of data bits, the amount of overhead, and the overall size of the packet or frame may be adjusted. As depicted in Figure, a frames or packets 400, 402, 404, 406 differ in the number of data bits 408, 412, 416, 420, overhead 410, 414, 418, 422 and in the overall length of the packet or frame. In accordance with the present invention, channel quality estimation is used to provide flexibility in all of these parameters, as depicted in Figure 8.

Of course, the principles of the present invention to adjust overhead in response to channel quality could also be utilized by monitoring the traffic channel itself rather than the control channel. However, due to the many fluctuations and the inherent unreliability of the traffic channel to determine signal quality, the control channel is the more desirable embodiment. To use the control channel, the requirement is that the control channel signal quality is representative of the traffic channel quality. This is the case where the channels are related, as is usually the case. Such relation between the channels may be frequency, frequency band, or simply experiencing similar interference or fading.

Methods and apparatus for evaluating the quality of the control channel other than those described herein may be employed without departing from the teachings of the invention disclosed herein. Likewise, those of ordinary skill in the art may develop other benefits from using the control channel to evaluate quality of the traffic channel.

For example, in one alternatively embodiment the present invention may monitor the channel condition on a paging channel or broadcast channel, both of which are control channels. The estimated BER from these channels can determine the bit rate during call setup, thus maximizing the effective data throughput or speech quality at the beginning of a call or transmission.

It is contemplated that the apparatus evaluating the control channel be embodied in hardware and/or software and integrated into both of a mobile station 102 and/or base station 106.

WHAT IS CLAIMED IS:

1. A method for modifying the bit rate for at least one connection in a communication system having at least one control channel and at least one traffic channel, said method comprising the steps of:

monitoring the quality of said at least one control channel;

assigning a comparable quality to said at least one traffic channel;

selecting an encoding scheme or data rate to apply to said traffic channel based upon the quality assigned to said control channel.

2. The method of Claim 1, wherein said control channel signal is an encoded signal, said step of monitoring comprises the steps of:

receiving a control channel signal over said at least one control channel;

decoding said control channel signal;

reencoding the control channel signal; and

comparing the received control channel signal with the re-encoded control channel signal to determine the difference between the received and reencoded signal, said difference representing errors in said control channel signal.

3. The method of Claim 1, wherein said control channel signal is an encoded signal, said step of monitoring comprises the steps of:

receiving a control channel signal over said at least one control channel;

decoding said control channel signal, and if a PASS results,

reencoding the control channel signal; and

comparing the received control channel signal with the re-encoded control channel signal to determine the difference between the received and reencoded signal, said difference representing errors in said control channel signal.

4. The method of Claim 2, wherein receiving a control channel signal comprises using an antenna to receive a signal via radio waves.

5. The method of Claim 2, wherein said step of decoding comprises applying a decoding algorithm to said signal to obtain a signal representative of the signal prior to initial encoding.

6. The method of Claim 2, further comprising filtering said difference.

7. The method of Claim 2, wherein the difference is used to generate a bit error rate.

8. The method of Claim 3, wherein the difference is used to generate a bit error rate.

9. The method of Claim 2, wherein the traffic channel carries digitized voice signals.

10. The method of Claim 2, wherein said at least one control channel comprises a slow associated control channel in a GSM system.

11. The method of Claim 2, further comprising permitting additional mobile stations to communicate with a base station during periods of high channel quality.

12. The method of Claim 2, wherein selecting the encoding scheme comprises selecting the amount of error correction overhead.

13. The method of Claim 1, wherein said step of selecting comprises selecting an encoding scheme and a data rate.

14. The method of Claim 1, wherein said step of monitoring comprises the steps of:

receiving a control channel signal over said at least one control channel;

decoding said control channel signal;

reencoding the control channel signal; and

determining a frame error rate for said control channel.

15. The method of Claim 3, wherein said step of monitoring comprises the steps of:

receiving a control channel signal over said at least one control channel;

decoding said control channel signal;

reencoding the control channel signal; and

determining a frame error rate for said control channel.

16. A method of estimating the channel quality for a traffic channel in a communication system having at least one traffic channel and at least one control channel, said method comprising the steps of:

determining quality of said at least one control channel; and

assigning a comparable channel quality to said at least one traffic channel.

17. The method of Claim 16, wherein said step of determining comprises the steps of:

receiving a control channel panel signal over said at least one control channel;

decoding said control channel signal;

re-encoding said control channel signal; and

comparing the received control channel signal with the re-encoded control channel signal to determine the difference between the received and re-encoded signal.

18. The method of Claim 17, further comprising the steps of calculating a bit error rate based upon the difference obtained in said step of comparing.

19. The method of Claim 18, further comprising a method of selecting an encoding scheme, said method comprising the step of selecting an encoding scheme to be applied to said traffic channel based upon the quality of said control channel.

20. An error correction controller selector which selects the amount of error correction overhead to apply to a traffic channel signal in a communication system having at least one control channel and at least one traffic channel, said controller comprising:

a control channel signal quality estimator;

a traffic channel encoding selector coupled to said control channel signal quality estimator, said encoding selector selecting an appropriate error correction scheme to apply to data transmissions on said at least one traffic channel in response to said control channel signal quality estimator.

21. The error correction controller of Claim 20, wherein said control channel signal quality estimator comprises a control channel signal storage module, a control channel re-encoding module, a comparator coupled to said control channel signal storage module and said re-encoding module, and an error evaluator.

22. A station in a wireless communication system comprising;

an antenna;

a receiver coupled to said antenna and configured to receive a signal from the antenna and to demodulate said signal;

a control channel quality estimator which evaluates a signal arriving on a control channel;

an error correction selector coupled to said control channel quality estimator and responsive to said control channel quality estimator to select error correction encoding of data transmitted on a traffic channel.

23. The mobile station of Claim 22, wherein said station comprises a cellular telephone.

24. The base station of Claim 22, wherein said station comprises a cellular site.

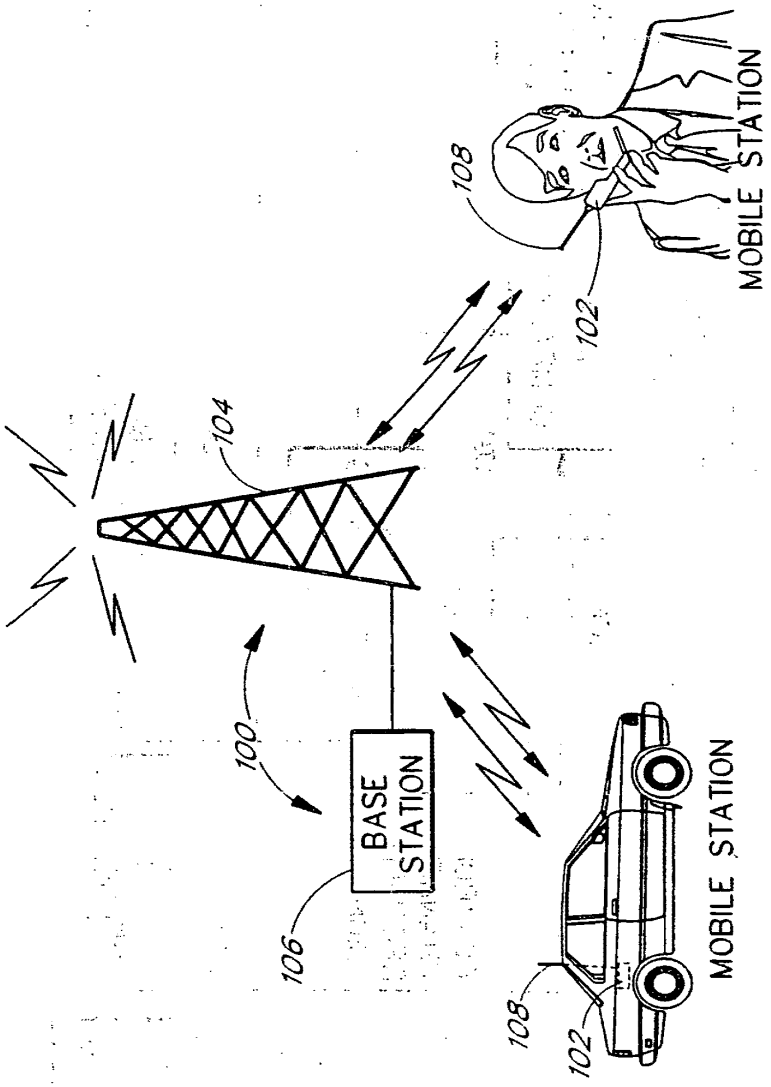

MOBILE STATION
108
102
104
100
BASE STATION
106
MOBILE STATION
108
102

FIG. 1

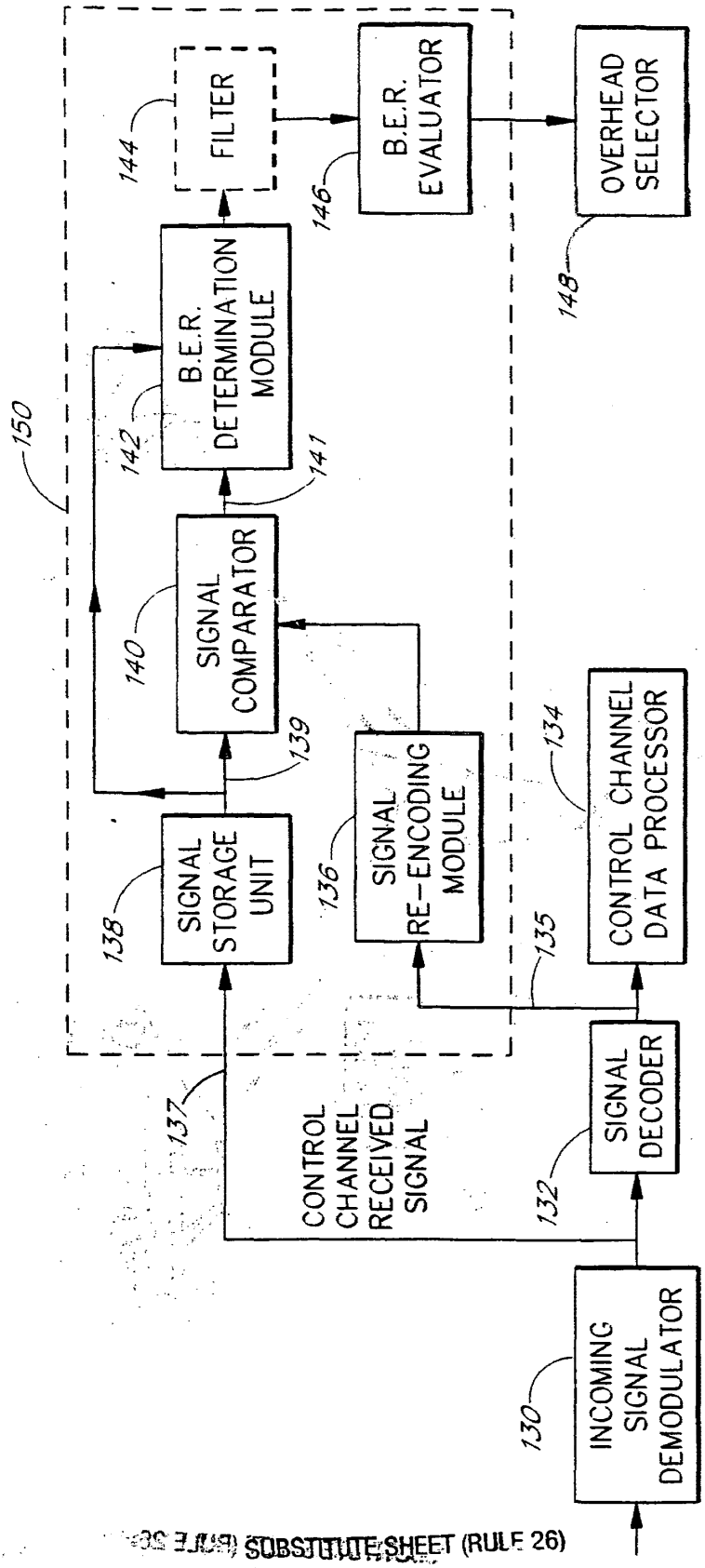

INCOMING SIGNAL DEMODULATOR
130
SIGNAL DECODER
132
CONTROL CHANNEL RECEIVED SIGNAL
137
SIGNAL STORAGE UNIT
138
SIGNAL RE-ENCODING MODULE
136
CONTROL CHANNEL DATA PROCESSOR
134
135
SIGNAL COMPARATOR
140
139
B.E.R. DETERMINATION MODULE
142
141
FILTER
144
B.E.R. EVALUATOR
146
OVERHEAD SELECTOR
148
150

FIG. 2

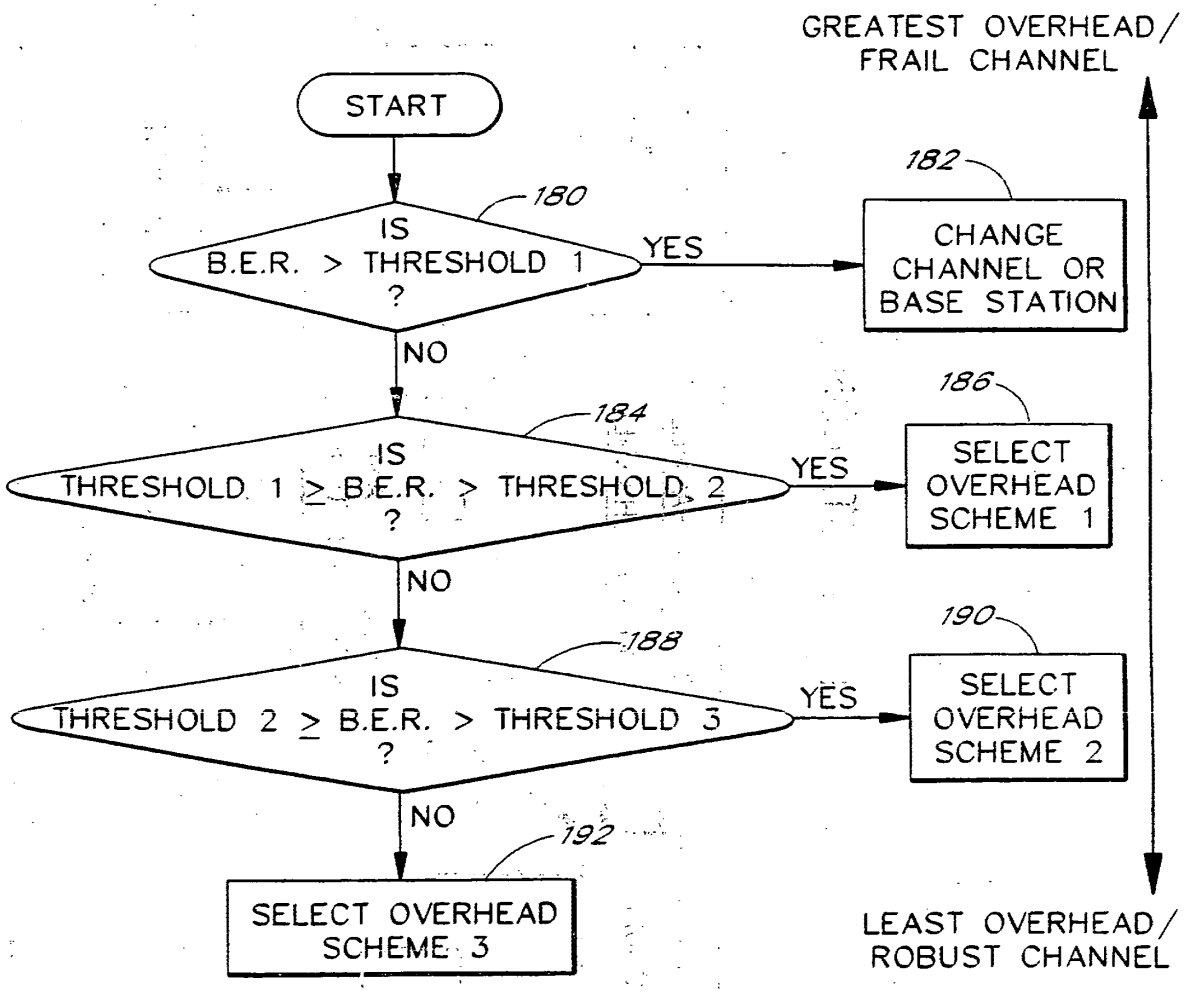

GREATEST OVERHEAD/
FRAIL CHANNEL
START
180
IS
B.E.R. > THRESHOLD 1
?
YES
182
CHANGE
CHANNEL OR
BASE STATION
NO
184
IS
THRESHOLD 1 ≥ B.E.R. > THRESHOLD 2
?
YES
186
SELECT
OVERHEAD
SCHEME 1
NO
188
IS
THRESHOLD 2 ≥ B.E.R. > THRESHOLD 3
?
YES
190
SELECT
OVERHEAD
SCHEME 2
NO
192
SELECT OVERHEAD
SCHEME 3
LEAST OVERHEAD/
ROBUST CHANNEL

FIG. 3

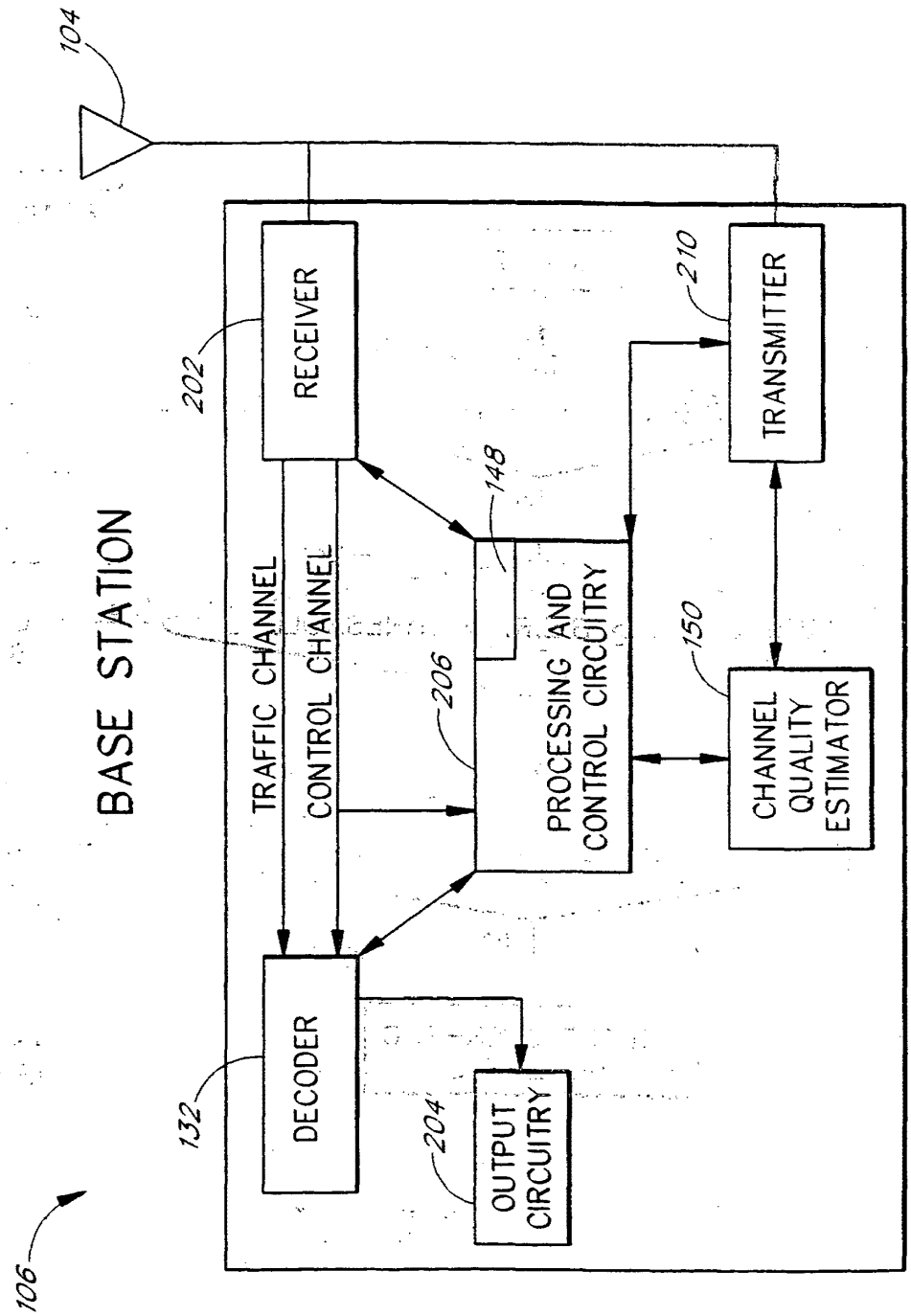

104
BASE STATION
RECEIVER
202
TRANSMITTER
210
148
TRAFFIC CHANNEL
CONTROL CHANNEL
PROCESSING AND CONTROL CIRCUITRY
206
150
CHANNEL QUALITY ESTIMATOR
DECODER
132
OUTPUT CIRCUITRY
204
106

FIG. 4

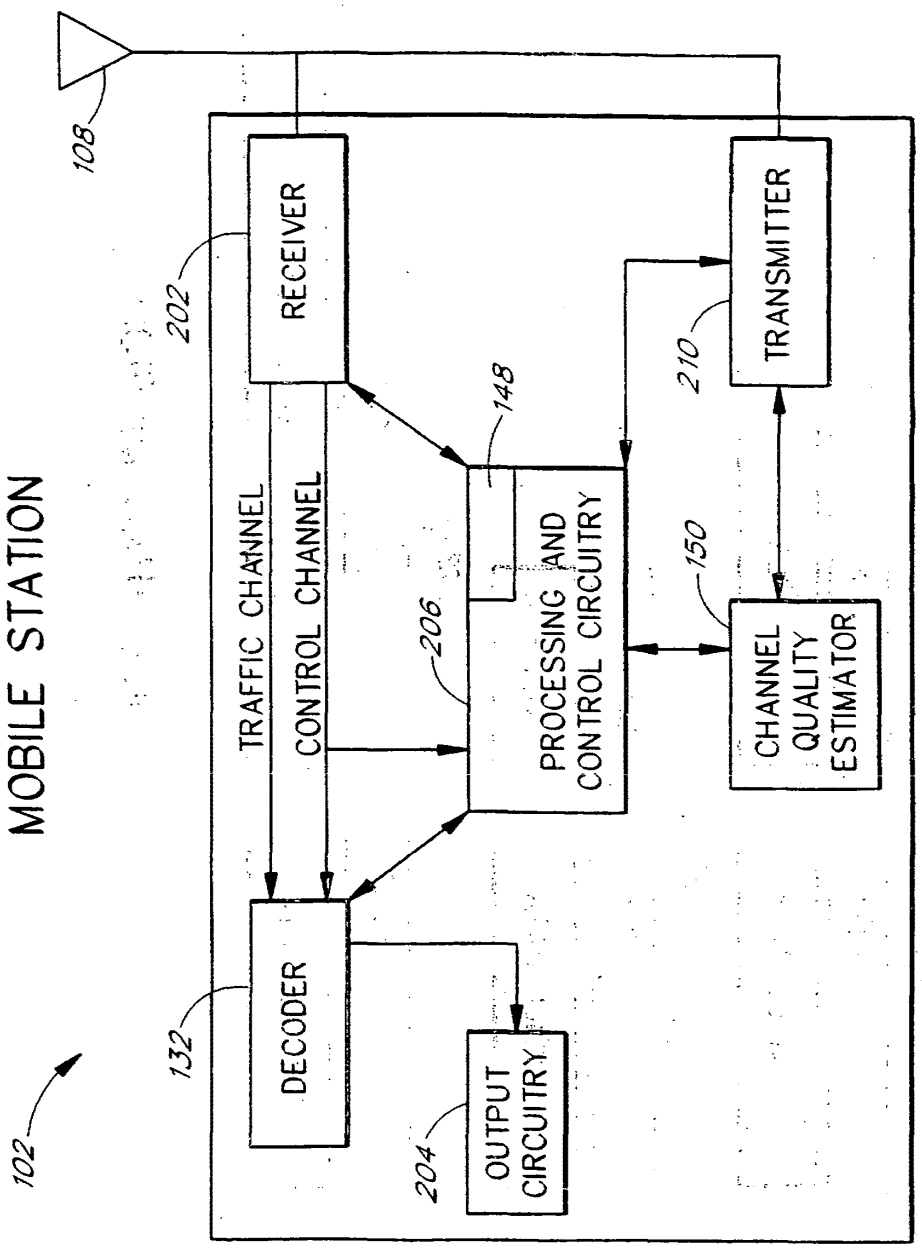
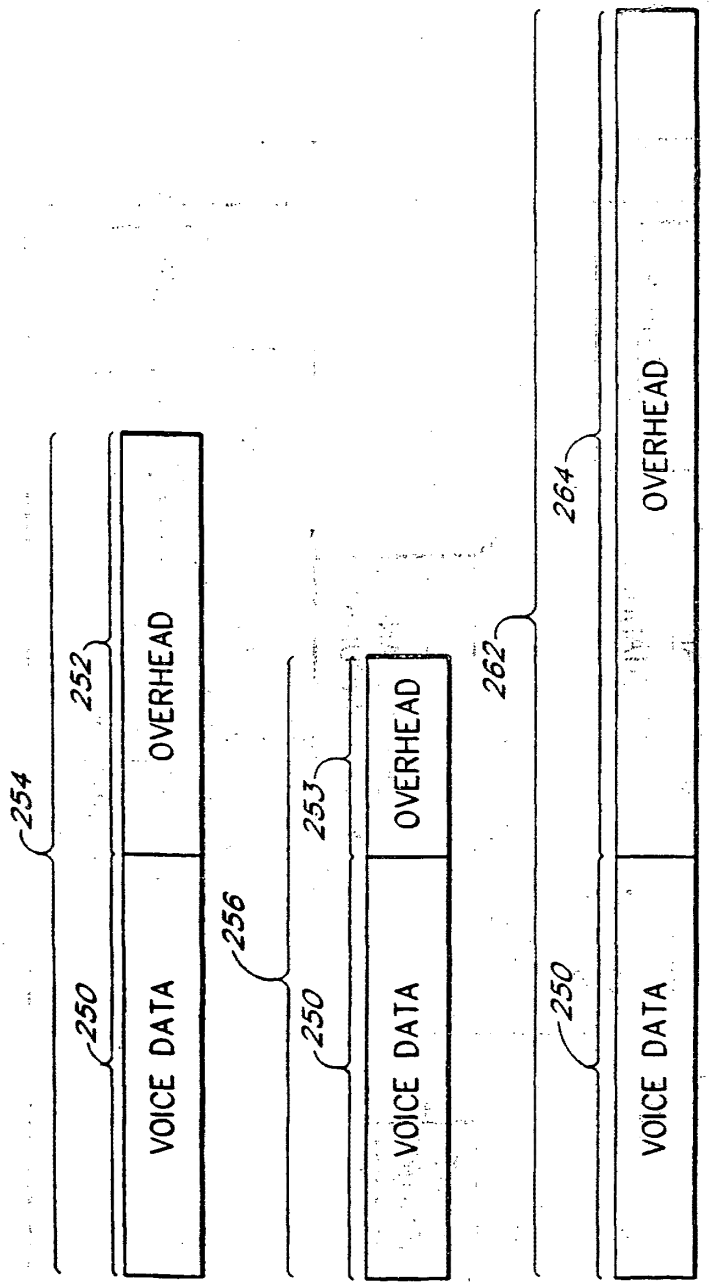
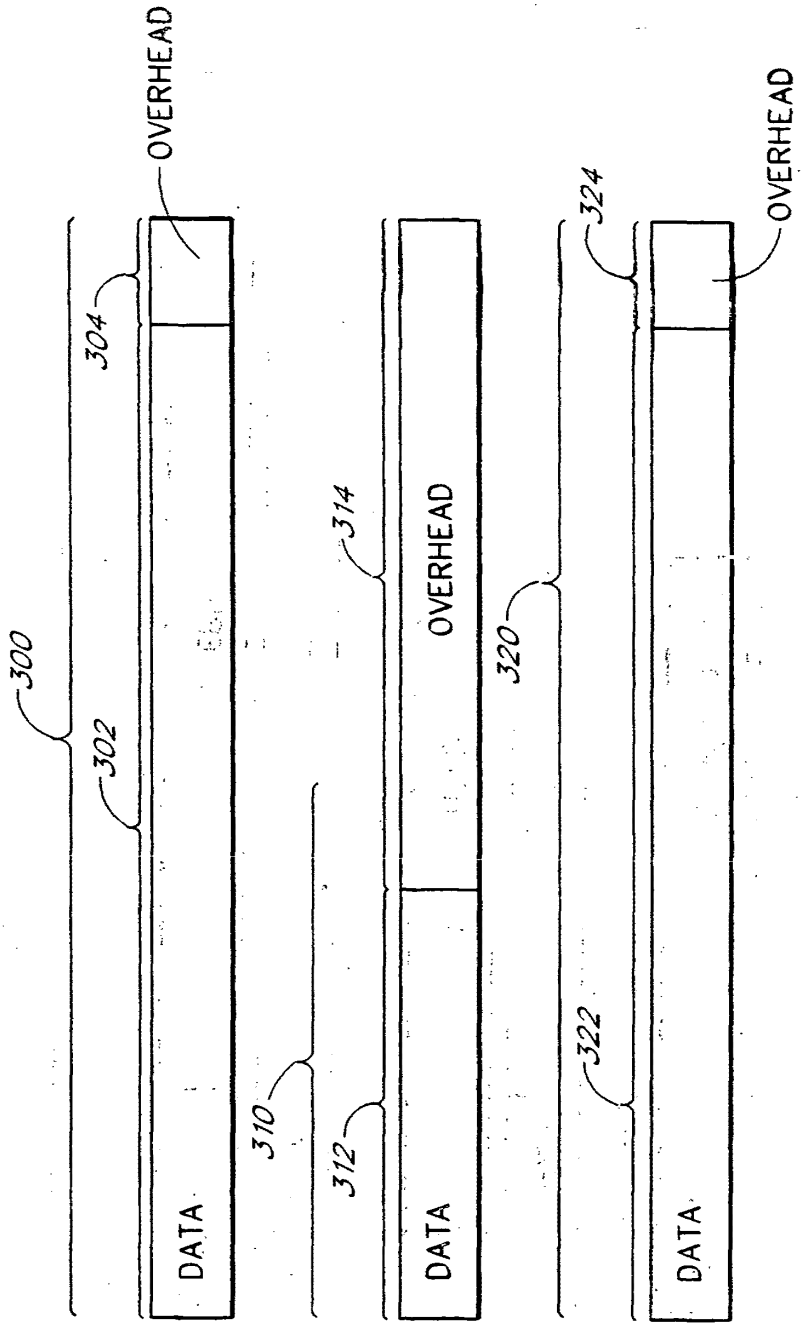

MOBILE STATION
102
108
RECEIVER
202
TRANSMITTER
210
148
TRAFFIC CHANNEL
CONTROL CHANNEL
206
PROCESSING AND CONTROL CIRCUITRY
150
CHANNEL QUALITY ESTIMATOR
DECODER
132
OUTPUT CIRCUITRY
204

FIG. 5



VOICE TRANSMISSION

FIG. 6



DATA TRANSMISSION

FIG. 7

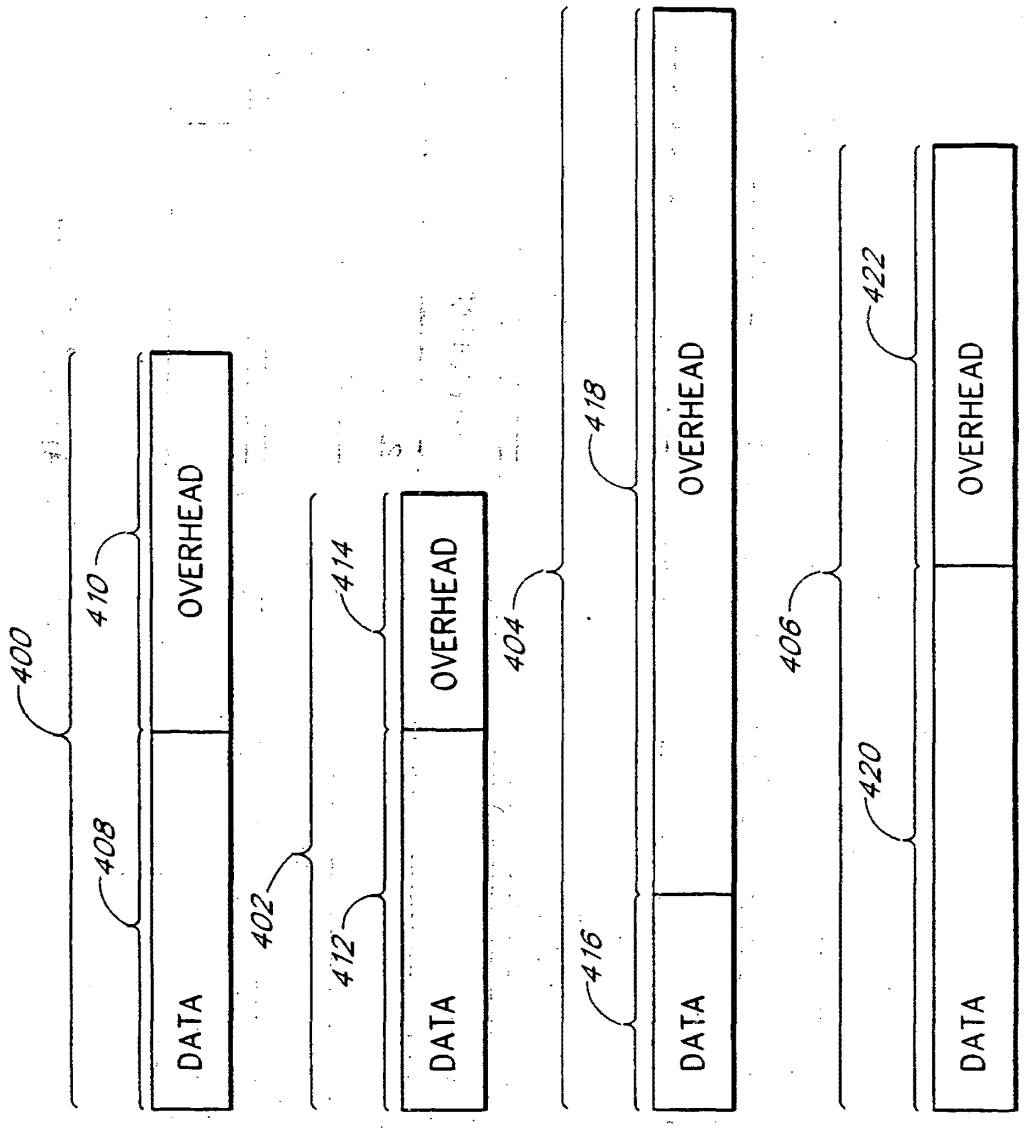

400
410
OVERHEAD
408
DATA
402
414
OVERHEAD
412
DATA
404
418
OVERHEAD
416
DATA
406
422
OVERHEAD
420
DATA

FIG. 8

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 99/04947

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04L1/12

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 6 H04Q H04L

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 97 15131 A (ERICSSON TELEFON AB L M ;ERICSSON GE MOBILE INC (US)) 24 April 1997 see page 18, line 22 - page 19, line 7 see page 19, line 28 - page 20, line 10	1,16,20, 22
A	US 5 404 573 A (OHMORI MASARU ET AL) 4 April 1995 see column 4, line 5 - line 21 see column 6, line 41 - column 7, line 29	1,16,20, 22

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

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"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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 June 1999	09/07/1999

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	Bernedo Azpiri, P

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter onal Application No
PCT/US 99/04947

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9715131 A	24-04-1997	US 5757813 A	26-05-1998
		AU 7452296 A	07-05-1997
US 5404573 A	04-04-1995	JP 5235843 A	10-09-1993

1992)

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(54) System and method for incremental redundancy transmission in a communication system

(57) A system and method for incremental redundancy transmission in a communication system. A time slot is provided having at least one sub-slot with a fixed size, and a data block sized to fit in the sub-slot, a header having a one data block sequence number in the header for the time slot. A parity block is sized smaller than the data block such that the parity block and the data block sequence number fit within the sub-slot. The data block and parity block are trnasmitted in the sub-slot within the time slot. In the header for the time slot the number of data blocks and parity blocks transmitted are identified.

EP 0 938 207 A2

Printed by Jouve, 75001 PARIS (FR)

Fig. 21 shows mapping of RLP frames to layer-1 data symbols for 4-level, 8-level and 16-level modulation formats on the uplink;

Fig. 22 shows a Mode 1 downlink time slot structure; and

Fig. 23 shows a Mode 1 uplink time slot format.

Detailed Description

[0014] Adaptive data rate schemes based on a combination of incremental redundancy coding and adaptive modulation are described earlier for circuit data. Such a channel quality measured technique is described in the commonly owned U.S. patent application SN 08/921454 titled "SYSTEM AND METHOD FOR MEASURING CHANNEL QUALITY INFORMATION; by Krishna Balachandran, Sanjiv Nanda, Srinivas R. Kadaba and Richard P. Ejzak, filed on August 24, 1997, and U. S. patent application SN 08/938031 titled "ADAPTIVE MODIFICATION OF MODULATED AND CODED SCHEMES IN A COMMUNICATION SYSTEM", by Richard P. Ejzak, filed on September 21, 1997, the disclosures of which are hereby incorporated by reference. These schemes achieve high throughput under delay constraints. Provided herein in accordance with the invention is a detailed description of the application of these techniques to 136+ packet data services.

[0015] Described in the application SN 08/938031 by Ejzak is the use of fixed size blocks of size such that an integer number can be accommodated in a slot of a time slotted transmission channel, as a method that enables adaptive modulation. In particular, two, three and four, blocks are accommodated respectively, in a QPSK, 8 PSK and 16 PSK TDMA slot. The requirements of a large per block sequence number to identify the data and parity packets, reduces the efficiency of this method of providing an incremental redundancy, adaptive modulation data communication system using a time slotted communication channel.

[0016] In describing the invention this application uses the media access control (MAC) layer assumptions which are based on the Open System Interconnections (OSI) model. OSI is an internationally accepted frame work of standards for communication between different systems made by different vendors. Most of the dominant communication protocols used today have a structure based on the OSI model. The OSI model organizes the communication process into seven different categories and places these categories in layered sequence based on their relation to the user. Layer 7 through 4 deal with the end to end communication message source and the message destination. While layers 3 through 1 deal with network access.

[0017] Layer 1, the physical layer, deals with the physical means of sending data over lines i.e. the electrical, mechanical and functional control of data circuits. Layer 2, the data link layer, deals with procedures and protocols for operating communication lines. Layer 3, the network layer, determines how data is transferred between computers and routing within and between individual networks.

[0018] It is appreciated that the packet data channel is capable of supporting multiple modulations. The MAC layer is provided with layer 3 frames and translates them into a byte stream using flag delimiters. A radio link protocol (RLP), also referred to as a retransmission link protocol, is used to transfer layer 2 frames between a cell and the mobile station and vice versa. The layer 3 byte stream is segmented into RLP frames, and a sliding window retransmission scheme is used for in-sequence delivery and recovery.

[0019] MAC layer transaction preferably starts with the transmission of a BEGIN frame. On the uplink and downlink, the MAC layer converts the layer 3 frames into a byte stream and packs the byte stream into a series of CONTINUE frames. The last new data burst of a transaction is transmitted using an END frame.

[0020] The BEGIN frame of each transaction is transmitted using 4-level modulation in a stop and wait mode to obtain an acknowledgment from the receiver. On reception of the BEGIN frame, the receiver initializes an RLP. The BEGIN frame is also used to initialize a partial echo (PE) for the transaction, and to specify the mode of operation for subsequent automatic retransmission request (ARQ) mode CONTINUE frames in that transaction.

[0021] There are two possible modes of operation for ARQ mode CONTINUE frames on the downlink and uplink. The first is incremental redundancy (Mode 0) and the second is fixed coding (Mode 1).

[0022] ARQ checks for errors in transmitted data. The sender encodes an error-detection (check) field in the transmitted data based on the contents of the message. The receiver then recalculates the check field and compares it with the check field received. If the check fields match, an ACK (acknowledgment) is transmitted to the sender. If both check fields do not match, a NAK (negative acknowledgment) is returned, and the sender retransmits the message.

[0023] For both uplink and downlink transmissions, bitmap feedback in the form of an ARQ status is provided. In addition, ACK/NAK feedback is provided on a per time slot basis for uplink transmissions.

[0024] For the best tradeoff between high throughput under delay objectives, incremental redundancy or fixed coding is combined with adaptive modulation. Results in the patent applications incorporated by reference herein previously show that if a delay objective is set, 8 or 16-level modulations fail to meet that objective across the $\frac{C}{I+N}$ range of

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[0012] These and other features and advantages of the present invention will become apparent from the following detailed description, the accompanying drawings and the appended claims.

Brief Description Of The Drawings

[0013]

Fig. 1 shows a block diagram describing operation on a packet data channel in accordance with the invention;

Fig. 2 shows a block diagram of the transmitter operation for Mode 0 and shows the blocks involved in conversion of Layer 3 frames into Layer 1 frames;

Fig. 3 shows a block diagram of the transmitter operation for Mode 1 and shows the blocks involved in conversion of Layer 3 frames into Layer 1 frames;

Fig. 4 shows a block diagram describing Mode 0 with a base station to mobile communication link and feedback interactions between the uplink and downlink;

Fig. 5 illustrates the format for a time slot frame with of a data and header frame;

Fig. 6 shows a construction of data and parity blocks from radio link protocol (RLP) frames;

Fig. 7 illustrates the format for a data segment header (DSH) with the number of bits required for each field indicated,

Fig. 8 shows logical layer-1 frame formats assuming 4-level modulation;

Fig. 9 shows logical layer-1 frame formats assuming 8-level modulation with 3 blocks transmitted in each IS-136 time slot;

Fig. 10 shows logical layer-1 frame formats assuming 16-level modulation with 4 blocks transmitted in each IS-136 time slot;

Fig. 11 shows a part of a composite logical flow chart, shown also in Fig. 12, of the process performed at the incremental redundancy soft decoder and FCS checker of Fig 4;

Fig. 12 shows another part of the composite logical flow chart, shown also in Fig. 11, of the process performed at the receive RLP of Fig. 4;

Fig. 13 shows a logical flow chart of the process of generating the feedback signal from the receive RLP and incremental redundancy soft decoder and FCS checker to the Mode 0 RLP of Fig. 4;

Fig. 14 shows a logical flow chart of the process of updating the bit maps at the Mode 0 RLP from the feedback described in Fig. 13;

Fig. 15 shows a logical flow chart of the process of determining the transmission of data and/or parity blocks for each RLP frame without using block bitmaps;

Fig. 16 shows a logical flow chart of the process of determining the transmission of data and/or parity blocks for each RLP frame using block bitmaps and frame bitmaps;

Fig. 17 shows a Mode 0 downlink time slot format;

Fig. 18 shows a Mode 0 uplink time slot formal;

Fig. 19 shows uplink ARQ Status block logical format with 2 bits used for channel quality feedback;

Fig. 20 shows mapping of RLP frames to layer-1 data symbols for 4-level, 8-level and 16-level modulation formats on the downlink;

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cating acknowledgment of the data and parity blocks. The transmit RLP 275 and modulation decision unit 278 is a functional block that represents the functions of Mode 0 RLP 200 of Fig. 2.

[0032] The IRSD 265 receives the output from the receive RLP 260 and produces three outputs. The first output is a decoded data sequence of the received layer 1 frames 120 that is input into a flag remover 280. The second is an ACK/NAK feedback 270 output to the transmit RLP 275. The third output is a channel quality feedback signal 125, which is transmitted back to the transmit RLP 275 and modulation decision unit 278. The flag remover 280 removes the flags from the received data and outputs the received layer 3 frames 285.

[0033] Fig. 5 shows the format of the RLP frame 290, output of the Mode 0 RLP framer 160, which is constructed by adding a FCS 295 to RLP data, R, 300. The FCS 295 is a cyclic redundancy check (CRC) of length L_{DCRC} 305 computed over the data bits. The FCS 295 is added to each RLP frame 300 which consists of L_{DATA} 310 data bits. The lengths L_{DATA} 310 and L_{DCRC} 305 are design parameters. The frames of length L_{FRAME} 315 = L_{DATA} 310 + L_{DCRC} 305 are passed to the encoder 165 of Fig. 2.

[0034] Fig. 6 shows that each RLP frame 290, of size L_{FRAME} 315, Fig. 5, bits, is encoded using a binary rate 1/2 systematic convolutional code by encoder 165. The rate 1/2 binary convolutional encoder 165 is preferably a 32 state maximum free distance code with octal generators. There are L_{FRAME} 315, Fig. 5, data bits 170, and L_{FRAME} 315 parity bits 175, at the output of the encoder 165, Fig. 6, which are divided into blocks as described as follows.

[0035] The L_{FRAME} 315, Fig. 5, data bits 170 at the output of the encoder 165 are segmented into D blocks of length $L_{BLOCK} = \frac{L_{FRAME}(315)}{D}$. These blocks are called data blocks 320 which are denoted by D_{ij} 320 ($j = 1 \ldots D$). The parameter D determines the delay and/or throughput performance as described in the patent applications incorporated by reference herein. The parity bits 175 are punctured and segmented into D parity blocks 325 of equal size denoted by P_{ij} 325 ($j = 1 \ldots D$ as an example P_{i1} 330, P_{i2} 335 and P_{i3} 340). It is appreciated that puncturing of outputs of a convolutional encoder is a procedure of deleting a set of predetermined bits to decrease the number of parity bits. Of the L_{FRAME} 315 parity bits 175 at the encoder 165 output, Dh parity bits are punctured (h in each of the D parity blocks 325); h is the size of the header required for each parity block.

[0036] To each parity block 330, 335 and 340, a parity/control block header (PCBH) 345, 350 and 355 is appended to the front of the parity block P_{ij} 325. For parity blocks, PCBH 345, 350 and 355 contains a one bit PCBH header type (=1 for parity block) and a ten bit block sequence number (BSN). The PCBH 345, 350 and 355 is selectively encoded using a Hamming code.

[0037] The data blocks, Di_1 to D_{iD} 320 contain no redundancy and represent a one to one mapping to the frame R_i 290. The parity blocks Pi_1 to P_{iD} 325 contain parity information derived from R_i 290 and are used by the protocol for forward error correction (FEC) upon decoding failure at the receiver 130 of Fig. 1. Fig. 6 is illustrative of the mapping of data 170 and parity 175 bits to blocks 320 and 325 when D=3 (i.e., with three data blocks per frame). A separate header for each data block 320 is not required. The data 320 and parity 325 blocks are derived from R_i 290 by using a systematic rate 1/2 binary convolutional encoder 165 as shown. For a non-systematic convolutional encoder the same procedure is used. The output bits of the encoder 165 are mapped to the blocks 320 and 325 in an interleaved manner to maximize time and code diversity.

[0038] The Mode 0 RLP 200 of Fig. 2 delivers data in-sequence by initially sending just the RLP data blocks $D_{i1} \ldots D_{iD}$ 320 followed by sending additional RLP parity blocks P_{ij} 325 whenever the receiver 130 of Fig. 1 fails to decode the RLP frame R_i 290 of Fig. 5 correctly. The transmitter 115 of Fig. 1 cannot discard the data 170 and parity 175 bits corresponding to a RLP frame R_i 290 until it has received a positive acknowledgment from the receiver 130, Fig. 1, for R_i 290. The protocol operates by maintaining in a table, frame table and block table, a bitmap for blocks that have been transmitted but not yet acknowledged. Upon obtaining feedback from the receiver 130, Fig. 1, the transmitting protocol updates the table and decides on which data 320 and/or parity 325 blocks to transmit in subsequent time slots.

[0039] Control blocks may be inserted instead of parity blocks 325 in the time slot. For each control block, the PCBH 345 header type bit is set to 0. Examples of control blocks include ARQ Status Block - indicates a bit map of received blocks along with the last in-sequence received block sequence number and END Block - used to indicate completion of a transmission.

[0040] The receive RLP 260 and the IRSD 265 of Fig. 4 is the peer of the Mode 0 RLP 200 of Fig. 2 and is responsible for combining the received blocks D_{ij} 320 and P_{ij} 325, Fig. 6, and jointly decoding them to recover the layer 2 frame R_i 290. The receive RLP 260, Fig. 4, maintains a table to store the received data and parity blocks and decoded RLP frames 300, Fig. 6, until they are delivered in-sequence to layer-3 as layer 3 frames 285, Fig. 4. The blocks are retrieved from layer-1 in soft-decision format and to reduce memory overhead are stored in the receive table by quantizing to q levels.

[0041] The incremental redundancy decoder 265, Fig. 4, corresponds to the transmit encoder 165 of Fig. 4. It is passes the received subset of the soft-decision blocks D_{ij} and P_{ij} and attempts to decode using preferably a soft decision Viterbi algorithm. Any missing soft bits are treated as erasures by the decoder 265 of Fig. 4. The output of the Viterbi decoder is passed to the FCS decoder which computes the FCS and indicates to the receive RLP 260 whether the received frame R_i 290 passed the frame check.

interest. As the ratio of signal to interference plus noise decreases a smaller constellation (i.e. level 4 modulation) density is applied. Adaptation to 4 level modulation is employed under delay spread conditions.

[0025] Fig. 1 shows a high level block diagram of operation on the packet data channel 100 in accordance with the invention. A incremental redundancy transmission communication system 102 is shown were layer 3 frames 105 are provided to the layer 2, MAC layer 110, at the transmitter 115 and are translated into a byte stream using flags for demarcation. This permits the MAC layer 110 to provide a unified transport mechanism for different layer 3 protocols. This byte stream is segmented into RLP frames and assigned a frame sequence number (FSN). The FSN is not explicitly transmitted as part of the RLP frame.

[0026] For higher throughput in either mode, Layer 1 120 data is mapped into symbols chosen from a 4-level, 8-level or 16-level modulation based on knowledge of layer 2 backlog and channel quality feedback 125 from the receiver 130. The channel quality is measured in terms of the signal to interference plus noise ratio, $\frac{C}{I+N}$ at the input to the decoder in the layer 2 block 135 via physical layer 140 at the receiver 130. The decoder 135 then outputs the layer 3 frames 145.

[0027] Fig. 2 shows the layer 2 110 functions (i.e. the procedure for mapping layer 3 frames 105 into layer 1 frames 120) of Fig. 1 for Mode 0. In Mode 0, the layer 3 frames 105 are translated by a flag delimiter 150 in a byte stream 155 time slot signal. The byte stream 155 is segmented into fixed length RLP frames and a frame check sequence (FCS) is computed, by a computation unit, on the data portion of the RLP frame (excluding the FSN) by an RLP framer 160 (a time slot signal generator). The resulting RLP frame is encoded using, for illustration purposes, a Rate 1/2 systematic convolutional encoder 165. A non-systematic convolutional encoder may alternatively be employed. The sub-slots of data bits 170 and the parity bits 175 from the systematic encoder 165 (also known as both a data block signal generator and parity block signal generator) are interleaved separately in Mode 0 interleavers (a first segmenter) 180 and (a second segmenter) 185, and are blocked, by a blocker 190 (also known as an assembler), into D data (a data block signal) and D parity blocks (a parity block signal) 195 which are assigned block identifications $1, \ldots D, D+1, \ldots 2D$, respectively. The block sequence number (BSN), also known as a data block signal sequence number, is determined as a combination of the frame sequence number (FSN) and block identification. Fifteen parity bits are punctured in each parity block so that a parity block header containing the block sequence number may be added. Preferably the data blocks do not contain a block header. Depending on whether 4-level, 8-level or 16-level modulation is used, two, three or four blocks (data or parity), outputted from the Mode 0 RLP 200, are respectively combined into a single layer 1 data segment, by a MAC and layer 1 field adder (header adder and puncturing unit) 210, which is transmitted in a single IS-136 time slot signal. A data segment header indicating the block sequence number of the first data block in the segment is used to identify data block sequence numbers. The remaining data blocks have consecutive block sequence numbers. Along with the coded data segment header (CDSH), other MAC and physical layer headers such as modulation type and partial echo (PE), are added in each time slot signal.

[0028] In Mode 1, Fig. 3, the layer 3 frames 105 are translated by a flag delimiter (flag marker 150) in a byte stream 155. The byte stream 155 is segmented into fixed length RLP frames and a FCS is computed on the data portion of the RLP frame by Mode 1 RLP framer 161. The resulting RLP frames are processed by the Mode 1 RLP 220. Depending on whether 4-level, 8-level or 16-level modulation is used, two, three or four consecutive RLP frames, outputted from the Mode 1 RLP 220, are respectively combined into a single data segment by a data segment and FCS combiner 230 (also called header and FCS adder). The FCS computed on this data segment and a data segment header indicating the FSN of the first RLP frame are added in header and FCS adder 230.

[0029] Then, the header, data and FCS are encoded using a Rate ½ convolutional encoder 235. The output of the encoder 235 is run through a Mode 1 interleaver 240 and additional MAC and physical layer header fields are added by a header adder 210. The output constitutes layer 1 data 120 which is transmitted in a single time slot. The data segment header is transmitted as part of the encoded layer 1 data segment in this case.

[0030] The advantage of incremental redundancy (Mode 0) is that it achieves a higher throughput because redundant bits are transmitted when necessary. The combination of incremental redundancy and adaptive modulation is proposed for both downlink and uplink directions.

[0031] Fig. 4 shows both the transmitting (shown in Fig. 1 as layer 2 functions) and receiving functions for the Mode 0 procedure of Fig. 2. The procedure described at transmitter 115 from the receipt of layer 3 frames 105 to the output 195 of blocker 190 is the same as described with reference to Fig. 2. The layer 1 frames 120 are output from the header adder 210 and input into an adaptive modulator 250. The adaptive modulator 250 modulates and transmits the layer 1 frames 120 through the packet data channel 100 to the channel demodulator 255 at the receiver 130. The channel demodulator 255 demodulates the modulated layer I frames 120 received from the packet data channel 100 and input the results to a receiver RLP 260. The receiver RLP 260 decodes the data segment header to determine the sequence numbers of the received data blocks, as well as the number of parity blocks. The receiver RLP 260 also decodes the parity block header to determine the sequence numbers of the parity blocks. If any of the headers of data on parity blocks are decoded correctly, the data is provided to the incremental redundancy soft decoder and FCS checker (IRSD) 265, and ACK/NAK (acknowledgment/non-acknowledgment) feedback 270 is provided to the transmit RLP 275 indi-

[0052] If the FCS check is successful, the IRSD 265, Fig. 4, in step 460, Fig. 12, updates the table from the RLP frames and in step 475 stores the successfully decoded frames in sequence buffer. In step 480, the IRSD 265, Fig. 4, passes the in-sequence data to the flag remover 280 and updates the frame bit map table and ends the process at 470, Fig. 12.

[0053] Fig. 13 illustrates the process of generating the feedback signal 270 of Fig. 4. First the receive RLP 260, Fig. 4, obtains the frame bit map from the frame bit map table in step 485, Fig. 13. The receive RLP 260, Fig. 4, then obtains the data and/or parity block bit map from the block bit map table in step 490, Fig. 13, and transmits the bit maps via feedback signal 270, Fig. 4, to the mode 0 RLP 275 in step 495, Fig. 13.

[0054] Fig. 14 is illustrative of the mode 0 RLP 275, Fig. 4, processing the feedback signal 270. In step 505, the mode 0 RLP 275, Fig. 4, receives the bit maps transmitted by the receive RLP 260. The mode 0 RLP 275 then updates the RLP frame bit maps in step 510. Fig. 14, and updates the data and/or parity block bit maps in step 515.

[0055] Fig. 15 illustrates the process of transmitting data and/or parity blocks for each RLP frame if only frame bit map are used. In step 525, the mode 0 RLP 275, Fig. 4 receives a new encoded blocked RLP frame and in step 530 orders the block of the RLP frame into a transmit sequence. As an example a round robin sequence of D_{i1}, D_{i2}, D_{i3}, P_{i1}, P_{i2} and P_{i3} is used where D_{i1} repeats after P_{i3}. In step 535, the mode 0 RLP 275, Fig. 4, transmits the data blocks D_{i1}, D_{i2} and D_{i3}. In decision step 540, if the frame bit map indicates a frame acknowledgement (ACK) at the receive RLP 260, Fig. 4, the process continues to step 545. If instead a NAK is registered at the receive RLP 260, Fig. 4, the process continues to step 550. In step 550, the mode 0 RLP 275, Fig. 4, discards the transmit sequence and the process ends at 555.

[0056] At step 545, the mode 0 RLP 275, Fig. 4, transmits the next data or parity block in the transmit sequence and waits in step 560 for the receive RLP 260 to respond. The process then continues back to decision step 540 and the process continues unit all the blocks are properly transmitted.

[0057] Fig. 16 illustrates the process of transmitting data and/or parity blocks for each RLP frame if both a block and a frame bit map are used. In step 565, the mode 0 RLP 275, Fig. 4, receives a new encoded blocked RLP frame and in step 570 orders the block of the RLP frame into a transmit sequence. As an example a round robin sequence of D_{i1}, D_{i2}, D_{i3}, P_{i1}, P_{i2} and P_{i3} is used where D_{i1} repeats after P_{i3}. In step 575, the mode 0 RLP 275, Fig. 4, transmits the data blocks D_{i1}, D_{i2} and D_{i3}. In decision step 580, if the frame bit map indicates a frame acknowledgement (ACK) at the receive RLP 260, Fig. 4, the process continues to step 585. If instead a NAK is registered at the receive RLP 260, Fig. 4, the process continues to step 590. In step 590, the mode 0 RLP 275, Fig. 4, discards the transmit sequence and the process ends at 595.

[0058] At decision step 585, if the block bit map indicates a block non-acknowledgement (NAK) at the receive RLP 260, Fig. 4, the process continues to step 600. If instead, decision step 585 result in ACK, the process continues to step 605. At step 605, the mode 0 RLP 275, Fig. 4, transmits the next data or parity block in the transmit sequence and waits in step 610 for the receive RLP 260 to respond. The process then continues back to decision step 580 and the process continues unit all the blocks are properly transmitted.

[0059] If a NAK is the result of decision step 585, the process proceeds to step 600. At step 600, the mode 0 RLP 275, Fig. 4, transmits NAK data or parity block without a transmit sequence and waits in step 610 for the receive RLP 260 to respond. The process then continues back to decision step 580 and the process continues unit all the blocks are properly transmitted.

[0060] Fig. 17 shows a downlink time slot format for Mode 0. The time slot has the following fields: SYNC - synchronization field (SYNC) 615, packet channel feedback (PCF) 620, coded superframe phase (CSFP) and coded adaptation field (CAF) (shown as CSFP/CAF 625), coded partial echo (CPE) 630, coded data segment header (CDSH) 635, 385, Figs. 8, 9 and 10, reserved (RSVD) 640 and data block 320 Figs. 6, 8, 9 and 10.

[0061] The time slot structures for the downlink and uplink preferably use differentially encoded PSK (DPSK) constellations. If coherent PSK is used, pilot symbols and reference symbols are inserted at appropriate positions in the time slot structure.

[0062] The PCF 620 fields are used as a mechanism for providing ACK/NAK 270, Fig. 4, and channel quality feedback 125, Fig. 4, and time slot assignments on the reverse packet data channel. The CAF 625 on the downlink consists of two bits which indicate the modulation format (4-level, 8-level or 16-level) used for the data. The layer-1 data fields consist of two, three or four blocks which are constructed using the procedure described earlier in Figs. 8, 9, 10 and 11. The adaptation field, superframe phase (SFP) and one reserved bit are encoded together using the same Hamming code that is used for CDVCC in IS-136, 22 bits are used for the CDSH field 635, and a 12 bit CPE 630 field is used to identify the recipient of the data. The SYNC 615 field is transmitted using $\pi/4$-DQPSK. The CSFP/CAF 625, PCF 620, CPE 630 and CDSH 635 are also transmitted using 4-level modulation.

[0063] Contention accesses are transmitted using 4-level modulation. Higher level modulations (8-level and 16-level) are used by mobile stations which have more than one burst to transmit in ARQ CONTINUE mode, and are sniffing for reservation based transmission opportunities.

[0064] Figure 18 shows the preferred uplink time slot structure. The guard (G) 645, ramp (R) 650, preamble (PREAM)

[0042] The data bit stream 170, Fig. 4, and parity bit stream 175 at the encoder output 165 are separately interleaved, by Mode 0 interleavers 180 and 185, and segmented into data and parity blocks by blocker 190. The two, three or four (combinations of data and parity/control) blocks, outputted by the Mode 0 RLP 200, are transmitted in each time slot corresponding to the use of 4-level, 8-level or 16-level modulation respectively. Data or parity blocks are selectively mapped directly into the Layer 1 data portion of an IS-136 time slot (DATA fields shown in Fig. 11 and 12). Figs. 8, 9 and 10 illustrate the logical Layer 1 frame 120, Fig. 5, formats as a function of the modulation type.

[0043] Fig. 7 illustrates that a Layer 1 frame 120, Fig. 4, is associated with a data segment header (DSH) 360. The DSH 360 contains a block sequence number (BSN) 365 which preferably consists often bits. The BSN 365 is associated with the first data block in a time slot; if there are no data blocks, then the BSN 365 is given a default value which is ignored by the receiver 130 of Fig. 4. The DSH 360 also includes a poll indicator (PI) 370; Fig. 7, which preferably consists of one bit. The PI 370 is used by the system 102, Fig. 1, to request an ARQ status frame. The DSH 360 also includes parity/control block pointer (PCBP) 375 which preferably consists of two bits. The PCBP 375 indicates the composition of the time slot in terms of data and parity/control blocks. The DSH 360 also has a reserved (RSVD) 380 header which is preferably one bit in length for future needs.

[0044] The 14 bit DSH 360, Fig. 7, is encoded to obtain a 22 bit coded DSH (CDSH) 385 of Fig. 8, 9 and 10. The encoding preferably employs Hamming codes. In addition each time slot contains a 12 bit coded partial echo (PE) assigned to the transaction in progress which identifies the recipient of the data on the downlink or the originator on the uplink.

[0045] On the downlink, each RLP frame of size 336 bits (40 octet RLP data frame + 16 bits CRC) is encoded using a rate 1/2, memory five, systematic convolutional code. The number of data blocks per RLP frame *(D)* is set to a nominal value of three. The output of the encoder is segmented into three data blocks, each of size 112 bits, and three parity blocks, each of size, 97 bit (punctured from 112 bits). A 15 bit header parity/control block (PCBH) 390, Figs. 8, 9 and 10, is used for each parity block. These blocks are carried two, three or four per time slot as discussed above.

[0046] On the uplink, each frame of size 342 bits (41 octet RLP frame + 14 bits CRC) may be encoded using a rate 1/2, memory five, systematic convolutional code. The number of data blocks per RLP frame *(D)* is set to three. The output of the encoder is segmented into three data blocks, each of size 114 bits, and three parity blocks, each of size, 99 bits (punctured from 114 bits). A 15 bit header (PCBH) 390, Figs. 8, 9 and 10, is used for each parity block. These blocks are carried two, three or four per time slot as discussed above.

[0047] Fig. 8 shows the logical layer-1 frame formats assuming level 4 modulation with two blocks transmitted in each IS-136 time slot. The PCBP 375 value in the DSH 360, Fig. 7, is used to identify the composition of the data segment in the time slot in terms of data and parity blocks. As an example, PCBP 375 = 00 indicated two parity-blocks, PCBP 375 = 01 indicates one data and one parity block and PCBP 375 = 10 indicates two parity blocks. Fig. 9 shows the use of PCBP and the composition of time slot for 8 level modulation and Fig. 10 is for 16 level modulation.

[0048] Fields such as adaptation field (AF) 395, Figs. 8, 9 and 10, and DSH 360, Fig. 7, assume special positions in the time slot and are not transmitted as part of the layer-1 data. The block sequence number (BSN) 365, Fig. 6, in the CDSH 385, Figs. 8, 9 and 10, denotes the sequence number corresponding to the first data block 320 in the slot. If only parity blocks 340 are transmitted, this field is ignored. In addition to the fields shown above, the coded PE assigned to the MAC Layer transaction is used as a mobile station identifier.

[0049] Figs. 11, 12, 13 and 14 are illustrative of examples of the process performed by the receive RLP 260, Fig. 4, IRSD 265, feedback 270 to the Mode 0 RLP 275, and the Mode 0 RLP 275. In step 400 of Fig. 11, the receive RLP 260, Fig. 4, receives a demodulated time slot from the channel demodulation 255 and in step 405, Fig. 11, decodes the data segment header (DSH) 360 of Fig. 7. In decision step 410, if the DSH 360, Fig. 7, is successfully decoded the process continues to step 415, Fig. 11. If the DSH 360, Fig. 7, is not successfully decoded the process instead continues to step 420, Fig. 11. In step 420, the receive RLP 260, Fig. 4, discards the time slot and the process continues to node A 425, Fig. 11, which starts the new process at the IRSD 265 of Fig. 4.

[0050] If the DSH 360, Fig. 7, is successfully decoded the receive RLP 260, Fig. 4, in step 415, Fig. 11, reads the PCBP 375, Figs. 7, 8, 9 and 10, in the DSH 360, Fig. 7, and determines the number of data 320, Fig. 6, and parity blocks 325 and decodes the PCBH 345, 350, 355 Fig. 6, 390 Figs. 8, 9 and 10 for the parity blocks. The receive RLP 260, Fig. 4, then, in step 430, Fig. 11, updates the block bitmap table for the received data and parity blocks and in step 435 passes the soft information and data/parity block sequence numbers to the IRSD 265 and continues the process at the IRSD 265 at node A 425.

[0051] Fig. 12 shows the process performed by the IRSD 265 of Fig. 4. The process starts in step 440, Fig. 12, the IRSD 265, Fig. 4, receives soft information and data/parity block numbers from the receive RLP 260. In step 445, Fig. 12, the IRSD 265, Fig. 4, decodes the RLP frames associated with the new received data and/or parity blocks using previously stored data and/or parity blocks associated with the RLP frames. The IRSD 265, in step 450, Fig. 12, then checks the FCS associated with each RLP frame decoded. In decision step 455, if the FCS check is successful the process continues to step 460. If the FCS check is not successful the process instead continues to step 465. In step 465, the new soft information associated with the received data/parity block is stored and the process ends at 470.

segment header (DSH) which contains a ten bit block sequence number (BSN) and one bit poll indicator (PI) to request ARQ status

[0075] The resulting data segment, containing RLP frames, DSH, and CRC bits, is encoded using a memory 5, rate 1/2 convolutional code. The coded bits are punctured and mapped to symbols that are chosen from a 4-level, 8-level or 16-level constellation. The puncturing depends on the modulation format used for the transmission of that slot as shown in Figs. 20 and 21.

[0076] Since the frame check on the data segment consisting of two, three, or four RLP frames, if the CRC fails at the receiver, then all frames in the slot will be lost and will have to be recovered through ARQ recovery. Assigning a FCS to each "small" RLP frame is inefficient due to excessive overhead.

[0077] On the downlink, each RLP frame consists of 88 bits (eleven octets). To each set of two, three or four RLP frames, an eleven bit DSH and ten bit CRC are added. The resulting combination is encoded using a rate 1/2, memory 5 convolutional code as shown in Figure 20. At the encoder output, 128, 201 or 254 bits are punctured depending on whether 4-level, 8-level or 16-level modulation is used, and the remaining bits are mapped to the desired modulation format, and inserted in the DATA fields in the time slot.

[0078] On the uplink each RLP frame consists of 96 bits (12 octets). To each set of two, three or four RLP frames, an eleven bit DSH and ten bit CRC are added. The resulting combination is encoded using a rate 1/2, memory 5 convolutional code as shown in Fig. 21. At the encoder output, 176, 243 or 310 bits are punctured depending on whether 4-level, 8-level or 16-level modulation is used, and the remaining bits are mapped to the desired modulation format.

[0079] The slot formats assume the use of DPSK. If coherent PSK or QAM are used, then pilot symbols are inserted at appropriate positions in the time slot.

[0080] The downlink time slot format is shown in Figure 22. The packet channel feedback (PCF) 800 fields are used as a mechanism for providing ACK/NAK and channel quality feedback and time slot assignments on the reverse packet data channel. The layer-1 data fields consist of two, three or four RLP frames which are constructed using the procedure described above. The adaptation field (AF) on the downlink consists of two bits which indicate the modulation format (4 level, 8 level or 16 level) used for the data. The adaptation field, superframe phase (SFP) and one reserved bit are encoded together using the same (12,8) Hamming code that is used for CDVCC in IS-136. A 12 bit CPE 810 field is used to identify the recipient of the data 805. The SYNC 805 field is transmitted using $\pi/4$-DQPSK. The CSFP/CAF 820, PCF 800 and CPE 810 are transmitted using 4-level modulation.

[0081] Fig. 23 shows the proposed uplink time slot structure. The guard (G) 825, ramp (R) 830, preamble (PREAM) 835 and SYNC 815 fields are maintained as in IS-136, a new coded adaptation field (CAF) 840 is introduced to indicate the modulation format for the data 845. A 12 bit CPE 810 is used to indicate the transmitter identity. Two bits are used for the modulation type; these are encoded using a (6,2) code. G 825, R 830, PREAM 835, CPE 810 and CAF 840 are transmitted using 4-level modulation.

[0082] Contention accesses are transmitted using 4-level modulation. Higher level modulations (8-level and 16-level) are used in ARQ Mode CONTINUE frames by mobile stations which have more than one burst to transmit, and are sniffing for reservation based transmission opportunities.

[0083] Adaptive modulation as in Mode 0, the modulation type is fixed only for a time slot and not over an entire MAC Layer transaction. Layer 1 determines the modulation type to use for the next time slot based on the channel quality feedback from the receiver and the needs of Layer 2. Since the RLP frame sizes in Mode 1 are chosen to be the same independent of the modulation type, retransmitted frames may be sent on a different modulation type from the original transmission. The modulation formats considered are 4 level (DQPSK or $\pi/4$-coherent PSK), 8 level (differential or coherent) and 16 level (PSK, DPSK or QAM) modulation. A two bit adaptation field is used to describe the coding and/or modulation format used. Table 1 shows the mapping of the AF values to corresponding modulation formats.

[0084] A default value specifies the default DQPSK format with Rate 5/6 coding. This permits different packet data channel frame formats and interworking between incremental redundancy and coding modes.

[0085] Similar to Mode 0, the downlink Channel Quality Feedback (CQF) is provided by the mobile station on the reverse packet data channel in a layer-2 "ARQ Status" frame. The ARQ status frame may be transmitted in any reserved uplink time slot. A two bit channel quality indicator is used to denote the maximum allowable modulation type, and the cell transmitter uses this information along with knowledge of the Layer-2 data backlog in order to determine the modulation to use in subsequent slots.

[0086] For the uplink, channel quality feedback is provided in the PCF corresponding to reserved slots. The subchannel feedback (SF) field in the PCF provides ACK/NAK and channel quality feedback for the previous slot as well as channel quality feedback (CQF) which serves as a modulation format advisory for subsequent assignments to the mobile station being acknowledged. For ACK/NAK feedback, as in Mode 0, a simple (6,1) repetition code is used. A (6,2) code is used for channel quality feedback.

[0087] Stated generally, the present invention encompasses an incremental redundancy transmission communication system 102, Fig. 2. The system comprises a time slot signal generator 160 that creates a time slot signal 155

655 and SYNC 615 fields are maintained as in IS-136; a new coded adaptation 20 field (CAF) 660 is introduced to indicate the modulation format for the data. Two bits are used for the modulation type; these are encoded using a (6,2) code. The CDSH 635 uses 22 bits, and a 12 bit CPE 665 is used to identify the mobile station. G 645, R 650, PREAM 655, CPE 665, CDSH 635 and CAF 660 are transmitted using 4-level modulation.

[0065] The modulation type is fixed for a time slot and not over an RLP frame or an entire MAC Layer transaction. Layer 1 determines the modulation type to use for the next time slot based on the channel quality feedback 125, Fig. 4, from the receiver 130 and the needs of layer 2. The modulation formats utilized are 4 level (DQPSK or $\pi/4$-coherent PSK), 8 level (differential or coherent) and 16 level (PSK, DPSK or QAM) modulation. A two bit adaptation field is used to indicate the coding and/or modulation format used. Table 1 shows the mapping of the AF values to corresponding modulation formats.

[0066] A default value specifies the default DQPSK format with Rate 5/6 coding within the time slot to allow different packet data channel frame formats and interworking between incremental redundancy and coding modes.

Table 1

AF	Coding and/or Modulation Format
00	4-level ($\pi/4$-QPSK or $\pi/4$-DQPSK)
01	8-level (PSK or DPSK)
10	16-level (QAM, PSK or DPSK)
11	Default (e.g. rate 5/6, memory 5 convolutional coding with 4-level modulation)

[0067] Channel Quality Feedback (CQF) 125, Fig. 4, is provided by the mobile station on the reverse packet data channel in a layer-2 "ARQ Status" block as shown in Fig. 19. The ARQ status block is preferably transmitted in any reserved uplink time slot. A two bit channel quality indicator is used to denote the maximum allowable modulation type.

[0068] The PCBH 670 for the ARQ status block consists of one bit PCBH header type (= 0), one bit control block type (= 0, for ARQ status block), two bit CQF field, seven bit frame sequence number (FSN), identifying the beginning frame for the bit-map feedback.

[0069] The PCBH 670 is encoded using the (15,11) code. The rest of the ARQ status block consists of the bit-map feedback 675 and CRC 680, encoded using the default 5/6 rate convolutional code.

[0070] For the uplink, channel quality feedback is provided in the PCF corresponding to reserved slots. The subchannel feedback (SF) field in the PCF provides ACK/NAK and channel quality feedback for the previous slot as well as channel quality feedback (CQF) which serves as a modulation format advisory for subsequent assignments to the mobile station being acknowledged. For ACK/NAK feedback, a simple (6,1) repetition code is used A (6,2) code is used for channel quality feedback.

[0071] The receiver 130, Fig 4, obtains channel quality information by averaging the Euclidean distance between the received symbol sequence and the decoded sequence of symbols to obtain an implicit measure of the signal to interference plus noise ratio, C/(I+N) at the input to the decoder 265. As described in the patent applications incorporated by reference herein, this method yields good estimates under both noise limited and interference limited conditions for different coded modulation schemes across the range of Doppler frequencies. The metric computation is independent of the actual decoder implementation and can be computed using the decoded information sequence.

Table 2

Channel Conditions	Channel Quality Indicator - Maximum Allowable Modulation Format
$C/(I+N) < \theta_L$	00 (4-level)
$\theta_L < C/(I+N) < \theta_H$	01 (8-level)
$C/(I+N) > \theta_H$	10 (16-level)

[0072] Table 2 shows the scheme for determining the maximum allowable modulation type based on C/(I+N) estimated at the receiver. The mobile station receiver uses the channel quality metric along with knowledge of C/(I+N) thresholds, θ_L, θ_H and which are transmitted over the packet broadcast control channel (PBCCH).

[0073] As in Mode 0, the byte stream obtained from Layer 3 frames is segmented into RLP frames. However, in this mode, RLP frames are smaller in size than in the incremental redundancy case. Two, three or four RLP frames are transmitted in each time slot depending on the modulation type (i.e., if 4-level, 8-level or 16-level modulation respectively, is used).

[0074] Two, three or four RLP frames are concatenated with a ten bit frame check sequence (FCS) and a data

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7. The system of claim 1 including a transmitter that transmits a parity block signal with the data block signal sequence number in the sub-slot.

8. The system of claim 1 including a receiver that identifies the sequence of data block signals in the time slot as being consecutive from a first data block.

9. The system of claim 1 including a transmitter that sizes the data block signals for operation in a plurality of modulation schemes.

10. The system of claim 9 wherein the transmitter selectively sizes the data block signals so that the data block signals fit within the sub-slot at each one of the plurality of modulation schemes.

11. The method of claim 10 wherein the transmitter uses a code rate defined by the equation

$$\frac{ND}{(ND + MP)} = \frac{N}{(2N - q)}$$

in which N is the data block signal size, M is a parity block signal size, q is the length of the data block signal sequence number field, D is the number of data blocks and P is the number of parity blocks.

12. The system of claim 1 including a computation unit that computes a frame check sequence, and a adder that adds the frame check sequence to the radio link protocol frame to define a frame Bi.

13. The system of claim 12 including an encoder that encodes the frame Bi into N data bits and N parity bits, a first segmenter that segments the N data bits into D data block signals, a second segmentor that segments the N parity bits into P parity block signals of equal size, and a puncturing unit that selectively punctures the P parity block signals to insert a header.

14. The system of claim 13 wherein the header includes a header type identifier and a data block signal sequence number for selected parity block signals.

15. The system of claim 13 further includes a memory unit that stores information corresponding to the N data bits and N parity bits.

16. The system of claim 15 wherein the memory unit includes a bitmap for delivered D data block signals and P parity block signals.

17. A method for incremental redundancy transmission in a communication system that uses radio protocol frames, comprising the steps of:

creating a time slot signal having at least one sub-slot with a fixed size;
creating a data block signal sized to fit in the sub-slot;
establishing a header having a data block signal sequence number in the header for the time slot signal; and
identifying in the header for the time slot signal the number of data block signals consecutively transmitted.

18. The method of claim 17 including the steps of creating a parity block signal sized smaller than the data block signal such that the parity block signal and the data block signal sequence number fit within the sub-slot and transmitting the data block signal and parity block signal in the sub-slot within the time slot signal.

19. The method of claim 17 including the step of transmitting the parity block signal with the data block signal sequence number in the sub-slot.

20. The method of claim 17 including the step of identifying the sequence of data block signals in the time slot as consecutive from a first data block.

21. The method of claim 17 including the step of sizing the data block signals for operation in a plurality of modulation schemes.

having at least one sub-slot with a fixed size and a data block signal generator 165 that creates a data block signal 170 sized to fit in the time slot. A header adder 210 that generates a header having a data block signal sequence number in the header for the time slot signal is also provided. A receiver 130, Fig. 4,is also provided that identifies in the header for the time slot signal, a number of data block signals 170 consecutively transmitted.

[0088] The invention further includes a parity block signal generator 165, Fig. 2, that creates a parity block signal 175 sized smaller than the data block signal 170 such that the parity block signal 175 and the data block signal sequence number fit within the sub-slot, and a transmitter 115 that transmits the data block signal 170 and parity block signal 175 in the sub-slot within the time slot signal.

[0089] The present invention further encompasses a method for incremental redundancy transmission in a communication system that uses radio (or retransmission) protocol link frames. The method comprises the step of creating a time slot signal having at least one sub-slot with a fixed size, creating a data block signal 170, Fig. 2, sized to fit in the sub-slot, establishing a header having a data block signal sequence number in the header for the time slot signal and identifying in the header for the time slot signal, the number of data block signals 170 consecutively transmitted. The steps of providing, in a header of the time slot signal, a data block sequence number for a first data block signal 170 in a sequence of data block signals 170 and creating a parity block signal 175 smaller than the data block signal 170 such that the parity block signal 175 sequence number fits within the sub-slot signal are also provided.

[0090] While the specification in this invention is described in relation to certain implementations or embodiments, many details are set forth for the purpose of illustration. Thus, the foregoing merely illustrates the principles of the invention. For example, this invention may have other specific forms without departing from its spirit or essential characteristics. The described arrangements are illustrative and not restrictive. To those skilled in the art, the invention is susceptible to additional implementations or embodiments and certain of the details described in this application can be varied considerably without departing from the basic principles of the invention. It will thus be appreciated that those skilled in the art will be able to devise various arrangements which, although not explicitly described or shown herein, embody the principles of the invention are thus within its spirit and scope.

Claims

1. An incremental redundancy transmission communication system comprising:

   a time slot signal generator that creates a time slot signal having at least one sub-slot with a fixed size;

   a data block signal generator that creates a data block signal sized to fit in the at least one sub-slot;

   a header adder that generates a header having a data block signal sequence number in the header for the time slot signal; and

   a receiver that identifies in the header for the time slot signal a number of data block signals consecutively transmitted.

2. The system of claim 1 including a parity block signal generator that creates a parity block signal sized smaller than the data block signal such that the parity block signal and the data block signal sequence number fit within the sub-slot, and a transmitter that transmits the data block signal and parity block signal in the sub-slot within the time slot signal.

3. The system of claim 2 wherein the receiver identifies in the header for the time slot signal the number of data block signals and parity block signals in the time slot signal.

4. The system of claim 2 wherein the data block signal generator and parity block signal generator create an integer number of total data block signals and the parity block signals that fit in the time slot signal.

5. The system of claim 2 including an encoder that separately encodes the sequence of data block signals and parity block signals, and an interleaver that separately interleaves the sequence of data block signals and parity block signals.

6. The system of claim 5 further including an assembler that assembles the sequence of data block signals and parity block signals into time slot signals as determined by a retransmission protocol after to the encoder and interleaver.

37. The method of claim 35 including the steps of storing in a memory information corresponding to the N data bits and N parity bits, transmitting the D data block signals corresponding to the radio link protocol, decoding the Bi frame, and transmitting additional P parity block signals corresponding to the radio link protocol when whenever the Bi frame is not correctly decoded.

38. The method of claim 37 including the step of clearing the memory whenever the Bi frame is correctly decoded.

39. The method of claim 37 in which the memory includes a bitmap for delivered D data block signals and P parity block signals.

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22. The method of claim 21 including the step of selectively sizing of the data block signals so that the data block signals fit within the sub-slot at each one of the plurality of modulation schemes.

23. A method for incremental redundancy transmission in a communication system, comprising the steps of:

creating a time slot signal having a sub-slot with a fixed size;
creating a data block signal sized to fit within the sub-slot;
providing, in a header of the time slot signal, a data block signal sequence number for a first data block signal in a sequence of data block signals; and
creating a parity block signal smaller than the data block signal such that the parity block signal and the data block signal sequence number fit within the sub-slot signal.

24. The method of claim 23including the step of transmitting the parity block signal with the data block signal sequence number in the sub-slot.

25. The method of claim 23 including the step of identifying the sequence of data block signals in the time slot signal as consecutive from the first data block signal.

26. The method of claim 18 or 23 including the step of identifying in the header for the time slot signal the number of data block signals and parity block signals in the time slot signal.

27. The method of claim 26 including the step of sizing the data block signals for operation in a plurality of modulation schemes.

28. The method of claim 27 including the step of selectively sizing of the data block signals so that the data block signals fit within the sub-slot at each one of the plurality of modulation schemes.

29. The method of claim 18 or 23 including the step of inserting into the time slot signal an integer number of total data block signals and parity block signals.

30. The method of claim 22 or 29 wherein the transmitter uses a code rate defined by the equation

$$\frac{ND}{(ND + MP)} = \frac{N}{(2N - q)}$$

in which N is the data block signal size, M is a parity block signal size, q is the length of the data block signal sequence number field, D is the number of data blocks and P is the number of parity blocks.

31. The method of claim 18 or 23 involving the steps of separately encoding the sequence of data block signals and parity block signals, and interleaving separately the sequence of data block signals and parity block signals.

32. The method of claim 18 or 31 including the step of assembling the sequence of data block signals and parity block signals into time slot signals as determined by a retransmission protocol prior to the steps of encoding and interleaving.

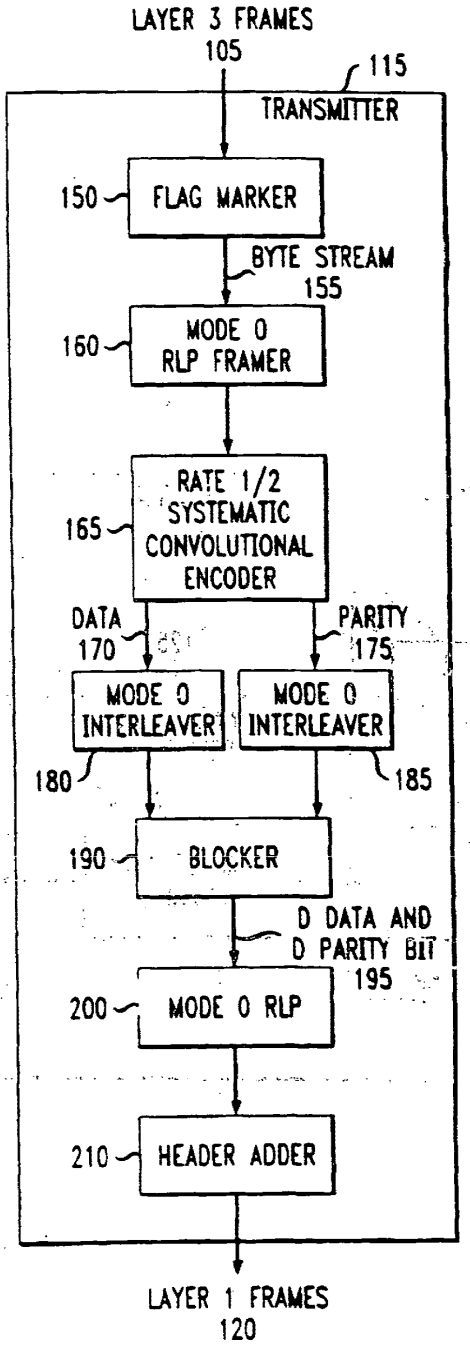
33. The The method of claim 32 including including the steps of decoding the sequence of data block signals and parity block signals, and decoding the data stored at the transmitter only when a positive acknowledgment is received that the time slot signal is correctly decoded.

34. The method of claim 17 or 33 including the steps of computing a frame check sequence, and adding the frame check sequence to the radio link protocol frame to define a frame Bi.

35. The method of claim 34 including the steps of encoding the frame Bi into N data bits and N parity bits, segmenting the N data bits into D data block signals, segmenting the N parity bits into P parity block signals of equal size, and selectively puncturing the P parity block signals to insert a header.

36. The method of claim 35 wherein the header includes a header type identifier and a data block signal sequence number for selected parity block signals.

FIG. 2



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FIG. 1

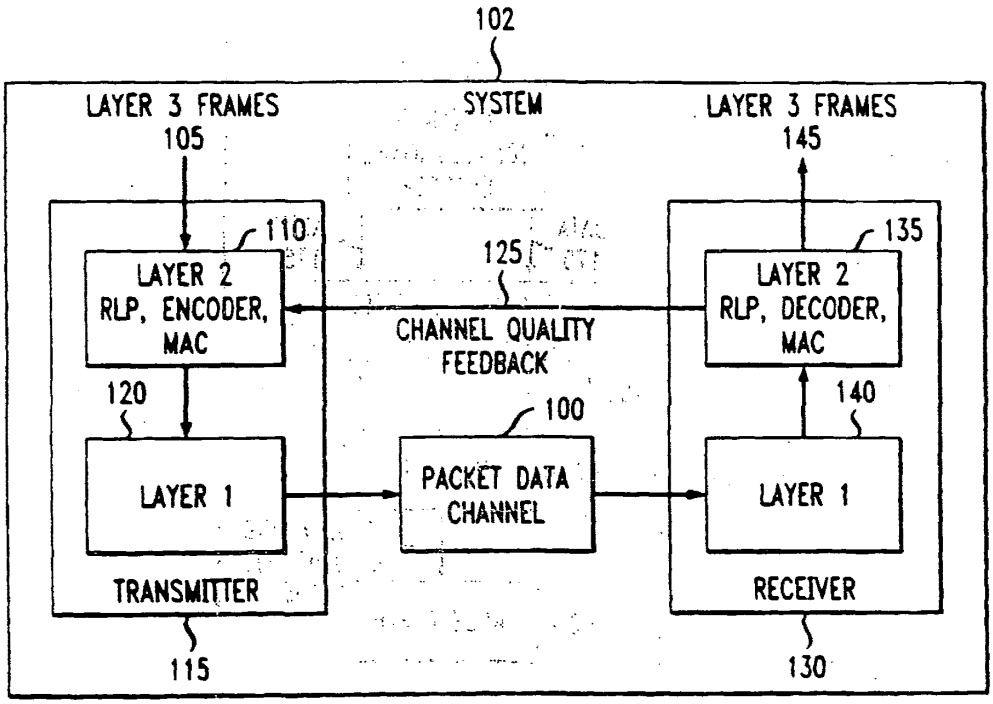

102
SYSTEM
LAYER 3 FRAMES
105
LAYER 3 FRAMES
145
110
LAYER 2
RLP, ENCODER,
MAC
125
CHANNEL QUALITY
FEEDBACK
135
LAYER 2
RLP, DECODER,
MAC
120
140
100
LAYER 1
PACKET DATA
CHANNEL
LAYER 1
TRANSMITTER
RECEIVER
115
130

FIG. 4

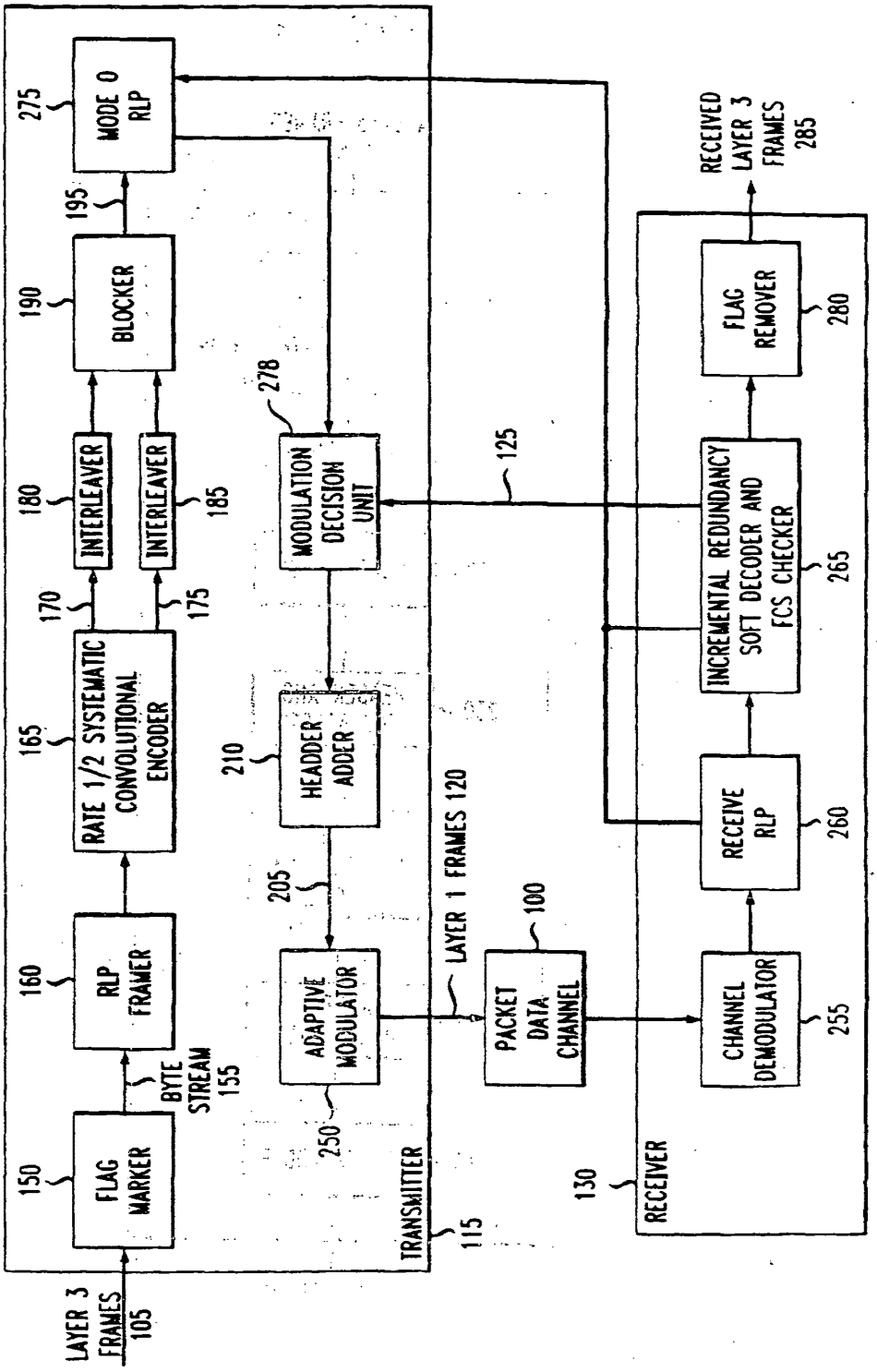
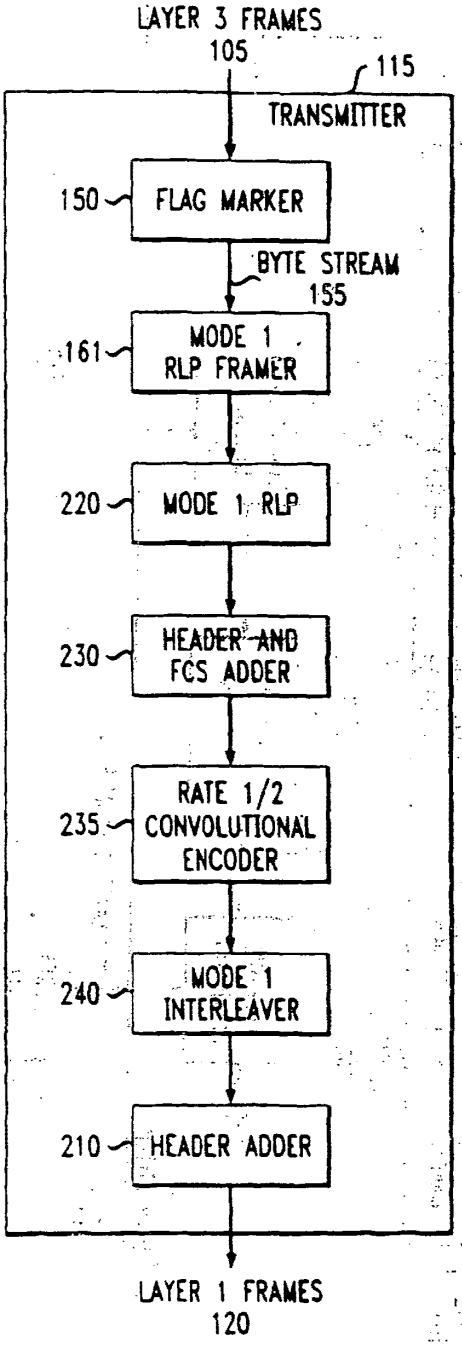

LAYER 3 FRAMES 105
FLAG MARKER 150
RLP FRAMER 160
BYTE STREAM 155
RATE 1/2 SYSTEMATIC CONVOLUTIONAL ENCODER 165
INTERLEAVER 170
INTERLEAVER 175
BLOCKER 180
INTERLEAVER 185
BLOCKER 190
MODE 0 RLP 195
MODE 0 RLP 275
MODULATION DECISION UNIT 278
HEADDER ADDER 210
ADAPTIVE MODULATOR 205
ADAPTIVE MODULATOR 250
TRANSMITTER 115
LAYER 1 FRAMES 120
PACKET DATA CHANNEL 100
125
RECEIVER 130
CHANNEL DEMODULATOR 255
RECEIVE RLP 260
INCREMENTAL REDUNDANCY SOFT DECODER AND FCS CHECKER 265
FLAG REMOVER 280
RECEIVED LAYER 3 FRAMES 285

FIG. 3



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FIG. 7

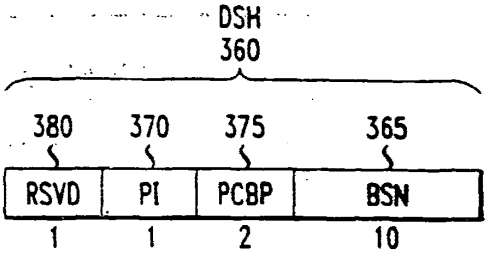

DSH
360
380
370
375
365
RSVD
PI
PCBP
BSN
1
1
2
10

FIG. 8

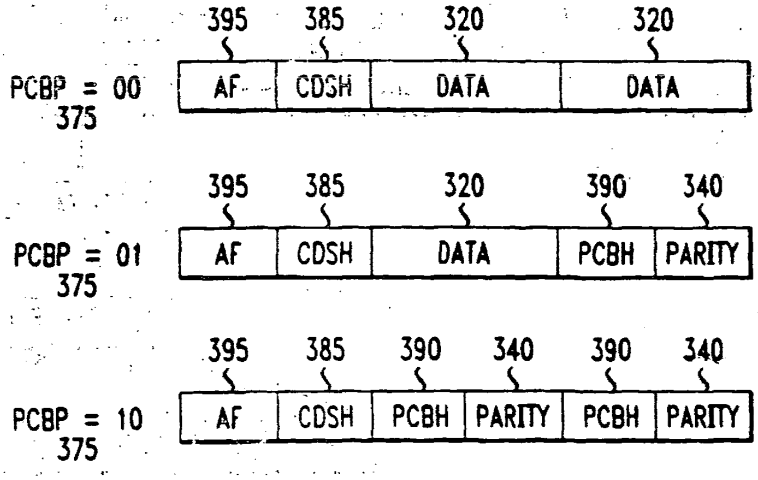

395
385
320
320
PCBP = 00
375
AF
CDSH
DATA
DATA
395
385
320
390
340
PCBP = 01
375
AF
CDSH
DATA
PCBH
PARITY
395
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340
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340
PCBP = 10
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CDSH
PCBH
PARITY
PCBH
PARITY

FIG. 5

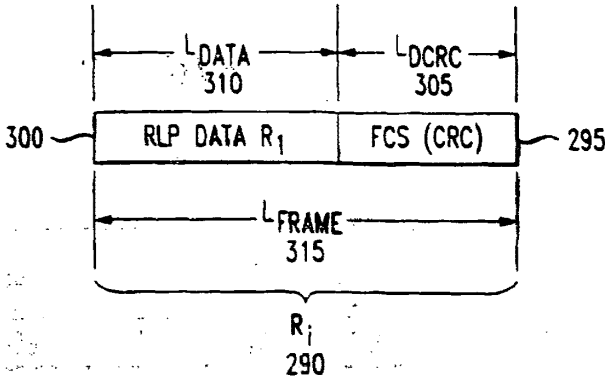
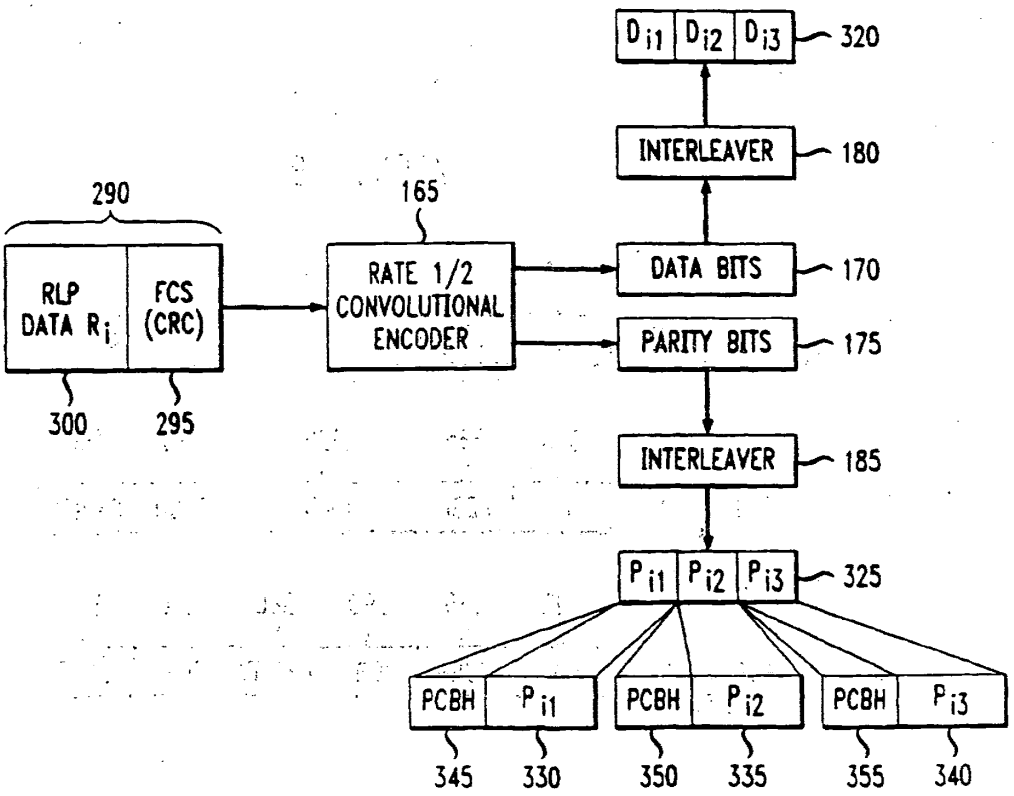
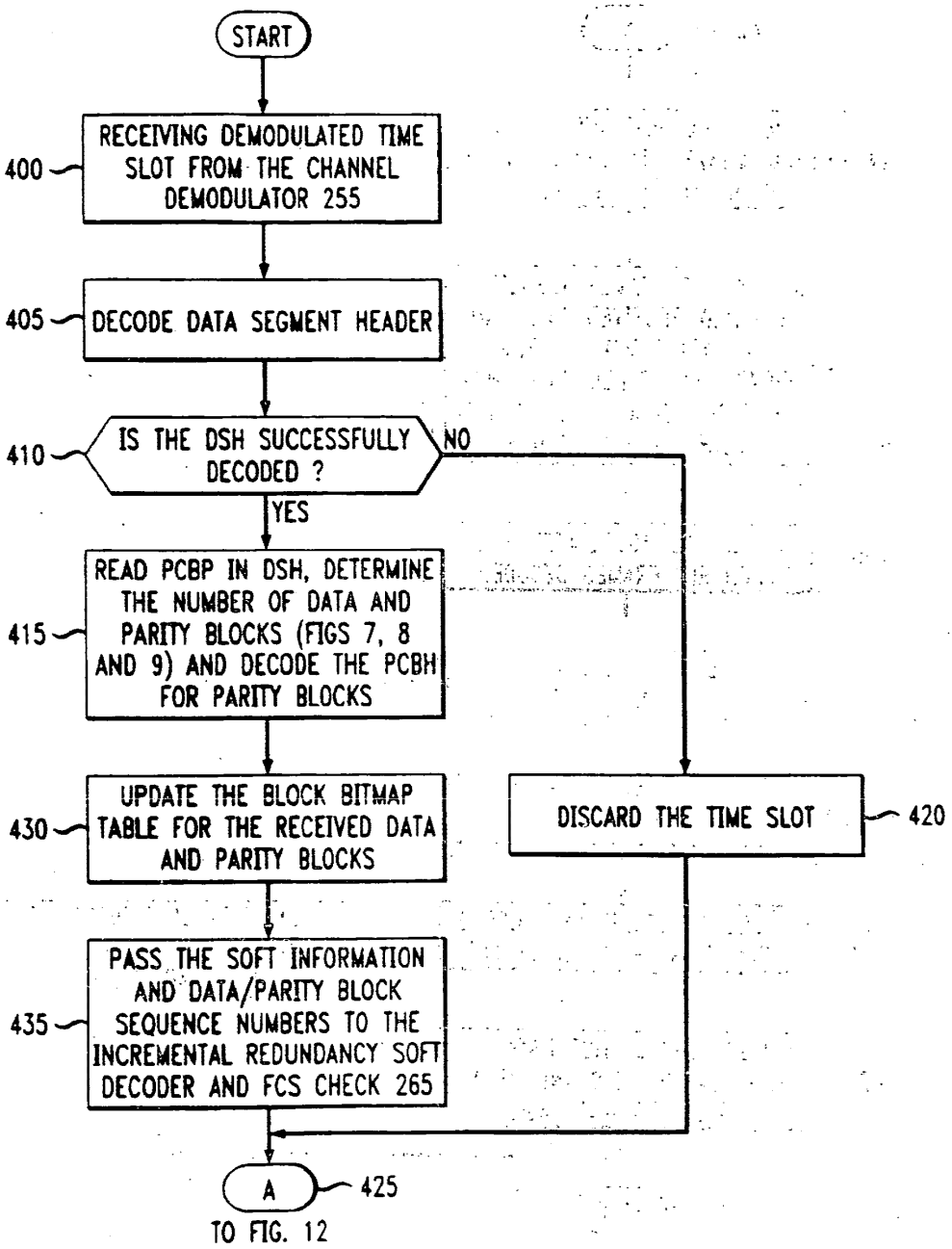


FIG. 6



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FIG. 11



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FIG. 12

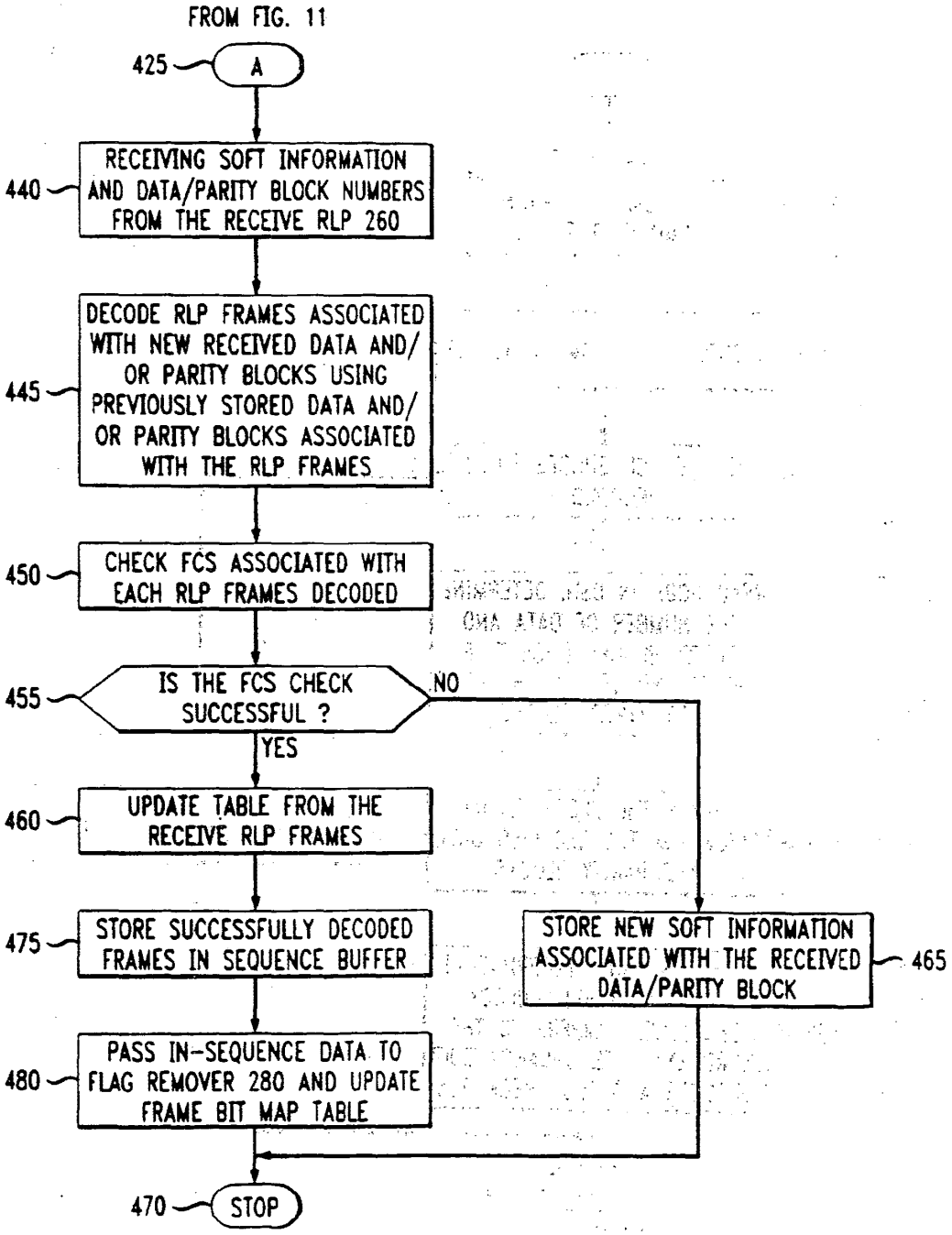

FROM FIG. 11
425
A
440
RECEIVING SOFT INFORMATION AND DATA/PARITY BLOCK NUMBERS FROM THE RECEIVE RLP 260
445
DECODE RLP FRAMES ASSOCIATED WITH NEW RECEIVED DATA AND/OR PARITY BLOCKS USING PREVIOUSLY STORED DATA AND/OR PARITY BLOCKS ASSOCIATED WITH THE RLP FRAMES
450
CHECK FCS ASSOCIATED WITH EACH RLP FRAMES DECODED
455
IS THE FCS CHECK SUCCESSFUL ?
NO
YES
460
UPDATE TABLE FROM THE RECEIVE RLP FRAMES
475
STORE SUCCESSFULLY DECODED FRAMES IN SEQUENCE BUFFER
480
PASS IN-SEQUENCE DATA TO FLAG REMOVER 280 AND UPDATE FRAME BIT MAP TABLE
STORE NEW SOFT INFORMATION ASSOCIATED WITH THE RECEIVED DATA/PARITY BLOCK
465
470
STOP

FIG. 13

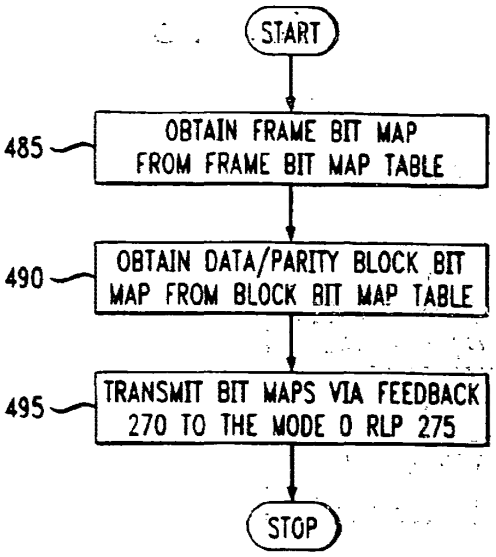

START
485
OBTAIN FRAME BIT MAP FROM FRAME BIT MAP TABLE
490
OBTAIN DATA/PARITY BLOCK BIT MAP FROM BLOCK BIT MAP TABLE
495
TRANSMIT BIT MAPS VIA FEEDBACK 270 TO THE MODE 0 RLP 275
STOP

FIG. 14

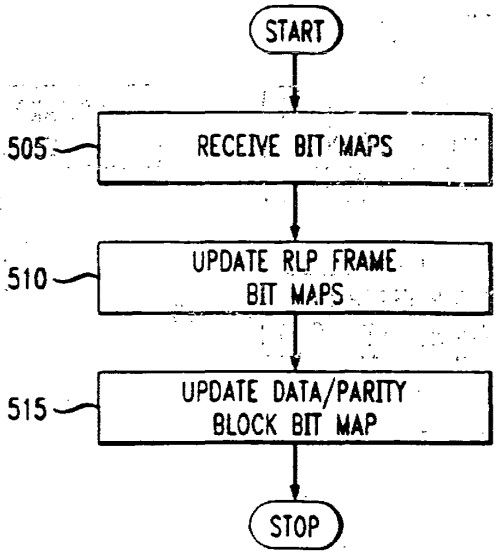

START
505
RECEIVE BIT MAPS
510
UPDATE RLP FRAME BIT MAPS
515
UPDATE DATA/PARITY BLOCK BIT MAP
STOP

FIG. 15

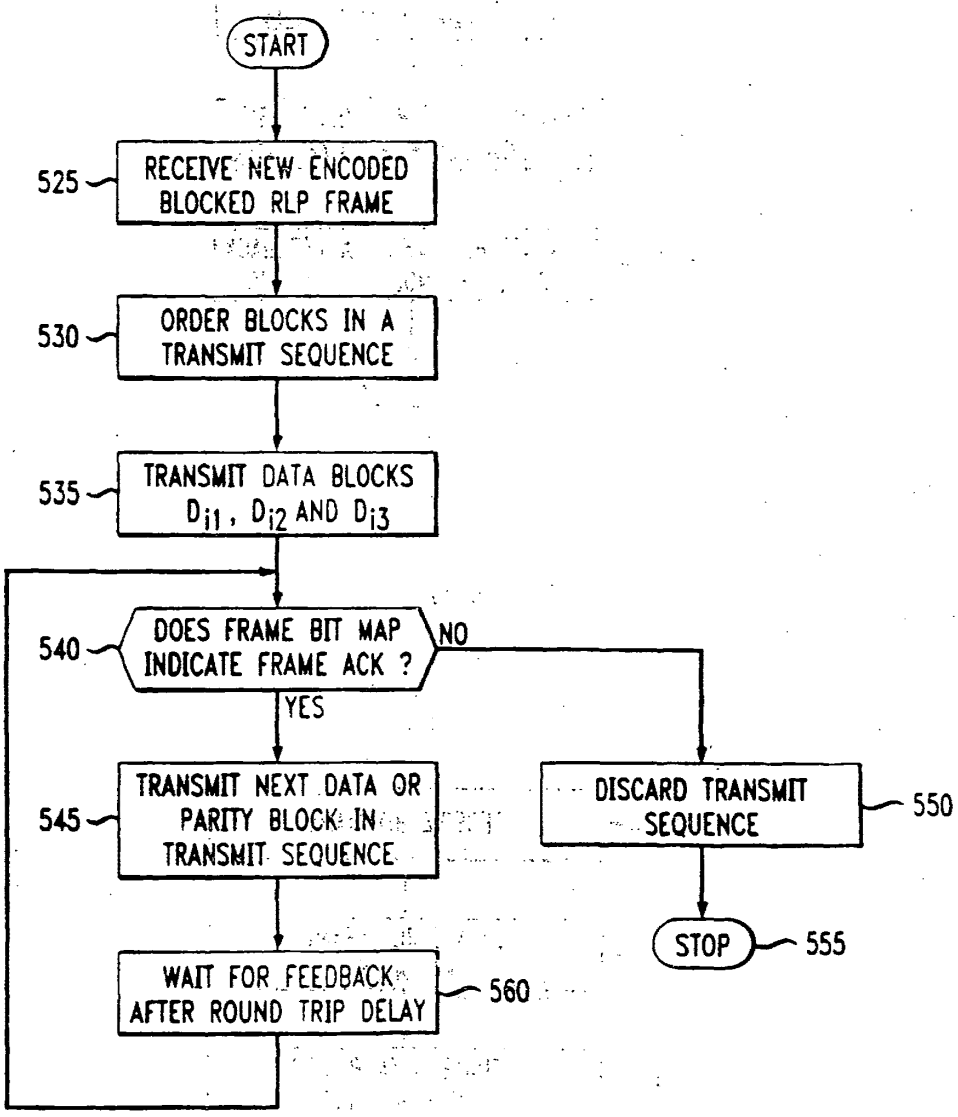
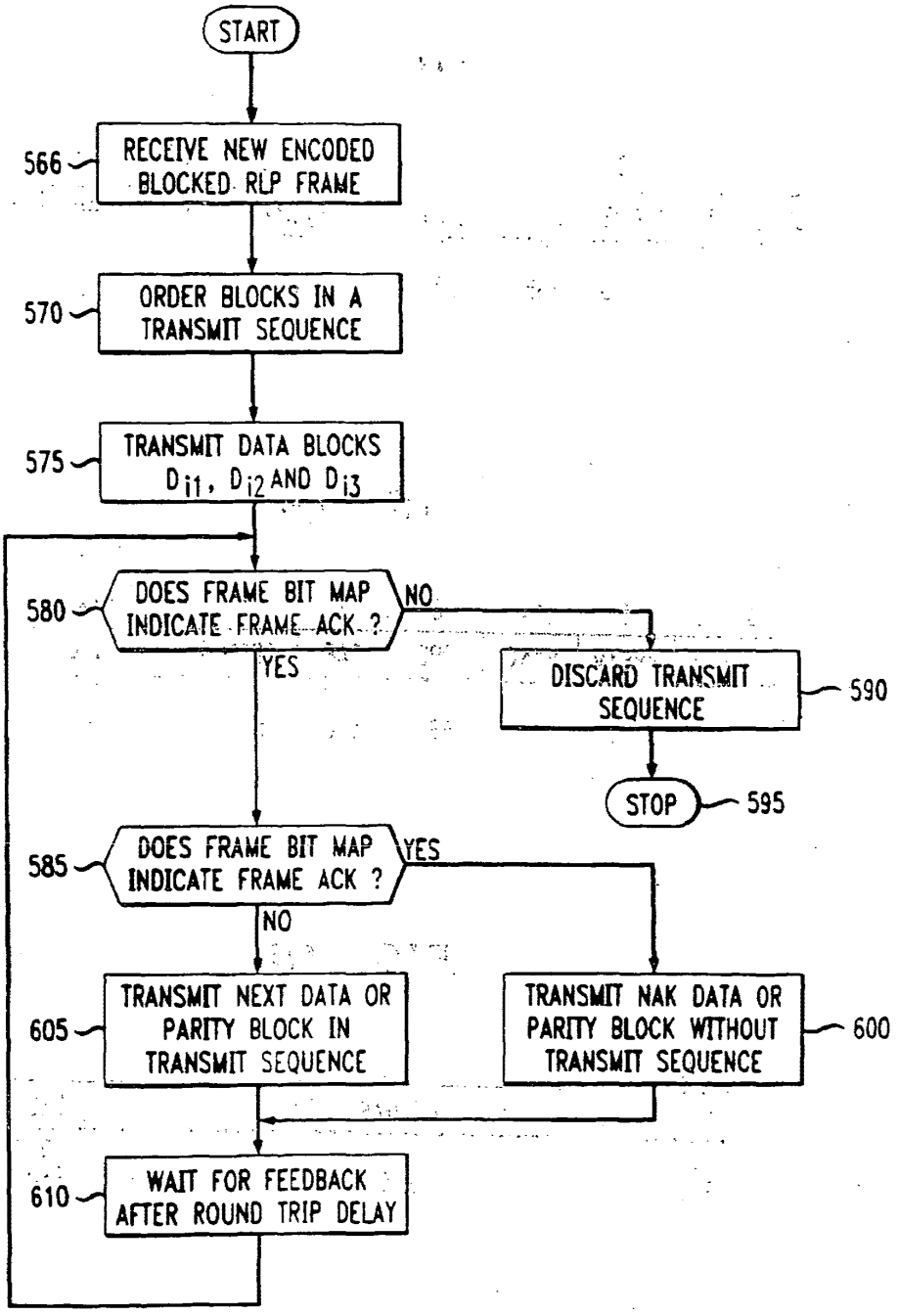

START
525
RECEIVE NEW ENCODED BLOCKED RLP FRAME
530
ORDER BLOCKS IN A TRANSMIT SEQUENCE
535
TRANSMIT DATA BLOCKS D_{i1}, D_{i2} AND D_{i3}
540
DOES FRAME BIT MAP INDICATE FRAME ACK ?
NO
YES
545
TRANSMIT NEXT DATA OR PARITY BLOCK IN TRANSMIT SEQUENCE
DISCARD TRANSMIT SEQUENCE
550
STOP
555
WAIT FOR FEEDBACK AFTER ROUND TRIP DELAY
560

FIG. 16



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FIG. 17

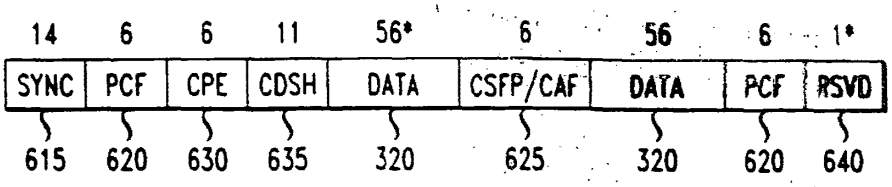


FIG. 18

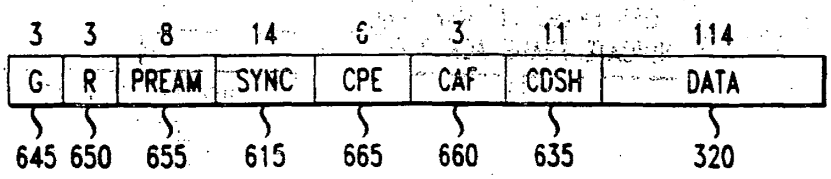


FIG. 19

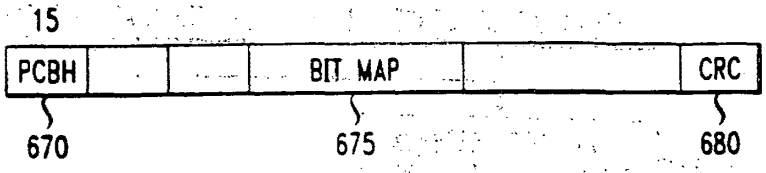
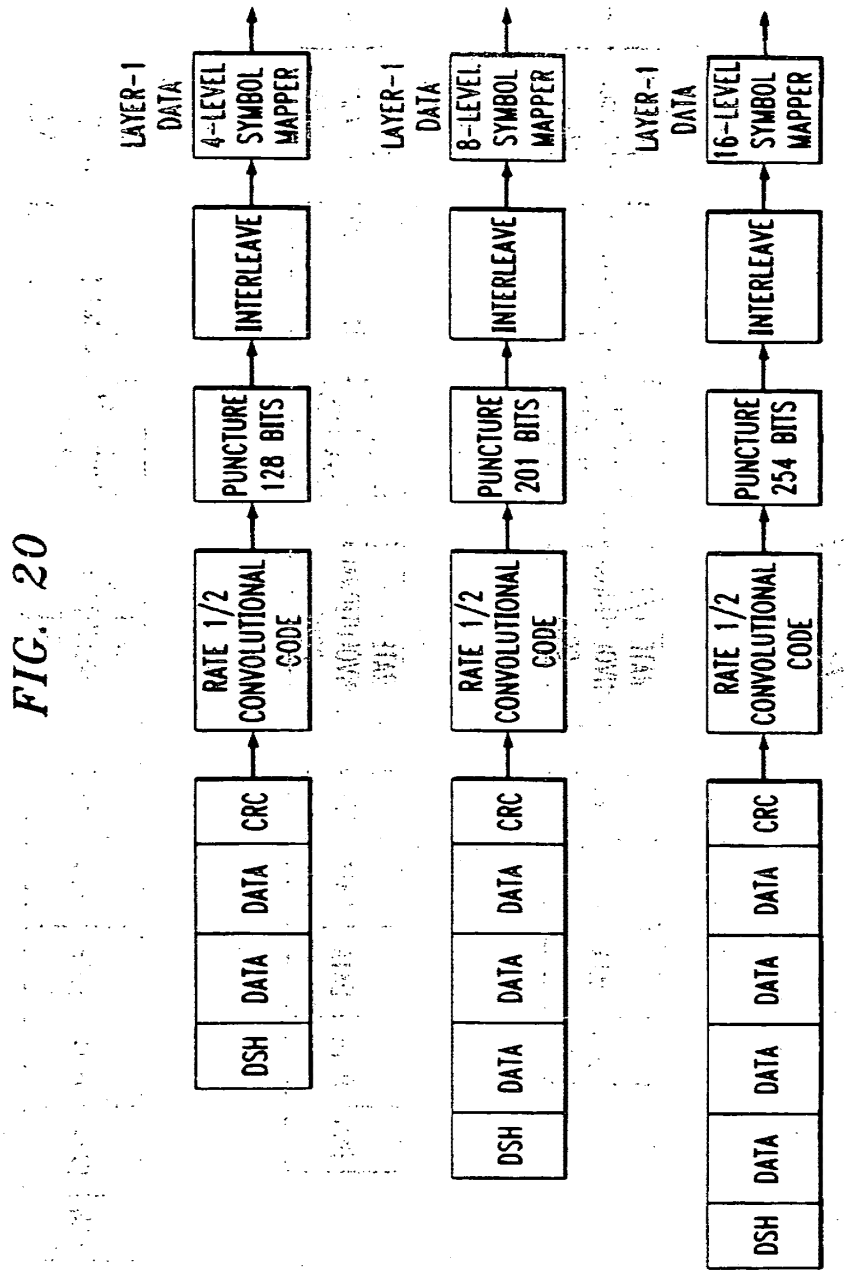


FIG. 20



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FIG. 21

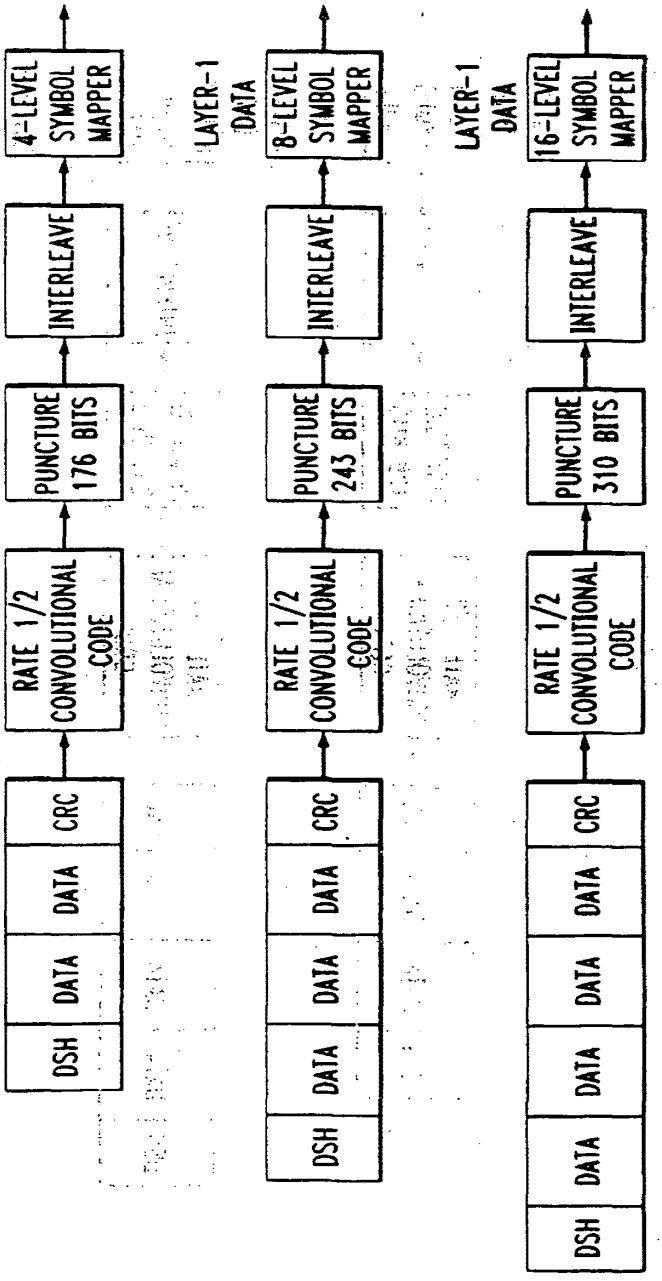

LAYER-1 DATA
DSH
DATA
DATA
CRC
RATE 1/2 CONVOLUTIONAL CODE
PUNCTURE 176 BITS
INTERLEAVE
4-LEVEL SYMBOL MAPPER
LAYER-1 DATA
DSH
DATA
DATA
CRC
RATE 1/2 CONVOLUTIONAL CODE
PUNCTURE 243 BITS
INTERLEAVE
8-LEVEL SYMBOL MAPPER
LAYER-1 DATA
DSH
DATA
DATA
DATA
CRC
RATE 1/2 CONVOLUTIONAL CODE
PUNCTURE 310 BITS
INTERLEAVE
16-LEVEL SYMBOL MAPPER

FIG. 22

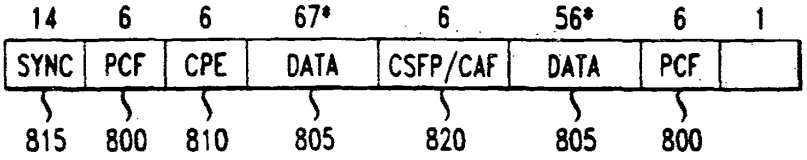
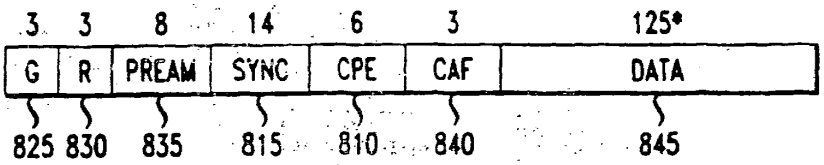

14
6
6
67*
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56*
6
1
SYNC
PCF
CPE
DATA
CSFP/CAF
DATA
PCF
815
800
810
805
820
805
800

FIG. 23


3
3
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14
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G
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PREAM
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825
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RECEIVED MAY 14 2002 Technology Center 2600

Patent Application

Inventor(s) Arnab Das
Farooq Ullah Khan

Case 14-18

Serial No. 10/002,746

Filing Date November 2, 2001

Examiner Group Art Unit 2681

Title Variable Rate Channel Quality Feedback in a Wireless Communication System

ASSISTANT COMMISSIONER FOR PATENTS
WASHINGTON, D.C. 20231

PRELIMINARY AMENDMENT

Sir:

Prior to examination of the above-identified application, please enter the following amendments and remarks.

In the Claims

Substitute the following claim for pending claim 1:

1. (Amended) A method for transmitting channel quality information in a wireless communication system comprising at least one base station and at least one mobile station, the method comprising:

varying a rate for reporting channel quality information from a mobile station to a base station as a function of the presence or absence of a reception of a transmission at the mobile station.

Substitute the following claim for pending claim 2:

2. (Amended) The method according to claim **1**, wherein the mobile station reports channel quality information at a first rate in the absence of a reception of a transmission from the base station and at a second rate in the presence of a reception of a transmission from the base station.

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PATENT APPLICATION

Arnab Das
Farooq Ullah Khan

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CASE 14-18

Serial No. 10/002746 **Group Art Unit** 2681

Filed November 2, 2001

Examiner

Title Variable Rate Channel Quality Feedback In A Wireless Communication System

ASSISTANT COMMISSIONER FOR PATENTS
WASHINGTON, D.C. 20231

SIR:

Enclosed is an amendment in the above-identified application.

NO ADDITIONAL FEE REQUIRED

In the event of non-payment or improper payment of a required fee, the Commissioner is authorized to charge or to credit **Deposit Account No. 12-2325** as required to correct the error.

Respectfully,

Gregory J. Murgia, Attorney
Reg. No. 41209
732-949-3578.

Date: 5/1/02

Docket Administrator (Room 3J-219)
Lucent Technologies Inc.
101 Crawfords Corner Road
Holmdel, NJ 07733-3030

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D.C. 20231, on MAY 1, 2002 (Date of Deposit)
Sharon Robles 5/1/02 Date

Substitute the following claim for pending claim 3:

3. (Amended) The method according to claim **1**, wherein the mobile station reports channel quality information at a first rate in the absence of a reception of a transmission from the base station and, upon detection of a reception of a transmission from the base station, the mobile station reports channel quality information at a second rate for a prescribed duration.

Substitute the following claim for pending claim 4:

4. (Amended) The method according to claim **1**, wherein the mobile station reports channel quality information at a first rate in the absence of a reception of a transmission from the base station and, upon detection of a reception of a transmission from the base station, the mobile station reports channel quality information at a plurality of rates over a prescribed time period after detection of the reception of a transmission, wherein the plurality of rates are different than the first rate.

Substitute the following claim for pending claim 11:

11. (Amended) A method for adapting the rate of reporting channel quality information in a wireless communication system including at least one base station and at least one mobile station, the method comprising:

reporting channel quality information from the at least one mobile station to the at least one base station at a first rate in the absence of a reception of a transmission at the at least one mobile station; and

in the presence of a reception of a transmission at the at least one mobile station, adapting the rate for reporting channel quality information from the at least one mobile station to the at least one base station from the first rate to a second rate.

REMARKS

By this preliminary amendment, originally filed claims 1-4 and 11 have been amended. Claims 1-15 are still pending in the application. Attached hereto is a marked-up version of the changes to the claims by the current amendment. The attached pages are captioned "Version With Markings to Show Changes Made".

Applicants submit that the amendments to the claims are not being made for any reason relating to patentability. In particular, the originally filed claims as well as those amended herein are believed to meet all statutory requirements for patentability.

Accordingly, consideration of this application is respectfully requested. Any questions can be directed to the Applicants' attorney at the number below.

Respectfully submitted,

By: _____

Gregory J. Murgia
Reg. No. 41,209
Attorney for Applicants
(732) 949-3578

Lucent Technologies Inc.
Date: 5/1/02

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Claims:

Amend claim 1 as follows:

1. (Amended) A method for transmitting channel quality information in a wireless communication system comprising at least one base station and at least one mobile station, the method comprising:

varying a rate for reporting channel quality information from a mobile station to a base station as a function of the presence or absence of a reception of a transmission [from the base station to] at the mobile station.

Amend claim 2 as follows:

2. (Amended) The method according to claim **1**, wherein the mobile station reports channel quality information at a first rate in the absence of a reception of a transmission from the base station and at a second rate in the presence of a reception of a transmission from the base station.

Amend claim 3 as follows:

3. (Amended) The method according to claim **1**, wherein the mobile station reports channel quality information at a first rate in the absence of a reception of a transmission from the base station and, upon detection of a reception of a transmission from the base station, the mobile station reports channel quality information at a second rate for a prescribed duration.

Amend claim 4 as follows:

4. (Amended) The method according to claim **1**, wherein the mobile station reports channel quality information at a first rate in the absence of a reception of a transmission from the base station and, upon detection of a reception of a transmission from the base station, the mobile station reports channel quality information at a plurality of rates over a prescribed time period after detection of the reception of a transmission, wherein the plurality of rates are different than the first rate.

Unchanged claim 5:

5. The method according to claim **4**, wherein the prescribed time period includes a plurality of time intervals such that the channel quality information is reported at one of the plurality of rates during one of the plurality of time intervals.

Unchanged claim 6:

6. The method according to claim **2**, wherein the second rate is faster than the first rate.

Unchanged claim 7:

7. The method according to claim **6**, further comprising the step of estimating channel quality at the base station while the mobile station is reporting at the second rate, wherein estimated channel quality is used to derive a transmission format for a subsequent transmission.

Unchanged claim 8:

8. The method according to claim **7**, wherein the transmission format includes one or more parameters selected from the group consisting of modulation format, number of codes, and transmission rate.

Unchanged claim 9:

9. The method according to claim **6**, further comprising the step of estimating channel quality at the base station while the mobile station is reporting at the second rate, wherein estimated channel quality is used to calculate an amount of redundancy needed for a retransmission of a previous transmission.

Unchanged claim 10:

10. The method according to claim **1**, wherein the channel quality information comprises a transmission rate calculated by the mobile station based on one or more channel conditions.

Amend claim 11 as follows:

11. (Amended) A method for adapting the rate of reporting channel quality information in a wireless communication system including at least one base station and at least one mobile station, the method comprising:

reporting channel quality information from the at least one mobile station to the at least one base station at a first rate in the absence of a reception of a transmission [from the at least one base station to the] at the at least one mobile station; and

in the presence of a reception of a transmission [from the at least one base station to the] at the at least one mobile station, adapting the rate for reporting channel quality information from the at least one mobile station to the at least one base station from the first rate to a second rate.

Unchanged claim 12:

12. The method according to claim **11**, wherein the second rate is faster than the first rate.

Unchanged claim 13:

13. A method for transmitting channel quality information in a wireless communication system including at least one base station and at least one mobile station, the method comprising:

varying a rate for reporting channel quality information from a mobile station to a base station as a function of the number of base stations that the mobile station is communicating with.

Unchanged claim 14:

14. The method according to claim **13**, wherein the mobile station reports channel quality information at a first rate when the mobile station is communicating with one base station and wherein the mobile station reports channel quality information at a second rate when the mobile station is communicating with a plurality of base stations.

Unchanged claim 15:

15. The method according to claim **14** wherein the second rate is faster than the first rate.

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IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE

PATENT APPLICATION

Arnab Das
Farooq Ullah Khan

CASE 14-18

TITLE Variable Rate Channel Quality Feedback In A Wireless Communication System

ASSISTANT COMMISSIONER FOR PATENTS
WASHINGTON, D.C. 20231

SIR:

NEW APPLICATION UNDER 37 CFR § 1.53(b)

Enclosed are the following papers relating to the above-named application for patent:

Specification
3 Informal Sheets of drawing(s)
1 Assignment(s) with Cover Sheet
Declaration and Power of Attorney

CLAIMS AS FILED				
	NO. FILED	NO. EXTRA	RATE	CALCULATIONS
Total Claims	15 - 20 =	0	x $18 =	$0
Independent Claims	3 - 3 =	0	x $84 =	$0
Multiple Dependent Claims, if applicable			+ $280 =	$0
Basic Fee				$740
			TOTAL FEE	$740

Please file the application and charge **Lucent Technologies Deposit Account No. 12-2325** the amount of $740, to cover the filing fee. Duplicate copies of this letter are enclosed. In the event of non-payment or improper payment of a required fee, the Commissioner is authorized to charge or to credit **Deposit Account No. 12-2325** as required to correct the error.

The Assistant Commissioner for Patents is hereby authorized to treat any concurrent or future reply, requiring a petition for extension of time under 37 CFR § 1.136 for its timely submission, as incorporating a petition for extension of time for the appropriate length of time if not submitted with the reply.

Please address all correspondence to **Docket Administrator (Room 3J-219), Lucent Technologies Inc., 101 Crawfords Corner Road, Holmdel, New Jersey 07733-3030**. However, telephone calls should be made to me at 732-949-3578.

Respectfully,

Gregory J. Murgia
Reg. No. 41209
Attorney for Applicant(s)

"Express Mail" mailing label number EK218523710US
Date of Deposit Nov. 2, 2001
I hereby certify that this appl is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Commissioner of Patents and Trademarks Washington, D.C. 20231
SHARON LOBOSCO
(Printed name of person mailing paper of fee)
Sharon Lobosco
(Signature of person mailing paper of fee)

Date: 11/2/01
Docket Administrator (Room 3J-219)
Lucent Technologies Inc.
101 Crawfords Corner Road
Holmdel, NJ 07733-3030
PT13 (10/01)

VARIABLE RATE CHANNEL QUALITY FEEDBACK IN A WIRELESS COMMUNICATION SYSTEM

Technical Field

The invention relates generally to wireless communication systems and, more particularly, to providing channel quality information from a mobile station to a base station in such systems.

Background of the Invention

In wireless communication systems, an air interface is used for the exchange of information between a mobile station and a base station or other communication system equipment. The air interface typically comprises a plurality of communication channels. In wireless transmission, a channel is time varying due to fading, mobility, and so on. More specifically, channel quality is affected by factors such as distance between the mobile and base station, speed of the mobile station, interference, and the like. Given the limited resources (e.g., bandwidth) of wireless transmission as well as the large number of mobile stations supported by a base station at any given time and therefore competing for those limited resources, it is therefore important to maximize throughput of a wireless communication system. For example, in a time-multiplexed system in which the transmission time interval spans one or more time slots, system throughput can be maximized by allowing a user with the best channel quality to transmit ahead of users with comparatively low channel quality.

In one known arrangement, a mobile station performs a rate calculation based on measurements of a pilot signal from the base station once every time slot and then reports back the rate at which it is going to receive data from the base station. Alternatively, the mobile station can send channel quality feedback information to the base station and the base station can then select the appropriate rate corresponding to that channel quality. In general, the purpose of sending channel quality feedback information from the mobile station to the base station is to inform the base station of the transmission rate that best matches the current conditions (e.g., quality) of the channel at that present time.

FIG. 1 shows one example of wireless transmission based on the well-known 1x-EV-DO (data only) standard in which a so-called fast rate adaptation scheme is used to maximize the system throughput by exploiting the time varying channel conditions. More specifically, FIG. 1 shows a signaling diagram between a base

station (BS) and a mobile station (MS). The data channel 100 for the downlink from the base station to the mobile station is divided into time slots 101-117, each of which has a duration τ. In the case of the 1x-EV-DO standard, the duration τ would be 1.67 milliseconds. In the example shown in FIG. 1, time slots 101-106 and 110-115 are not carrying transmissions from the base station to the mobile station. However, the base station is transmitting to the mobile station during time slots 107-109 and during time slots 116-117.

From the perspective of the mobile station, the uplink channel 200 is also divided into time slots 201-217, each of which has a duration τ. As shown in FIG. 1, the calculation and reporting of the rate for the dedicated control channel 200 by the mobile station is performed according to well-known methods once every time slot 201-217. More specifically, channel quality information (e.g., transmission rate in 1x-EV-DO systems) is transmitted via communications 151-165. For example, mobile station is transmitting channel quality information to the base station via communications 151-153 during time slots 201-203 indicating that rate R1 is the desired rate of transmission based on the channel quality. As shown in this example, this rate information is received at the base station during time slots 103-105, so there is some delay with respect to the calculation of the rate in the mobile station during a time slot and the subsequent reporting of that rate to the base station. In slot 204, the mobile station detected a change in channel quality and reported back to the base station that transmission should occur at rate R2. This channel quality feedback is received by the base station during its time slot 106. Because the base station is sending a transmission to the mobile station during time slots 107-109 and because the base station is receiving channel quality feedback indicating rate R2 as the desired rate (e.g., R2 reported by mobile station during its time slots 204-206 and received by the base station during its time slots 106-108), the transmission by the base station during time slots 107-109 is therefore sent at rate R2. In time slots 207-212, the mobile station is reporting rate R1 as the desired rate, but no transmissions are occurring from the base station during time slots 110-115. As shown, the mobile station reports rate R3 as the desired rate during time slots 213-216, which are received at the base station starting at time slot 115. Because the base station starts sending another transmission during time slot 116, this transmission therefore is sent at rate R3 based on the channel quality feedback received from the mobile station.

Another approach to providing rate feedback is described in U.S. Patent Application Serial No. 09/716,106, entitled *"Asymmetric Rate Feedback and Adjustment System for Wireless Communications"* and filed on November 17, 2000, the subject matter of which is incorporated herein by reference in its entirety. As described, rate calculation and prediction is still being performed at every time slot, but the reporting of this rate feedback from a mobile station to the base station occurs every third time slot. In this manner, the reporting of rate feedback from a plurality of mobile stations can be staggered such that each mobile station is only sending rate feedback every third time slot, but the base station is receiving rate feedback at each time slot (i.e., from different mobile stations).

There are several disadvantages to these constant rate feedback approaches. Performing rate calculation and prediction in every time slot uses up a large amount of processing overhead at the mobile station. Providing rate feedback to the base station at every time slot uses a large amount of transmission overhead and, because rate feedback is being provided regardless of whether there is a transmission being sent from the base station, transmission resources are therefore being inefficiently used. Even if rate feedback is provided at a slower rate (e.g., every third time slot), there is still inefficient use of resources because the rate feedback is being provided regardless of whether the base station is transmitting.

Summary of the Invention

Processing overhead for rate calculation/prediction and transmission overhead for rate feedback is substantially reduced for wireless transmissions according to the principles of the invention by varying the feedback rate for reporting channel quality information from a mobile station to a base station as a function of the presence or absence of a transmission from the base station to the mobile station. More specifically, channel quality feedback is provided from the mobile station to the base station at a variable rate such that the feedback rate is faster when the base station is transmitting to the mobile station and slower when there is no transmission occurring.

Wireless resources can be more efficiently used since the rate at which the mobile station reports channel quality to the base station is varied as a function of the absence or presence of transmission from the base station. When the base station is not transmitting to the mobile station, the feedback rate for reporting channel quality

from the mobile station is at a slower rate, which, in turn, frees up wireless resources that can be used for other purposes, e.g., for transmissions between the mobile station and the base station. When the base station is transmitting to the mobile station, the rate of reporting channel quality from the mobile station is increased so that rate adaptation can be carried out more accurately by the base station. Moreover, because of the short duration of time slots in wireless transmission, it is highly unlikely that the rate or channel quality will change over a period of a few time slots under most operating conditions.

Brief Description of the Drawing

A more complete understanding of the present invention may be obtained from consideration of the following detailed description of the invention in conjunction with the drawing, with like elements referenced with like reference numerals, in which:

FIG. 1 shows a simplified block diagram of a typical channel quality feedback and rate adaptation scheme in one prior art arrangement;

FIG. 2 shows a simplified block diagram of a channel quality feedback and rate adaptation scheme according to one exemplary embodiment of the invention; and

FIG.3 shows a simplified block diagram of a channel quality feedback and rate adaptation scheme according to another exemplary embodiment of the invention.

Detailed Description

FIG. 2 shows one exemplary embodiment for providing variable rate channel quality feedback according to the principles of the invention. By way of example only, this scheme will be described in the context of wireless transmission according to the 1x-EV-DO (data only) standard, but the teachings set forth herein are not at all limited to just this particular wireless implementation.

More specifically, FIG. 1 shows a signaling diagram between a base station (BS) and a mobile station (MS). The data channel 300 for the downlink from the base station to the mobile station is divided into time slots 301-317, each of which has a duration τ, e.g., 1.67 milliseconds. In the example shown in FIG. 2, time slots 301-306 and 310-315 are not carrying transmissions from the base station to the mobile station. However, the base station is transmitting to the mobile station during

time slots 307-309 and during time slots 316-317. From the perspective of the mobile station, the uplink control channel 400 is also divided into corresponding time slots 401-417, each of which has a duration τ.

As shown in FIG. 2, the calculation and reporting of the rate for the dedicated control channel 400 by the mobile station is performed using a variable rate in contrast to the prior art methods. In general, when there is no data transmission from the base station (e.g., time slots 301-306), the channel quality information (e.g., rate information) is sent from the mobile station every two (2) slots as shown by communications 352, 354, 361, 363, and 365. As previously described, there is a delay factor with respect to the uplink transmission (from the mobile station) and the downlink transmission (from the base station). When the mobile station is receiving a transmission over the forward link (e.g., downlink from the base station), the channel quality feedback is sent every slot as shown by communications 356-359. As such, the rate at which channel quality feedback is provided when there is a transmission from the base station is faster than the rate at which channel quality feedback is provided when there is no transmission from the base station.

More specifically, FIG. 2 depicts the mobile station transmitting channel quality information (e.g., rate information) to the base station via communications 352 at time slot 402 indicating that rate R1 is the desired rate of transmission based on the channel quality. As shown in this example, this rate information is received at the base station during time slot 304 because of the aforementioned delay factor. In slot 404, the mobile station detected a change in channel quality and reported back to the base station that transmission should occur at rate R2. This channel quality feedback is received by the base station during its time slot 306. Because the base station is sending a transmission to the mobile station during time slots 307-309 and because the base station is receiving channel quality feedback indicating rate R2 as the desired rate (e.g., R2 reported by mobile station in time slot 404 and received by the base station in time slot 306), the transmission by the base station during time slots 307-309 is therefore sent at rate R2. Because the base station is now transmitting data to the mobile station during time slots 307-309, the mobile station is adapted to send the channel quality feedback at a faster rate (e.g., every time slot) for the corresponding time slots 407-409, e.g., as shown by communications 357-359. It should be noted that, because transmission did not start until time slot 307 by

the base station and because of the delay factor, the channel quality feedback information indicating rate R2 via communication 356 is still being sent at the slower rate (e.g., every two (2) slots). The faster rate of reporting channel quality feedback does not begin until time slots 407-409 at the mobile station which correspond to time slots 307-309 where transmission is occurring from the base station.

When transmission from the base station ends and there is no further transmission, the mobile station resumes its reporting of channel quality information at the slower rate (e.g., every two (2) slots) as shown by communication 361. For example, there is no transmission from the base station in time slot 310, so the next report of rate information from the mobile station is sent at time slot 411, e.g., two time slots after time slot 409, which corresponded to time slot 309 when transmission ended from the base station.

It should be noted that the feedback rate for transmitting the channel quality information and the point in time when the information is reported (e.g., at the leading edge, during, or at the trail edge of the time slot) are all matters of design choice. As such, the example shown in FIG. 2 where the slower first rate is every two (2) slots and the faster second rate is every one (1) slot, and where the channel quality information is sent at the end of the corresponding time slot at the mobile station are all meant to be illustrative and not limiting in any way. However, those skilled in the art will appreciate that a large value for the reporting interval (time between the reports of channel quality from the mobile station) will reduce the channel quality feedback overhead. However, the resulting slower rate channel quality feedback may also result in large errors in channel quality estimates at the base station and performance degradation. Again, these are matters of design choice that are well understood by one skilled in the art.

According to another aspect of the invention, there are numerous implementations for providing rate feedback at a faster rate after detection of a transmission from the base station. For example, upon detection of a transmission from the base station, the mobile station can report channel quality information at a second rate for a prescribed duration after the detection of the transmission. In this manner, the rate feedback may therefore be provided at a faster rate for a period of time even though transmission from the base station has ended. By way of example, a mobile station may report rate feedback every 100 milliseconds in the absence of a

transmission. Upon detection of a transmission from the base station, the mobile station can then provide rate feedback every 20 milliseconds for a prescribed period of time regardless of whether transmission ends from the base station. At the end of that prescribed period of time and assuming there is an absence of a transmission, the mobile station would then resume reporting of rate feedback at the first rate of 100 milliseconds (e.g., the slower rate). In yet another example, the mobile station, upon detection of a transmission from the base station, can report channel quality information at a plurality of rates over a prescribed time period after detection of the transmission, wherein the plurality of rates are different than the first rate. More specifically, upon detection of a transmission, the mobile station would begin reporting rate feedback at a second rate that is faster than the first rate for a prescribed time period. At the end of this prescribed time period and assuming there is an absence of a transmission, the mobile station could then report rate feedback at a third rate that is different than the first and second rates, and so on. Other variations will also be apparent to those skilled in the art and are contemplated by the teachings herein.

On the downlink transmission from the base station, the total capacity is shared by a large number of mobile stations. Due to the bursty nature of the data traffic, the mobile stations are active only a fraction of the time. Therefore, an increased rate of channel quality feedback during the time of data transmission for a given mobile station will not result in any significant increase of overhead. The fast channel quality feedback rate during a transmission from the base station will result in better channel quality estimates that will be used for appropriate selection of transport format for new transmissions and retransmissions. Note that due to the bursty nature of the traffic, when a transmission is sent to a mobile station, it is likely that more transmissions or retransmissions will occur to the same mobile station within a short period of time.

According to another aspect of the invention, the increased feedback rate during data transmission also helps to estimate the quality of a transmission so that, in case of retransmissions, the appropriate amount of redundancy or repetition can be included in the retransmissions. This aspect of the invention is advantageous since it is possible that a transmission might initially start from the base station with a less accurate transmission rate (e.g., not matching up to the actual, current channel

quality) since a slower feedback rate is being used before transmission commences. So, although rate adaptation will be accurately performed once the feedback rate increases (e.g., to every time slot), there may be initial portions of the transmission that will require retransmission under certain circumstances. As such, the ability to estimate the quality of the transmission in the current feedback scheme will be helpful for the retransmission process. For example, these estimates can be used for selecting an appropriate transport format (e.g., modulation, number of codes, etc.) for retransmissions for the corresponding previous transmissions.

The embodiment shown in FIG. 3 helps to illustrate this aspect of the invention. Data channel 500 represents the downlink (forward link) from the base station to the mobile station and is shown as comprising two (2) millisecond frames or transmission time intervals (TTIs) 506. More specifically, data channel 500 shows multiple transmissions for the same user in data blocks 501-505, wherein data blocks 501-504 contain new transmissions while data block 505 contains a retransmission corresponding to the transmission in data block 501. As in the preceding embodiments, control channel 600 represents the uplink (reverse link) from the mobile station. The example shown in FIG. 3 depicts two (2) millisecond transmission time intervals 602, each of which comprises three (3) time slots 601 of .67 milliseconds each. This format is characteristic of the aforementioned HSDPA standard.

As in the preceding embodiments, the feedback rate for channel quality information from the mobile station is at a slower rate when there is no data transmission, e.g., as shown for time periods 603 and 604. However, when the mobile station detects transmission from the base station, the channel quality feedback rate is increased to once every transmission time interval (TTI), e.g., two (2) milliseconds, as shown by communications 610-614. In this example, the transport format for the retransmission 505 for data block A (RTX A) can be based on the most recent channel quality feedback (i.e. *m*) as well as the channel quality estimates *k* and *l* that, in turn, provide an estimate of the quality of the previous transmission 501 of data block A (NTX A). Accordingly, the appropriate rate, modulation, and coding scheme can be derived more accurately for the retransmission according to the principles of the invention.

In another exemplary embodiment of the invention, the feedback rate for channel quality information from the mobile station is varied as a function of the number of base stations that the mobile station is communicating with. In particular, this embodiment is particularly advantageous when handling so-called "soft handoffs" in CDMA wireless communication systems. As is well known, a "handoff" is the act of transferring support of a mobile station from one base station to another base station. A "soft handoff" occurs when the mobile station makes a connection to a new base station (e.g., cell) before leaving the current base station (e.g., cell) that is supporting the mobile station. In particular, a "soft handoff" is designed to ensure that there is connectivity with the old (e.g., current) base station while the new base station has been assigned to take control over the communication link with the mobile station. As such, a mobile station may be simultaneously communicating with multiple base stations at a given instant of time during such handoffs. According to the principles of the invention, the feedback rate for reporting channel quality information is adapted or otherwise varied to be slower when the mobile station is communicating with only one base station and faster during a "soft handoff" when the mobile station is communicating with two or more base stations. By increasing the rate of reporting quality information during "soft handoffs, the base stations can effectively and accurately perform the appropriate rate adaptations during such critical times such as "soft handoffs" and the like. It should be noted that other variations to this aspect of the invention will be apparent to those skilled in the art and are therefore contemplated by the teachings herein.

In general, the foregoing embodiments are merely illustrative of the principles of the invention. Those skilled in the art will be able to devise numerous arrangements, which, although not explicitly shown or described herein, nevertheless embody those principles that are within the scope of the invention. For example, although the invention was described in the context of wireless transmission according to the CDMA2000 1x-EV-DO standard, the invention could also be applicable to other known or to-be-developed wireless transmission standards. For example, the teachings of the invention may be applied to wireless transmission according to the well-known High Speed Downlink Packet Access (HSDPA) specification in the Universal Mobile Telecommunication System (UMTS) standard. Other modifications or substitutions will be apparent to those skilled in the art and are

contemplated by the teachings herein. Accordingly, the embodiments shown and described herein are only meant to be illustrative and not limiting in any manner. The scope of the invention is limited only by the claims appended hereto.

We Claim:

1. A method for transmitting channel quality information in a wireless communication system comprising at least one base station and at least one mobile station, the method comprising:

varying a rate for reporting channel quality information from a mobile station to a base station as a function of the presence or absence of a transmission from the base station to the mobile station.

2. The method according to claim **1**, wherein the mobile station reports channel quality information at a first rate in the absence of a transmission from the base station and at a second rate in the presence of a transmission from the base station.

3. The method according to claim **1**, wherein the mobile station reports channel quality information at a first rate in the absence of a transmission from the base station and, upon detection of a transmission from the base station, the mobile station reports channel quality information at a second rate for a prescribed duration.

4. The method according to claim **1**, wherein the mobile station reports channel quality information at a first rate in the absence of a transmission from the base station and, upon detection of a transmission from the base station, the mobile station reports channel quality information at a plurality of rates over a prescribed time period after detection of the transmission, wherein the plurality of rates are different than the first rate.

5. The method according to claim **4**, wherein the prescribed time period includes a plurality of time intervals such that the channel quality information is reported at one of the plurality of rates during one of the plurality of time intervals.

6. The method according to claim **2**, wherein the second rate is faster than the first rate.

7. The method according to claim **6**, further comprising the step of estimating channel quality at the base station while the mobile station is reporting at

the second rate, wherein estimated channel quality is used to derive a transmission format for a subsequent transmission.

8. The method according to claim **7**, wherein the transmission format includes one or more parameters selected from the group consisting of modulation format, number of codes, and transmission rate.

9. The method according to claim **6**, further comprising the step of estimating channel quality at the base station while the mobile station is reporting at the second rate, wherein estimated channel quality is used to calculate an amount of redundancy needed for a retransmission of a previous transmission.

10. The method according to claim **1**, wherein the channel quality information comprises a transmission rate calculated by the mobile station based on one or more channel conditions.

11. A method for adapting the rate of reporting channel quality information in a wireless communication system including at least one base station and at least one mobile station, the method comprising:

reporting channel quality information from the at least one mobile station to the at least one base station at a first rate in the absence of a transmission from the at least one base station to the at least one mobile station; and

in the presence of a transmission from the at least one base station to the at least one mobile station, adapting the rate for reporting channel quality information from the at least one mobile station to the at least one base station from the first rate to a second rate.

12. The method according to claim **11**, wherein the second rate is faster than the first rate.

13. A method for transmitting channel quality information in a wireless communication system including at least one base station and at least one mobile station, the method comprising:

varying a rate for reporting channel quality information from a mobile station to a base station as a function of the number of base stations that the mobile station is communicating with.

14. The method according to claim **13**, wherein the mobile station reports channel quality information at a first rate when the mobile station is communicating with one base station and wherein the mobile station reports channel quality information at a second rate when the mobile station is communicating with a plurality of base stations.

15. The method according to claim **14** wherein the second rate is faster than the first rate.

VARIABLE RATE CHANNEL QUALITY FEEDBACK IN A WIRELESS COMMUNICATION SYSTEM

Abstract of the Disclosure

A channel quality feedback method for wireless transmission is described in which the rate for reporting channel quality information from a mobile station to a base station is variable as a function of the presence or absence of a transmission from the base station to the mobile station. In particular, the feedback rate from the mobile station to the base station is increased when the mobile station detects a transmission from the base station. As such, the feedback rate is slower when there is no data transmission for the mobile station and faster when the mobile station is receiving data.

Attorney Docket No. 020375

FIG. 1

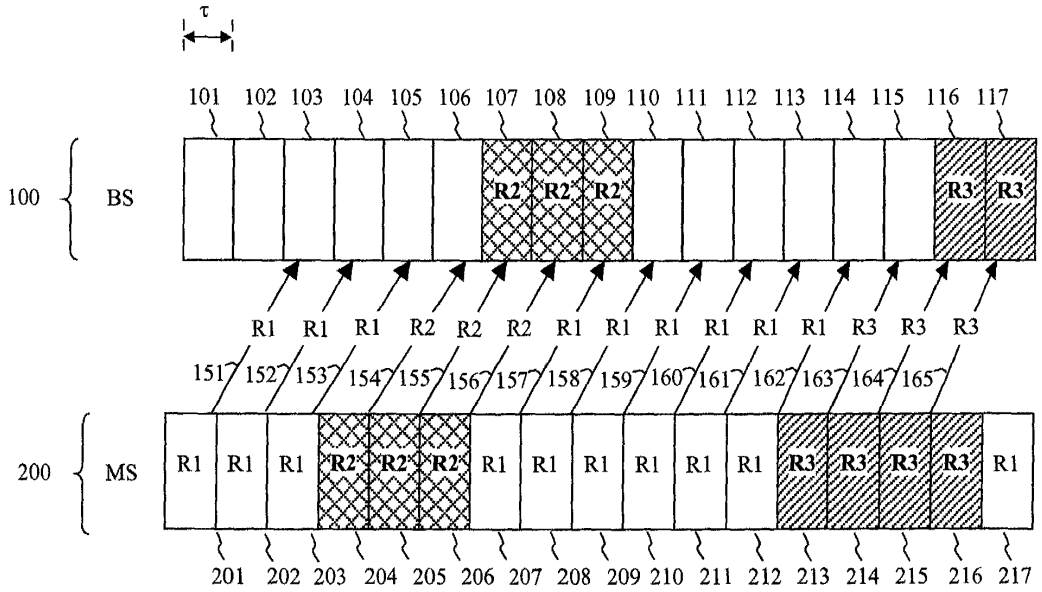

τ
101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117
100
BS
R2 R2 R2
R3 R3
R1 R1 R1 R2 R2 R2 R1 R1 R1 R1 R1 R1 R3 R3 R3
151 152 153 154 155 156 157 158 159 160 161 162 163 164 165
200
MS
R1 R1 R1 R2 R2 R2 R1 R1 R1 R1 R1 R1 R3 R3 R3 R3 R1
201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217

FIG. 2

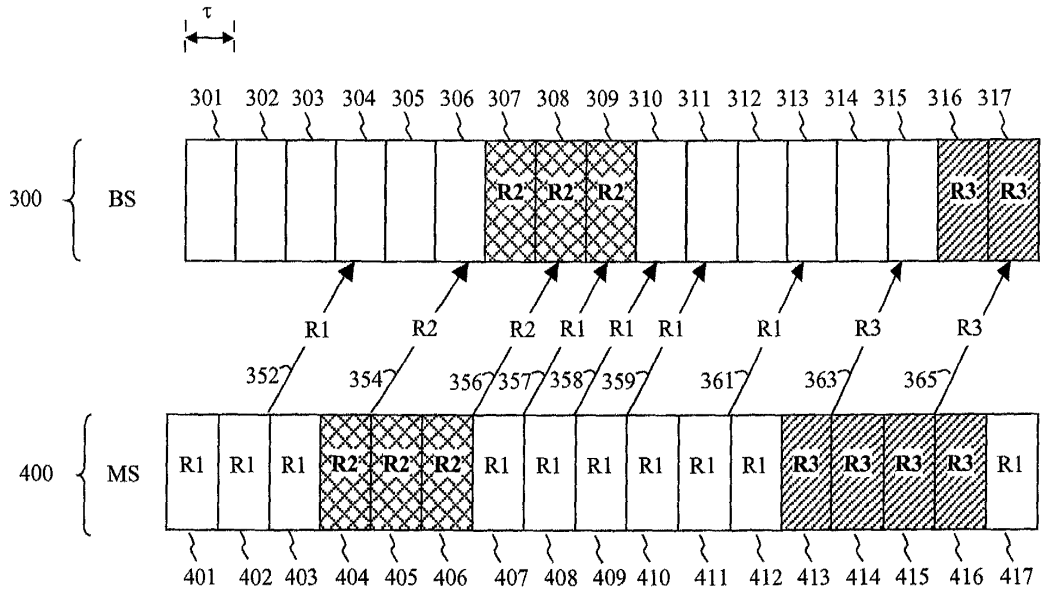
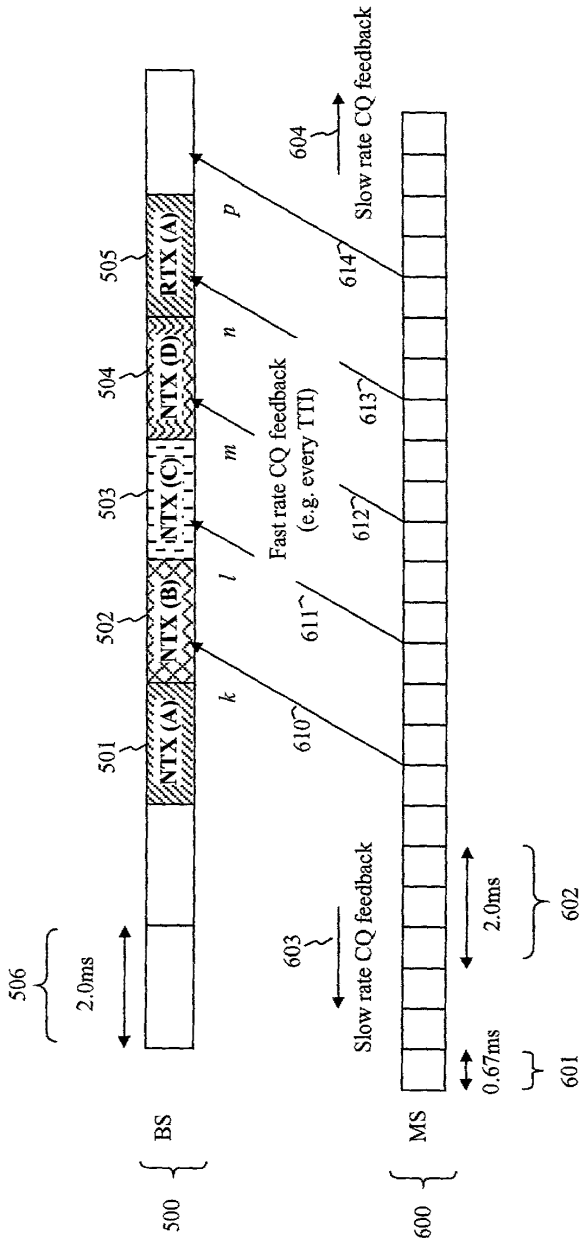

τ
301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317
300
BS
R2 R2 R2
R3 R3
R1 R2 R2 R1 R1 R1 R1 R3 R3
352 354 356 357 358 359 361 363 365
400
MS
R1 R1 R1 R2 R2 R2 R1 R1 R1 R1 R1 R1 R3 R3 R3 R3 R1
401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417

FIG. 3


506
2.0ms
BS
500
501
NTX (A)
502
NTX (B)
503
NTX (C)
504
NTX (D)
505
RTX (A)
k
l
m
n
p
610
611
612
613
614
Fast rate CQ feedback
(e.g. every TTI)
603
Slow rate CQ feedback
604
Slow rate CQ feedback
MS
600
0.67ms
2.0ms
601
602

IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE

Declaration and Power of Attorney

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am an original, first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled **Variable Rate Channel Quality Feedback In A Wireless Communication System** the specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by an amendment, if any, specifically referred to in this oath or declaration.

I acknowledge the duty to disclose all information known to me which is material to patentability as defined in Title 37, Code of Federal Regulations, 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

None

I hereby claim the benefit under Title 35, United States Code, 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

None

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

I hereby appoint the following attorney(s) with full power of substitution and revocation, to prosecute said application, to make alterations and amendments therein, to receive the patent, and to transact all business in the Patent and Trademark Office connected therewith:

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Bruce S. Schneider	(Reg. No. 27949)
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Inventor's signature Amab Das Date 11/02/2001

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Full name of 2nd inventor: Farooq Ullah Khan

Inventor's signature _____ Date 11/02/01

Residence: Manalapan, Monmouth County, New Jersey

Citizenship: Pakistan

Post Office Address: 22 Inverness Drive
Manalapan, New Jersey, 07726

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10/002746 US PTO 11/02/01

PATENT NUMBER and ISSUE DATE

U.S. UTILITY Patent Application

APPL NUM	FILING DATE	CLASS	SUBCLASS	GAU	EXAMINER
10002746	11/02/2001	455	521	2684	Nguyen Thuan

**APPLICANTS: Das Arnab; Khan Farooq;

**CONTINUING DATA VERIFIED:
THIS APPLICATION IS A CON OF 09/560,205 05/26/2000
WHICH CLAIMS BENEFIT OF 60/186,357 03/02/2000

** FOREIGN APPLICATIONS VERIFIED:

PG-PUB DO NOT PUBLISH ☐ RESCIND ☐

Foreign priority claimed	☐ yes ☐ no	ATTORNEY DOCKET NO
35 USC 119 conditions met	☐ yes ☐ no	14-18
Verified and Acknowledged Examiners's initials		

TITLE : Variable rate channel quality feedback in a wireless communication system

U.S.DEPT. OF COMM./PAT.& TM-PTO-436L(Rev. 12-94)

NOTICE OF ALLOWANCE MAILED	Assistant Examiner	CLAIMS ALLOWED: Total Claims / Print Claim for O.G
ISSUE FEE: Amount Due / Date Paid	Primary Examiner	DRAWING: Sheets Drwg. / Figs.Drwg. / Print Fig.
☐ TERMINAL DISCLAIMER	PREPARED FOR ISSUE	Application Examiner

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SEARCH

Class	Sub.	Date	Exmr.
455	67.11	9/8/03	BM
	67.13		
	522		
	550.1		
	95		
	575		
	115.1		
	127.1		
	452.1		
	452.2	4	4
Updated search		4/22/04	BM
(and search updated again)			

INTERFERENCE SEARCHED

Class	Sub.	Date	Exmr.

SEARCH NOTES

(List databases searched. Attach search strategy inside.)

	Date	Exmr.
First search	9/8/03	Z
updated	9/10/03	BM
Last updated on	4/20/04	Z
	4/22/04	Z

ISSUE SLIP STAPLE AREA (for additional cross-references)

ISSUING CLASSIFICATION			
ORIGINAL		CROSS REFERENCE(S)	
CLASS	SUBCLASS	CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)
INTERNATIONAL CLASSIFICATION			
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INDEX OF CLAIMS

✓ ..... Rejected - (Through numeral) ... Canceled N ..... Non-elected A ..... Appeal
= ..... Allowed + ... Restricted I ..... Interference O ..... Objected

Claim Final	Claim Original	Date	Claim Final	Claim Original	Date	Claim Final	Claim Original	Date
	1			51			101	
	2			52			102	
	3			53			103	
	4			54			104	
	5			55			105	
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	7			57			107	
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	40			90			140	
	41			91			141	
	42			92			142	
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	49			99			149	
	50			100			150	

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11/02/01 JC1058 U.S. PTO

12-05-01

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JC973 U.S. PTO 10/002746 11/02/01

IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE

PATENT APPLICATION

Arnab Das
Farooq Ullah Khan

CASE 14-18

TITLE Variable Rate Channel Quality Feedback In A Wireless Communication System

ASSISTANT COMMISSIONER FOR PATENTS
WASHINGTON, D.C. 20231

SIR:

NEW APPLICATION UNDER 37 CFR § 1.53(b)

Enclosed are the following papers relating to the above-named application for patent:

Specification
3 Informal Sheets of drawing(s)
1 Assignment(s) with Cover Sheet
Declaration and Power of Attorney

CLAIMS AS FILED				
	NO. FILED	NO. EXTRA	RATE	CALCULATIONS
Total Claims	15 - 20 =	0	x $18 =	$0
Independent Claims	3 - 3 =	0	x $84 =	$0
Multiple Dependent Claims, if applicable			+ $280 =	$0
Basic Fee				$740
			TOTAL FEE	$740

Please file the application and charge **Lucent Technologies Deposit Account No. 12-2325** the amount of $740, to cover the filing fee. Duplicate copies of this letter are enclosed. In the event of non-payment or improper payment of a required fee, the Commissioner is authorized to charge or to credit **Deposit Account No. 12-2325** as required to correct the error.

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Respectfully,

Gregory J. Murgia
Reg. No. 41209
Attorney for Applicant(s)

"Express Mail" mailing label number EK218523710US
Date of Deposit Nov. 2, 2001
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Sharon Lobosco
(Signature of person mailing paper of fee)

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PT13 (10/01)

FIG. 1

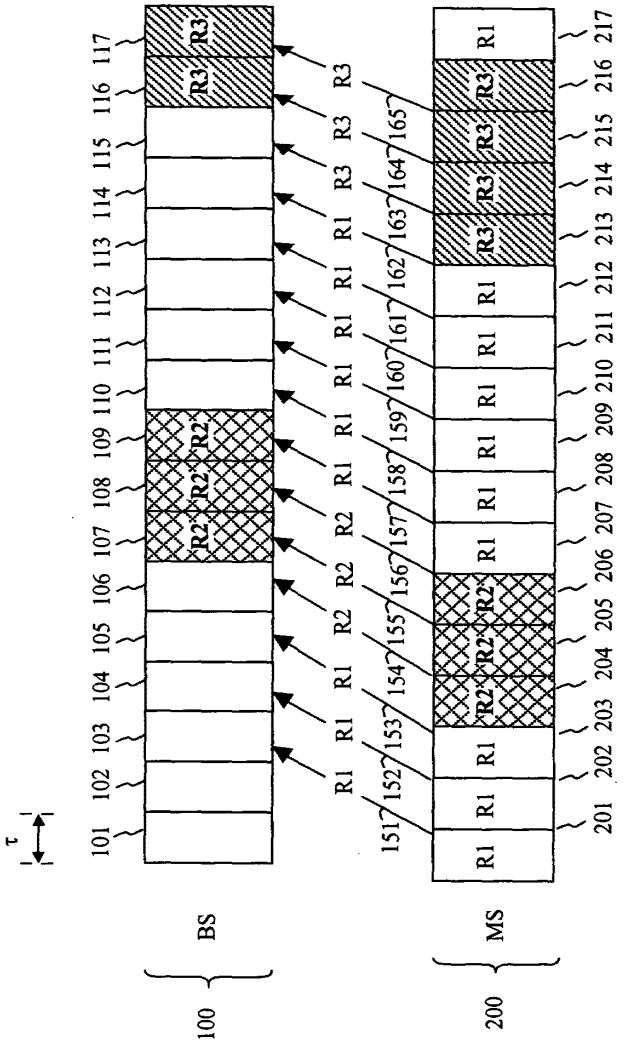

τ
101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117
R1 R1 R1 R2 R2 R2 R2 R2 R2 R1 R1 R1 R1 R1 R1 R3 R3
BS
100
151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 R1 R1 R1 R2 R2 R2 R2 R2 R2 R1 R1 R1 R1 R1 R1 R3 R3 R3 R3 R3 R3 R1
MS
200
201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217

FIG. 2

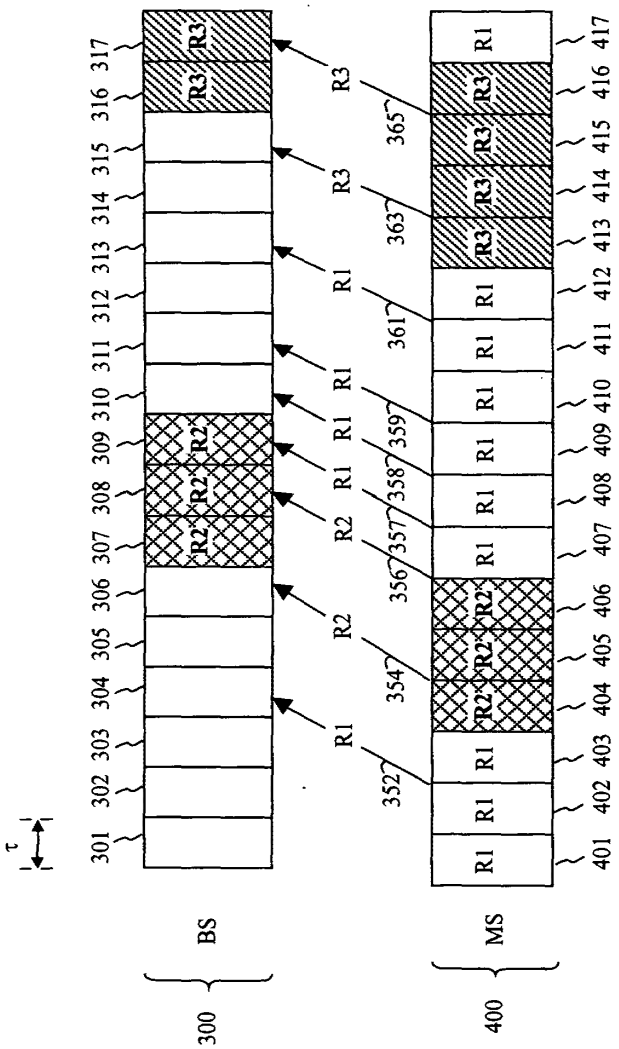
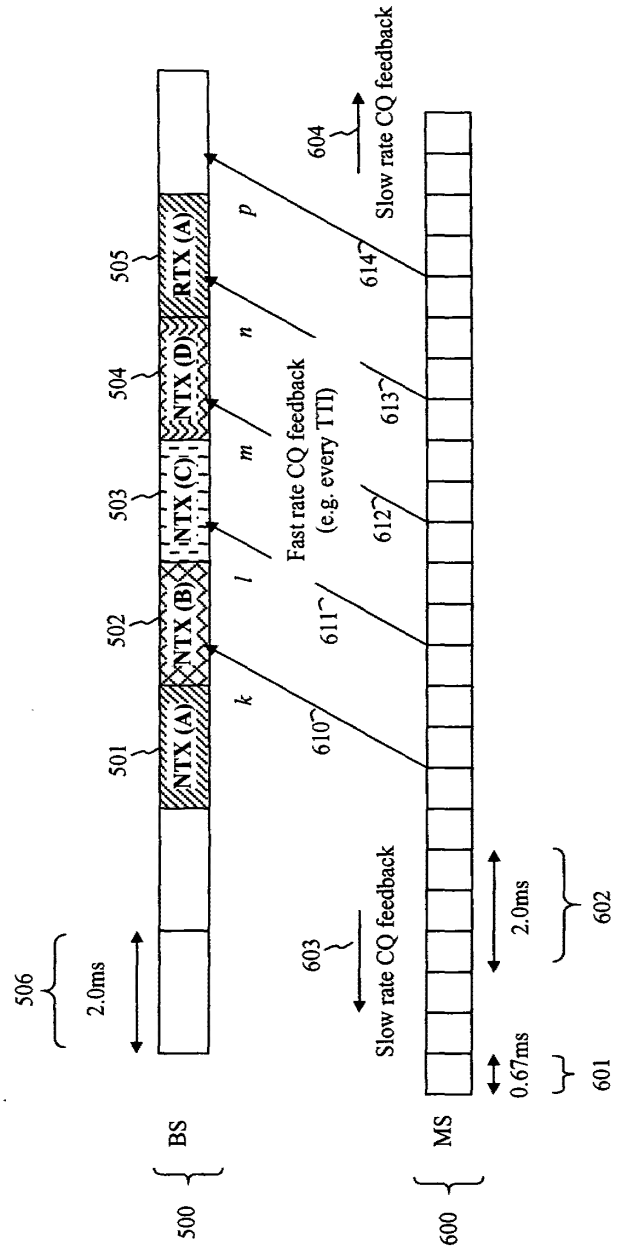

τ
301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317
R1 R2 R2 R2 R2 R1 R1 R1 R1 R1 R3 R3 R3
BS
300
352 354 356 357 358 359 361 363 365
401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417
R1 R1 R1 R2 R2 R2 R1 R1 R1 R1 R1 R1 R3 R3 R3 R3 R1
MS
400

FIG. 3


BS
MS
500
600
506
2.0ms
501
502
503
504
505
NTX (A)
NTX (B)
NTX (C)
NTX (D)
RTX (A)
k
l
m
n
p
603
Slow rate CQ feedback
604
Slow rate CQ feedback
Fast rate CQ feedback
(e.g. every TTI)
610
611
612
613
614
0.67ms
2.0ms
601
602

VARIABLE RATE CHANNEL QUALITY FEEDBACK IN A WIRELESS COMMUNICATION SYSTEM

Technical Field

The invention relates generally to wireless communication systems and, more particularly, to providing channel quality information from a mobile station to a base station in such systems.

Background of the Invention

In wireless communication systems, an air interface is used for the exchange of information between a mobile station and a base station or other communication system equipment. The air interface typically comprises a plurality of communication channels. In wireless transmission, a channel is time varying due to fading, mobility, and so on. More specifically, channel quality is affected by factors such as distance between the mobile and base station, speed of the mobile station, interference, and the like. Given the limited resources (e.g., bandwidth) of wireless transmission as well as the large number of mobile stations supported by a base station at any given time and therefore competing for those limited resources, it is therefore important to maximize throughput of a wireless communication system. For example, in a time-multiplexed system in which the transmission time interval spans one or more time slots, system throughput can be maximized by allowing a user with the best channel quality to transmit ahead of users with comparatively low channel quality.

In one known arrangement, a mobile station performs a rate calculation based on measurements of a pilot signal from the base station once every time slot and then reports back the rate at which it is going to receive data from the base station. Alternatively, the mobile station can send channel quality feedback information to the base station and the base station can then select the appropriate rate corresponding to that channel quality. In general, the purpose of sending channel quality feedback information from the mobile station to the base station is to inform the base station of the transmission rate that best matches the current conditions (e.g., quality) of the channel at that present time.

FIG. 1 shows one example of wireless transmission based on the well-known 1x-EV-DO (data only) standard in which a so-called fast rate adaptation scheme is used to maximize the system throughput by exploiting the time varying channel conditions. More specifically, FIG. 1 shows a signaling diagram between a base

station (BS) and a mobile station (MS). The data channel 100 for the downlink from the base station to the mobile station is divided into time slots 101-117, each of which has a duration τ. In the case of the 1x-EV-DO standard, the duration τ would be 1.67 milliseconds. In the example shown in FIG. 1, time slots 101-106 and 110-115 are not carrying transmissions from the base station to the mobile station. However, the base station is transmitting to the mobile station during time slots 107-109 and during time slots 116-117.

From the perspective of the mobile station, the uplink channel 200 is also divided into time slots 201-217, each of which has a duration τ. As shown in FIG. 1, the calculation and reporting of the rate for the dedicated control channel 200 by the mobile station is performed according to well-known methods once every time slot 201-217. More specifically, channel quality information (e.g., transmission rate in 1x-EV-DO systems) is transmitted via communications 151-165. For example, mobile station is transmitting channel quality information to the base station via communications 151-153 during time slots 201-203 indicating that rate R1 is the desired rate of transmission based on the channel quality. As shown in this example, this rate information is received at the base station during time slots 103-105, so there is some delay with respect to the calculation of the rate in the mobile station during a time slot and the subsequent reporting of that rate to the base station. In slot 204, the mobile station detected a change in channel quality and reported back to the base station that transmission should occur at rate R2. This channel quality feedback is received by the base station during its time slot 106. Because the base station is sending a transmission to the mobile station during time slots 107-109 and because the base station is receiving channel quality feedback indicating rate R2 as the desired rate (e.g., R2 reported by mobile station during its time slots 204-206 and received by the base station during its time slots 106-108), the transmission by the base station during time slots 107-109 is therefore sent at rate R2. In time slots 207-212, the mobile station is reporting rate R1 as the desired rate, but no transmissions are occurring from the base station during time slots 110-115. As shown, the mobile station reports rate R3 as the desired rate during time slots 213-216, which are received at the base station starting at time slot 115. Because the base station starts sending another transmission during time slot 116, this transmission therefore is sent at rate R3 based on the channel quality feedback received from the mobile station.

Another approach to providing rate feedback is described in U.S. Patent Application Serial No. 09/716,106, entitled *"Asymmetric Rate Feedback and Adjustment System for Wireless Communications"* and filed on November 17, 2000, the subject matter of which is incorporated herein by reference in its entirety. As described, rate calculation and prediction is still being performed at every time slot, but the reporting of this rate feedback from a mobile station to the base station occurs every third time slot. In this manner, the reporting of rate feedback from a plurality of mobile stations can be staggered such that each mobile station is only sending rate feedback every third time slot, but the base station is receiving rate feedback at each time slot (i.e., from different mobile stations).

There are several disadvantages to these constant rate feedback approaches. Performing rate calculation and prediction in every time slot uses up a large amount of processing overhead at the mobile station. Providing rate feedback to the base station at every time slot uses a large amount of transmission overhead and, because rate feedback is being provided regardless of whether there is a transmission being sent from the base station, transmission resources are therefore being inefficiently used. Even if rate feedback is provided at a slower rate (e.g., every third time slot), there is still inefficient use of resources because the rate feedback is being provided regardless of whether the base station is transmitting.

Summary of the Invention

Processing overhead for rate calculation/prediction and transmission overhead for rate feedback is substantially reduced for wireless transmissions according to the principles of the invention by varying the feedback rate for reporting channel quality information from a mobile station to a base station as a function of the presence or absence of a transmission from the base station to the mobile station. More specifically, channel quality feedback is provided from the mobile station to the base station at a variable rate such that the feedback rate is faster when the base station is transmitting to the mobile station and slower when there is no transmission occurring.

Wireless resources can be more efficiently used since the rate at which the mobile station reports channel quality to the base station is varied as a function of the absence or presence of transmission from the base station. When the base station is not transmitting to the mobile station, the feedback rate for reporting channel quality

from the mobile station is at a slower rate, which, in turn, frees up wireless resources that can be used for other purposes, e.g., for transmissions between the mobile station and the base station. When the base station is transmitting to the mobile station, the rate of reporting channel quality from the mobile station is increased so that rate adaptation can be carried out more accurately by the base station. Moreover, because of the short duration of time slots in wireless transmission, it is highly unlikely that the rate or channel quality will change over a period of a few time slots under most operating conditions.

Brief Description of the Drawing

A more complete understanding of the present invention may be obtained from consideration of the following detailed description of the invention in conjunction with the drawing, with like elements referenced with like reference numerals, in which:

FIG. 1 shows a simplified block diagram of a typical channel quality feedback and rate adaptation scheme in one prior art arrangement;

FIG. 2 shows a simplified block diagram of a channel quality feedback and rate adaptation scheme according to one exemplary embodiment of the invention; and

FIG.3 shows a simplified block diagram of a channel quality feedback and rate adaptation scheme according to another exemplary embodiment of the invention.

Detailed Description

FIG. 2 shows one exemplary embodiment for providing variable rate channel quality feedback according to the principles of the invention. By way of example only, this scheme will be described in the context of wireless transmission according to the 1x-EV-DO (data only) standard, but the teachings set forth herein are not at all limited to just this particular wireless implementation.

More specifically, FIG. 1 shows a signaling diagram between a base station (BS) and a mobile station (MS). The data channel 300 for the downlink from the base station to the mobile station is divided into time slots 301-317, each of which has a duration τ, e.g., 1.67 milliseconds. In the example shown in FIG. 2, time slots 301-306 and 310-315 are not carrying transmissions from the base station to the mobile station. However, the base station is transmitting to the mobile station during

time slots 307-309 and during time slots 316-317. From the perspective of the mobile station, the uplink control channel 400 is also divided into corresponding time slots 401-417, each of which has a duration τ.

As shown in FIG. 2, the calculation and reporting of the rate for the dedicated control channel 400 by the mobile station is performed using a variable rate in contrast to the prior art methods. In general, when there is no data transmission from the base station (e.g., time slots 301-306), the channel quality information (e.g., rate information) is sent from the mobile station every two (2) slots as shown by communications 352, 354, 361, 363, and 365. As previously described, there is a delay factor with respect to the uplink transmission (from the mobile station) and the downlink transmission (from the base station). When the mobile station is receiving a transmission over the forward link (e.g., downlink from the base station), the channel quality feedback is sent every slot as shown by communications 356-359. As such, the rate at which channel quality feedback is provided when there is a transmission from the base station is faster than the rate at which channel quality feedback is provided when there is no transmission from the base station.

More specifically, FIG. 2 depicts the mobile station transmitting channel quality information (e.g., rate information) to the base station via communications 352 at time slot 402 indicating that rate R1 is the desired rate of transmission based on the channel quality. As shown in this example, this rate information is received at the base station during time slot 304 because of the aforementioned delay factor. In slot 404, the mobile station detected a change in channel quality and reported back to the base station that transmission should occur at rate R2. This channel quality feedback is received by the base station during its time slot 306. Because the base station is sending a transmission to the mobile station during time slots 307-309 and because the base station is receiving channel quality feedback indicating rate R2 as the desired rate (e.g., R2 reported by mobile station in time slot 404 and received by the base station in time slot 306), the transmission by the base station during time slots 307-309 is therefore sent at rate R2. Because the base station is now transmitting data to the mobile station during time slots 307-309, the mobile station is adapted to send the channel quality feedback at a faster rate (e.g., every time slot) for the corresponding time slots 407-409, e.g., as shown by communications 357-359. It should be noted that, because transmission did not start until time slot 307 by

the base station and because of the delay factor, the channel quality feedback information indicating rate R2 via communication 356 is still being sent at the slower rate (e.g., every two (2) slots). The faster rate of reporting channel quality feedback does not begin until time slots 407-409 at the mobile station which correspond to time slots 307-309 where transmission is occurring from the base station.

When transmission from the base station ends and there is no further transmission, the mobile station resumes its reporting of channel quality information at the slower rate (e.g., every two (2) slots) as shown by communication 361. For example, there is no transmission from the base station in time slot 310, so the next report of rate information from the mobile station is sent at time slot 411, e.g., two time slots after time slot 409, which corresponded to time slot 309 when transmission ended from the base station.

It should be noted that the feedback rate for transmitting the channel quality information and the point in time when the information is reported (e.g., at the leading edge, during, or at the trail edge of the time slot) are all matters of design choice. As such, the example shown in FIG. 2 where the slower first rate is every two (2) slots and the faster second rate is every one (1) slot, and where the channel quality information is sent at the end of the corresponding time slot at the mobile station are all meant to be illustrative and not limiting in any way. However, those skilled in the art will appreciate that a large value for the reporting interval (time between the reports of channel quality from the mobile station) will reduce the channel quality feedback overhead. However, the resulting slower rate channel quality feedback may also result in large errors in channel quality estimates at the base station and performance degradation. Again, these are matters of design choice that are well understood by one skilled in the art.

According to another aspect of the invention, there are numerous implementations for providing rate feedback at a faster rate after detection of a transmission from the base station. For example, upon detection of a transmission from the base station, the mobile station can report channel quality information at a second rate for a prescribed duration after the detection of the transmission. In this manner, the rate feedback may therefore be provided at a faster rate for a period of time even though transmission from the base station has ended. By way of example, a mobile station may report rate feedback every 100 milliseconds in the absence of a

transmission. Upon detection of a transmission from the base station, the mobile station can then provide rate feedback every 20 milliseconds for a prescribed period of time regardless of whether transmission ends from the base station. At the end of that prescribed period of time and assuming there is an absence of a transmission, the mobile station would then resume reporting of rate feedback at the first rate of 100 milliseconds (e.g., the slower rate). In yet another example, the mobile station, upon detection of a transmission from the base station, can report channel quality information at a plurality of rates over a prescribed time period after detection of the transmission, wherein the plurality of rates are different than the first rate. More specifically, upon detection of a transmission, the mobile station would begin reporting rate feedback at a second rate that is faster than the first rate for a prescribed time period. At the end of this prescribed time period and assuming there is an absence of a transmission, the mobile station could then report rate feedback at a third rate that is different than the first and second rates, and so on. Other variations will also be apparent to those skilled in the art and are contemplated by the teachings herein.

On the downlink transmission from the base station, the total capacity is shared by a large number of mobile stations. Due to the bursty nature of the data traffic, the mobile stations are active only a fraction of the time. Therefore, an increased rate of channel quality feedback during the time of data transmission for a given mobile station will not result in any significant increase of overhead. The fast channel quality feedback rate during a transmission from the base station will result in better channel quality estimates that will be used for appropriate selection of transport format for new transmissions and retransmissions. Note that due to the bursty nature of the traffic, when a transmission is sent to a mobile station, it is likely that more transmissions or retransmissions will occur to the same mobile station within a short period of time.

According to another aspect of the invention, the increased feedback rate during data transmission also helps to estimate the quality of a transmission so that, in case of retransmissions, the appropriate amount of redundancy or repetition can be included in the retransmissions. This aspect of the invention is advantageous since it is possible that a transmission might initially start from the base station with a less accurate transmission rate (e.g., not matching up to the actual, current channel

quality) since a slower feedback rate is being used before transmission commences. So, although rate adaptation will be accurately performed once the feedback rate increases (e.g., to every time slot), there may be initial portions of the transmission that will require retransmission under certain circumstances. As such, the ability to estimate the quality of the transmission in the current feedback scheme will be helpful for the retransmission process. For example, these estimates can be used for selecting an appropriate transport format (e.g., modulation, number of codes, etc.) for retransmissions for the corresponding previous transmissions.

The embodiment shown in FIG. 3 helps to illustrate this aspect of the invention. Data channel 500 represents the downlink (forward link) from the base station to the mobile station and is shown as comprising two (2) millisecond frames or transmission time intervals (TTIs) 506. More specifically, data channel 500 shows multiple transmissions for the same user in data blocks 501-505, wherein data blocks 501-504 contain new transmissions while data block 505 contains a retransmission corresponding to the transmission in data block 501. As in the preceding embodiments, control channel 600 represents the uplink (reverse link) from the mobile station. The example shown in FIG. 3 depicts two (2) millisecond transmission time intervals 602, each of which comprises three (3) time slots 601 of .67 milliseconds each. This format is characteristic of the aforementioned HSDPA standard.

As in the preceding embodiments, the feedback rate for channel quality information from the mobile station is at a slower rate when there is no data transmission, e.g., as shown for time periods 603 and 604. However, when the mobile station detects transmission from the base station, the channel quality feedback rate is increased to once every transmission time interval (TTI), e.g., two (2) milliseconds, as shown by communications 610-614. In this example, the transport format for the retransmission 505 for data block A (RTX A) can be based on the most recent channel quality feedback (i.e. *m*) as well as the channel quality estimates *k* and *l* that, in turn, provide an estimate of the quality of the previous transmission 501 of data block A (NTX A). Accordingly, the appropriate rate, modulation, and coding scheme can be derived more accurately for the retransmission according to the principles of the invention.

In another exemplary embodiment of the invention, the feedback rate for channel quality information from the mobile station is varied as a function of the number of base stations that the mobile station is communicating with. In particular, this embodiment is particularly advantageous when handling so-called "soft handoffs" in CDMA wireless communication systems. As is well known, a "handoff" is the act of transferring support of a mobile station from one base station to another base station. A "soft handoff" occurs when the mobile station makes a connection to a new base station (e.g., cell) before leaving the current base station (e.g., cell) that is supporting the mobile station. In particular, a "soft handoff" is designed to ensure that there is connectivity with the old (e.g., current) base station while the new base station has been assigned to take control over the communication link with the mobile station. As such, a mobile station may be simultaneously communicating with multiple base stations at a given instant of time during such handoffs. According to the principles of the invention, the feedback rate for reporting channel quality information is adapted or otherwise varied to be slower when the mobile station is communicating with only one base station and faster during a "soft handoff" when the mobile station is communicating with two or more base stations. By increasing the rate of reporting quality information during "soft handoffs, the base stations can effectively and accurately perform the appropriate rate adaptations during such critical times such as "soft handoffs" and the like. It should be noted that other variations to this aspect of the invention will be apparent to those skilled in the art and are therefore contemplated by the teachings herein.

In general, the foregoing embodiments are merely illustrative of the principles of the invention. Those skilled in the art will be able to devise numerous arrangements, which, although not explicitly shown or described herein, nevertheless embody those principles that are within the scope of the invention. For example, although the invention was described in the context of wireless transmission according to the CDMA2000 1x-EV-DO standard, the invention could also be applicable to other known or to-be-developed wireless transmission standards. For example, the teachings of the invention may be applied to wireless transmission according to the well-known High Speed Downlink Packet Access (HSDPA) specification in the Universal Mobile Telecommunication System (UMTS) standard. Other modifications or substitutions will be apparent to those skilled in the art and are

contemplated by the teachings herein. Accordingly, the embodiments shown and described herein are only meant to be illustrative and not limiting in any manner. The scope of the invention is limited only by the claims appended hereto.

Petitioner's Exhibit 1002

We Claim:

1. A method for transmitting channel quality information in a wireless communication system comprising at least one base station and at least one mobile station, the method comprising:

varying a rate for reporting channel quality information from a mobile station to a base station as a function of the presence or absence of a transmission from the base station to the mobile station.

2. The method according to claim **1**, wherein the mobile station reports channel quality information at a first rate in the absence of a transmission from the base station and at a second rate in the presence of a transmission from the base station.

3. The method according to claim **1**, wherein the mobile station reports channel quality information at a first rate in the absence of a transmission from the base station and, upon detection of a transmission from the base station, the mobile station reports channel quality information at a second rate for a prescribed duration.

4. The method according to claim **1**, wherein the mobile station reports channel quality information at a first rate in the absence of a transmission from the base station and, upon detection of a transmission from the base station, the mobile station reports channel quality information at a plurality of rates over a prescribed time period after detection of the transmission, wherein the plurality of rates are different than the first rate.

5. The method according to claim **4**, wherein the prescribed time period includes a plurality of time intervals such that the channel quality information is reported at one of the plurality of rates during one of the plurality of time intervals.

6. The method according to claim **2**, wherein the second rate is faster than the first rate.

7. The method according to claim **6**, further comprising the step of estimating channel quality at the base station while the mobile station is reporting at

the second rate, wherein estimated channel quality is used to derive a transmission format for a subsequent transmission.

8. The method according to claim **7**, wherein the transmission format includes one or more parameters selected from the group consisting of modulation format, number of codes, and transmission rate.

9. The method according to claim **6**, further comprising the step of estimating channel quality at the base station while the mobile station is reporting at the second rate, wherein estimated channel quality is used to calculate an amount of redundancy needed for a retransmission of a previous transmission.

10. The method according to claim **1**, wherein the channel quality information comprises a transmission rate calculated by the mobile station based on one or more channel conditions.

11. A method for adapting the rate of reporting channel quality information in a wireless communication system including at least one base station and at least one mobile station, the method comprising:

reporting channel quality information from the at least one mobile station to the at least one base station at a first rate in the absence of a transmission from the at least one base station to the at least one mobile station; and

in the presence of a transmission from the at least one base station to the at least one mobile station, adapting the rate for reporting channel quality information from the at least one mobile station to the at least one base station from the first rate to a second rate.

12. The method according to claim **11**, wherein the second rate is faster than the first rate.

13. A method for transmitting channel quality information in a wireless communication system including at least one base station and at least one mobile station, the method comprising:

varying a rate for reporting channel quality information from a mobile station to a base station as a function of the number of base stations that the mobile station is communicating with.

14. The method according to claim **13**, wherein the mobile station reports channel quality information at a first rate when the mobile station is communicating with one base station and wherein the mobile station reports channel quality information at a second rate when the mobile station is communicating with a plurality of base stations.

15. The method according to claim **14** wherein the second rate is faster than the first rate.

VARIABLE RATE CHANNEL QUALITY FEEDBACK IN A WIRELESS COMMUNICATION SYSTEM

Abstract of the Disclosure

A channel quality feedback method for wireless transmission is described in which the rate for reporting channel quality information from a mobile station to a base station is variable as a function of the presence or absence of a transmission from the base station to the mobile station. In particular, the feedback rate from the mobile station to the base station is increased when the mobile station detects a transmission from the base station. As such, the feedback rate is slower when there is no data transmission for the mobile station and faster when the mobile station is receiving data.

Document provided by IPEXL

IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE

Declaration and Power of Attorney

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am an original, first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled **Variable Rate Channel Quality Feedback In A Wireless Communication System** the specification of which is attached hereto.

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by an amendment, if any, specifically referred to in this oath or declaration.

I acknowledge the duty to disclose all information known to me which is material to patentability as defined in Title 37, Code of Federal Regulations, 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

None

I hereby claim the benefit under Title 35, United States Code, 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

None

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

I hereby appoint the following attorney(s) with full power of substitution and revocation, to prosecute said application, to make alterations and amendments therein, to receive the patent, and to transact all business in the Patent and Trademark Office connected therewith:

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Donald P. Dinella	(Reg. No. 39961)
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Inventor's signature _____ Date 11/02/01

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Bib Data Sheet

CONFIRMATION NO. 3832

SERIAL NUMBER	FILING DATE / RULE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
10/002,746	11/02/2001	455	~~2681~~ 2681	14-18

APPLICANTS

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Farooq Ullah Khan, Manalapan, NJ;

**** CONTINUING DATA **************************** No

**** FOREIGN APPLICATIONS ********************** No

IF REQUIRED, FOREIGN FILING LICENSE GRANTED
** 12/20/2001

		STATE OR COUNTRY	SHEETS DRAWING	TOTAL CLAIMS	INDEPENDENT CLAIMS
Foreign Priority claimed	☐ yes ☑ no	NJ	3	15	3
35 USC 119 (a-d) conditions met	☐ yes ☑ no ☐ Met after Allowance				
Verified and Acknowledged	Examiner's Signature Initials				

ADDRESS

Docket Administrator (Room 3J-219)
Lucent Technologies Inc.
101 Crawfords Corner Road
Holmdel ,NJ 07733-3030

TITLE

Variable rate channel quality feedback in a wireless communication system

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

PATENT APPLICATION SERIAL NO. _____

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE
FEE RECORD SHEET

12/07/2001 BSAYASI1 00000054 122325 10002746
01 FC:101 740.00 CH

PTO-1556
(5/87)

*U.S. GPO: 2000-468-987/39595

PATENT APPLICATION FEE DETERMINATION RECORD
Effective October 1, 2001

Application or Docket Number: 14-18

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS	16	
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	16 minus 20=	*
INDEPENDENT CLAIMS	3 minus 3 =	*
MULTIPLE DEPENDENT CLAIM PRESENT		☐

* If the difference in column 1 is less than zero, enter "0" in column 2

SMALL ENTITY TYPE ☐		OR	OTHER THAN SMALL ENTITY	
RATE	FEE		RATE	FEE
BASIC FEE	370.00	OR	BASIC FEE	740.00
X$ 9=		OR	X$18=	
X42=		OR	X84=	
+140=		OR	+280=	
TOTAL		OR	TOTAL	740

CLAIMS AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	* 15	Minus	** 20	=
Independent	* 3	Minus	*** 3	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
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X42=		OR	X84=	
+140=		OR	+280=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B

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

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AMENDMENT C

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

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* 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.

CLAIMS ONLY

SERIAL NO.	FILING DATE
APPLICANT(S)	

CLAIMS

	AS FILED		AFTER 1st AMENDMENT		AFTER 2nd AMENDMENT	
	IND.	DEP.	IND.	DEP.	IND.	DEP.
1	1		1			
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TOTAL DEP.						
TOTAL CLAIMS						

*MAY BE USED FOR ADDITIONAL CLAIMS OR ADMENDMENTS

FORM PTO-2022 (1-98)

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*U.S. Government Printing Office: 1998 - 433-214/70303

11/02/01 j1058 U.S. PTO

12-05-01

A

jc973 U.S. PTO 10/002746 11/02/01

IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE

PATENT APPLICATION

Arnab Das
Farooq Ullah Khan

CASE 14-18

TITLE Variable Rate Channel Quality Feedback In A Wireless Communication System

ASSISTANT COMMISSIONER FOR PATENTS
WASHINGTON, D.C. 20231

SIR:

NEW APPLICATION UNDER 37 CFR § 1.53(b)

Enclosed are the following papers relating to the above-named application for patent:

Specification
3 Informal Sheets of drawing(s)
1 Assignment(s) with Cover Sheet
Declaration and Power of Attorney

CLAIMS AS FILED				
	NO. FILED	NO. EXTRA	RATE	CALCULATIONS
Total Claims	15 - 20 =	0	x $18 =	$0
Independent Claims	3 - 3 =	0	x $84 =	$0
Multiple Dependent Claims, if applicable			+ $280 =	$0
Basic Fee				$740
			TOTAL FEE	$740

Please file the application and charge **Lucent Technologies Deposit Account No. 12-2325** the amount of $740, to cover the filing fee. Duplicate copies of this letter are enclosed. In the event of non-payment or improper payment of a required fee, the Commissioner is authorized to charge or to credit **Deposit Account No. 12-2325** as required to correct the error.

The Assistant Commissioner for Patents is hereby authorized to treat any concurrent or future reply, requiring a petition for extension of time under 37 CFR § 1.136 for its timely submission, as incorporating a petition for extension of time for the appropriate length of time if not submitted with the reply.

Please address all correspondence to **Docket Administrator (Room 3J-219), Lucent Technologies Inc., 101 Crawfords Corner Road, Holmdel, New Jersey 07733-3030**. However, telephone calls should be made to me at 732-949-3578.

Respectfully,

Gregory J. Murgia
Reg. No. 41209
Attorney for Applicant(s)

"Express Mail" mailing label number EK218523710US
Date of Deposit Nov. 2, 2001
I hereby certify that this appl. is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Commissioner of Patents and Trademarks Washington, D.C. 20231
SHARON LOBOSCO
(Printed name of person mailing paper of fee)
Sharon Lobosco
(Signature of person mailing paper of fee)

Date: 11/2/01

Docket Administrator (Room 3J-219)
Lucent Technologies Inc.
101 Crawfords Corner Road
Holmdel, NJ 07733-3030
PT13 (10/01)

11/02/01 j1058 U.S. PTO

12-05-01

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jc973 U.S. PTO 10/002746 11/02/01

IN THE UNITED STATES
PATENT AND TRADEMARK OFFICE

PATENT APPLICATION

Arnab Das
Farooq Ullah Khan

CASE 14-18

TITLE Variable Rate Channel Quality Feedback In A Wireless Communication System

ASSISTANT COMMISSIONER FOR PATENTS
WASHINGTON, D.C. 20231

SIR:

NEW APPLICATION UNDER 37 CFR § 1.53(b)

Enclosed are the following papers relating to the above-named application for patent:

Specification
3 Informal Sheets of drawing(s)
1 Assignment(s) with Cover Sheet
Declaration and Power of Attorney

CLAIMS AS FILED				
	NO. FILED	NO. EXTRA	RATE	CALCULATIONS
Total Claims	15 - 20 =	0	x $18 =	$0
Independent Claims	3 - 3 =	0	x $84 =	$0
Multiple Dependent Claims, if applicable			+ $280 =	$0
Basic Fee				$740
			TOTAL FEE	$740

Please file the application and charge **Lucent Technologies Deposit Account No. 12-2325** the amount of $740, to cover the filing fee. Duplicate copies of this letter are enclosed. In the event of non-payment or improper payment of a required fee, the Commissioner is authorized to charge or to credit **Deposit Account No. 12-2325** as required to correct the error.

The Assistant Commissioner for Patents is hereby authorized to treat any concurrent or future reply, requiring a petition for extension of time under 37 CFR § 1.136 for its timely submission, as incorporating a petition for extension of time for the appropriate length of time if not submitted with the reply.

Please address all correspondence to **Docket Administrator (Room 3J-219), Lucent Technologies Inc., 101 Crawfords Corner Road, Holmdel, New Jersey 07733-3030**. However, telephone calls should be made to me at 732-949-3578.

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