not more than three months prior to the filing of this information disclosure statement;

OR

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

☒ Applicant submits that the enclosed Information Disclosure Statement is timely; therefore, no fee is required.

☒ Except as provided for under 37 CFR § 1.98(a)(2), Applicant has enclosed a copy of each listed reference.

☐ The above referenced application relies upon Application No. _____, filed _____, for an earlier effective filing date under 35 U.S.C. 120. Although, pursuant to 37 CFR § 1.98(d), the references submitted herein are not required to be submitted for the Examiner to consider them, Applicant submits the references herein so that the information will be printed on the patent issuing from this application.

☐ Pursuant to 37 CFR § 1.704(d), Applicant certifies that each of the references cited herein were first cited in a communication from a foreign patent office in a counterpart application and that this communication was not received by any individual designated in 37 CFR § 1.56(c) more than thirty days prior to the filing of this Information Disclosure Statement.

Consideration of the listed references and favorable action are requested. If any additional fees are due in connection with the filing of this Information Disclosure Statement, the Commissioner is hereby authorized to charge such fees to Deposit Account 50-2776.

Respectfully submitted,

Date: 2018-10-05

By: /Michael V. North/
Michael V. North
Reg. No. 46963

Customer No.
146571
UNITED STATES PATENT AND TRADEMARK OFFICE

Charter Communications, Inc.
Exhibit 1006
Page #963

PTO/SB/08b (07-09)
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Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 1

Complete if Known	
Application Number	14/356,581
Filing Date	2014-05-06
First Named Inventor	Wonjong Rhee
Art Unit	2446
Examiner Name	Boris D. Grualva Lobos
Attorney Docket Number	20145-054US

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
	1	Office Action dated 2018-08-10, in Canadian Patent Application No. 2,855,461 (3pgs).	

Examiner Signature		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.

[1] Applicant's unique citation designation number (optional). [2] Applicant is to place a check mark here if English language Translation is attached.

This collection of information is required by 37 CFR 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours 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, 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 (1-800-786-9199) and select option 2.

Electronic Acknowledgement Receipt

EFS ID:	33936779
Application Number:	14356581
International Application Number:	
Confirmation Number:	4319
Title of Invention:	METHOD, APPARATUS, AND SYSTEM FOR OPTIMIZING PERFORMANCE OF A COMMUNICATION UNIT BY A REMOTE SERVER
First Named Inventor/Applicant Name:	Wonjong Rhee
Customer Number:	146571
Filer:	Michael V. North/Nita Miller
Filer Authorized By:	Michael V. North
Attorney Docket Number:	20145-054US
Receipt Date:	05-OCT-2018
Filing Date:	06-MAY-2014
Time Stamp:	18:50:23
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	054US_SIDS_Trans.pdf	32220 629c15e0374ce64011bf80e6bc862487856d7e4d	no	3
Warnings:					

Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	054US_SIDS_sb08b.pdf	136491 a9d9fbc858f2f0fc29e7472b099b0503cbb92bee	no	1
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
3	Non Patent Literature	054US_SIDS_NPL1.pdf	6401650 bc4c2a88a44601b08a4430d7ba7dbc1492b41618d	no	3
Warnings:					
Information:					
		Total Files Size (in bytes):	6570361		

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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.

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s)	:	Wonjong Rhee	Confirmation No.: 4319
Appl. No.	:	14/356,581	
Filing Date	:	2014-05-06	
Title	:	METHOD, APPARATUS, AND SYSTEM FOR OPTIMIZING PERFORMANCE OF A COMMUNICATION UNIT BY A REMOTE SERVER	
Art Unit	:	2446	
Examiner	:	Boris D. Grualvalobos	
Docket No.	:	20145-054US	

CERTIFICATE OF MAILING (37 CFR §1.8)

I hereby certify, pursuant to 37 CFR §1.8, that this correspondence is being electronically transmitted via EFS-Web addressed to Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on the date shown below:

Date: 2018-10-05 By: /Nita Miller/
Nita Miller

INFORMATION DISCLOSURE STATEMENT

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

SIR or MADAM:

Filed herewith, in accordance with the provisions of 37 CFR §§ 1.56 and 1.97–1.98, listing various references for consideration by the Examiner, is an Information Disclosure Statement ("IDS").

The filing of this IDS shall not be construed as a representation that a search has been made, or regarding the completeness of the list of references, or that no other material information exists. Furthermore, the filing of this IDS shall not be construed as a representation that inclusion of a reference in this list is an admission that it is prior art or is pertinent to this application, or as an admission that the information listed is, or may be considered to be, material to the patentability of the above referenced application. The filing of this IDS shall not be construed in any manner as an admission against interest.

This IDS is being filed:

Charter Communications, Inc.
Exhibit 1006
Page #967

☐ within three months of the filing date of a national application, other than a continued prosecution application under § 1.53(d);

☐ within three months of the date of entry of the national stage as set forth in § 1.491 in an international application;

☐ before the mailing of a first Office Action on the merits;

☐ before the mailing of a first Office Action after the filing of a request for continued examination under § 1.114;

☒ after three months of the filing date or entry into the national stage or after the mailing of a first Office action on the merits, but before the mailing date of any final action under § 1.113, a notice of allowance under §1.311, or an action that otherwise closes prosecution in the application;

AND

☒ enclosed herein is the fee set forth in 37 CFR § 1.17(p);

OR

☐ Applicant certifies pursuant to 37 CFR § 1.97(e):

☐ That each item of information contained in the information disclosure statement was first 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 information disclosure statement;

OR

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

☐ on or before the payment of the issue fee but after the mailing of a final action under § 1.113, a notice of allowance under §1.311, or an action that otherwise closes prosecution in the application;

AND

☐ enclosed herein is the fee set forth in 37 CFR § 1.17(p);

AND

☐ Applicant certifies pursuant to 37 CFR § 1.97(e):

☐ That each item of information contained in the information disclosure statement was first 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 information disclosure statement;

OR

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

☒ Applicant submits that the enclosed Information Disclosure Statement is timely; therefore, no fee is required.

☒ Except as provided for under 37 CFR § 1.98(a)(2), Applicant has enclosed a copy of each listed reference.

☐ The above referenced application relies upon Application No. _____, filed _____, for an earlier effective filing date under 35 U.S.C. 120. Although, pursuant to 37 CFR § 1.98(d), the references submitted herein are not required to be submitted for the Examiner to consider them, Applicant submits the references herein so that the information will be printed on the patent issuing from this application.

☐ Pursuant to 37 CFR § 1.704(d), Applicant certifies that each of the references cited herein were first cited in a communication from a foreign patent office in a counterpart application and that this communication was not received by any individual designated in 37 CFR § 1.56(c) more than thirty days prior to the filing of this Information Disclosure Statement.

Consideration of the listed references and favorable action are requested. If any additional fees are due in connection with the filing of this Information Disclosure Statement, the Commissioner is hereby authorized to charge such fees to Deposit Account 50-2776.

Respectfully submitted,

Date: 2018-10-05

By: /Michael V. North/
Michael V. North
Reg. No. 46963

Customer No.
146571
UNITED STATES PATENT AND TRADEMARK OFFICE

Charter Communications, Inc.
Exhibit 1006
Page #969

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

PTO/SB/08a (01-10)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	14356581
Filing Date	2014-05-06
First Named Inventor	Wonjong Rhee
Art Unit	2446
Examiner Name	Boris Grijalva Lobos
Attorney Docket Number	20145-054US

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20120151540	A1	2012-06-01	Kenneth Stanwood	

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

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2011079612	WO		2011-07-11	Qinghong Zhang		

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

NON-PATENT LITERATURE DOCUMENTS Remove

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

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Page #970

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14356581
	Filing Date	2014-05-06
	First Named Inventor	Wonjong Rhee
	Art Unit	2446
	Examiner Name	Boris Grijalva Lobos
	Attorney Docket Number	20145-054US

	1	Response filed 2018-03-14, in Canadian Patent Application No. 2,855,461 (3pgs).	
	2	Response filed 2018-02-09, and English translation of claims, in Chinese Patent Application No. 201180075399.4 (20pgs).	X
	3	Office Action dated 2018-05-31, and English translation thereof, in Chinese Patent Application No. 201180075399.4 (22pgs).	☒
	4	Preliminary Amendments made 2018-04-12, in Australian Patent Application No. 2018200888 (32pgs).	☐
	5	Notice of Allowance dated 2018-03-09, in European Patent Application No. 118028265 (7pgs).	☐
	6	Office Action dated 2017-02-10, in Australian Patent Application No. 2016200291 (4pgs).	☐
	7	Response filed 2017-05-24, in Australian Patent Application No. 2016200291 (36pgs).	☐
	8	Office Action dated 2017-06-19, in Australian Patent Application No. 2016200291 (3pgs).	☐
	9	Preliminary Amendment filed 2018-04-11, in Australian Patent Application No. 2018200787 (32pgs).	☐
	10	Office Action dated 2015-08-20, in Canadian Patent Application No. 2,858,030 (3pgs).	☐
	11	English translation of Office Action dated 2015-08-21, in Japanese Patent Application No. 2014545863 (5pgs).	☒

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14356581
	Filing Date	2014-05-06
	First Named Inventor	Wonjong Rhee
	Art Unit	2446
	Examiner Name	Boris Grijalva Lobos
	Attorney Docket Number	20145-054US

If you wish to add additional non-patent literature document citation information please click the Add button	Add		
EXAMINER SIGNATURE			
Examiner Signature		Date Considered	

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

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

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Exhibit 1006
Page #972

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14356581
	Filing Date	2014-05-06
	First Named Inventor	Wonjong Rhee
	Art Unit	2446
	Examiner Name	Boris Grijalva Lobos
	Attorney Docket Number	20145-054US

CERTIFICATION STATEMENT

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

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

OR

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

See attached certification statement.

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

☒ A certification statement is not submitted herewith.

SIGNATURE

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

Signature	/Michael North/	Date (YYYY-MM-DD)	2018-08-09
Name/Print	Michael North	Registration Number	46963

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

Privacy Act Statement

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

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

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

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

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

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

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

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

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

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

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

(12) 按照专利合作条约所公布的国际申请

(19) 世界知识产权组织
国 际 局

(43) 国际公布日
2011 年 7 月 7 日 (07.07.2011)

PCT

(10) 国际公布号
WO 2011/079612 A1

(51) 国际专利分类号:
H04W 28/08 (2009.01)

(21) 国际申请号: PCT/CN2010/074869

(22) 国际申请日: 2010 年 6 月 30 日 (30.06.2010)

(25) 申请语言: 中文

(26) 公布语言: 中文

(30) 优先权:
200910238810.X 2009 年 12 月 29 日 (29.12.2009) CN

(71) 申请人 (对除美国外的所有指定国): **中兴通讯股份有限公司** (ZTE CORPORATION) [CN/CN]; 中国广东省深圳市南山区高新技术产业园科技南路中兴通讯大厦, Guangdong 518057 (CN)。

(72) 发明人; 及

(75) 发明人/申请人 (仅对美国): **张庆宏** (ZHANG, Qinghong) [CN/CN]; 中国广东省深圳市南山区高新技术产业园科技南路中兴通讯大厦, Guangdong 518057 (CN)。 **李航** (LI, Hang) [CN/CN]; 中国广东省深圳市南山区高新技术产业园科技南路中兴通讯大厦, Guangdong 518057 (CN)。

(74) 代理人: **北京安信方达知识产权代理有限公司** (AFD CHINA INTELLECTUAL PROPERTY LAW OFFICE); 中国北京市海淀区学清路 8 号 B 座 1601A, Beijing 100192 (CN)。

(81) 指定国 (除另有指明, 要求每一种可提供的国家保护): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW。

(84) 指定国 (除另有指明, 要求每一种可提供的地区保护): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), 欧亚 (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), 欧洲 (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)。

[见续页]

(54) **Title**: METHOD FOR LINK ADAPTATION AND APPARATUS THEREOF

(54) **发明名称** : 一种链路自适应方法及装置

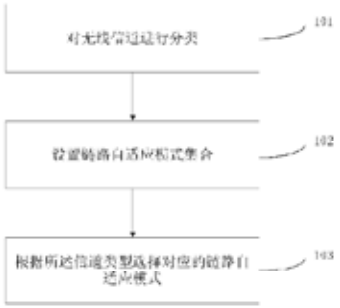


图 1 / **Fig.** 1

101 CLASSIFY RADIO CHANNELS
102 SET A SET OF LINK ADAPTATION MODES
103 SELECT A CORRESPONDING LINK ADAPTATION MODE ACCORDING TO THE TYPE OF THE RADIO CHANNEL

(57) **Abstract**: A method for link adaptation comprises: classifying radio channels; setting a set of link adaptation modes; and selecting a corresponding link adaptation mode according to the type of the radio channel. An apparatus for link adaptation comprises: classification module for classifying radio channels; setting module for setting a set of link adaptation modes; and mode selection module for selecting a corresponding link adaptation mode from the setting module according to the type of the classified radio channel. By accordingly selecting effective link adaptation modes in accordance with different types of radio channels, realizing the throughput maximization of system in different fading channels can be ensured, and the stable and reliable link quality can be maintained.

[见续页]

WO 2011/079612 A1

Charter Communications, Inc.
Exhibit 1006
Page #975

本国际公布:

— 包括国际检索报告(条约第 21 条(3))。

(57) 摘要:

一种链路自适应方法，其包括：对无线信道进行分类；设置链路自适应模式集合；以及根据所述无线信道的类型选择对应的链路自适应模式。一种链路自适应装置，其包括：分类模块，用于对无线信道进行分类；设置模块，用于设置链路自适应模式集合；以及模式选择模块，用于根据所述分类的无线信道类型从设置模块中选择对应的链路自适应模式。本发明根据无线信道的不同类型有针对性地选择有效的链路自适应模式，能够保证在不同的衰落信道下实现系统的吞吐量最大化，保持稳定可靠的链路质量。

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一种链路自适应方法及装置

技术领域

本发明涉及无线通信系统，尤其涉及一种链路自适应的技术。

背景技术

在无线通信系统中，由于无线信道复杂多变，且无固定的变化规律可循，为了实现无线通信系统的吞吐量最大化，就希望无线通信系统能够根据信道条件变化自动调整传输速率，即链路自适应技术。常规的链路自适应的方法就是将最新的信道质量的测量结果作为未来链路速率选择的依据。

发明内容

现有技术中的常规的链路自适应的方法是将最新的信道质量的测量结果作为未来链路速率选择的依据，该方法存在以下问题:

信道质量测量结果总会包含测量误差和随机干扰影响，即测量结果并不能准确反映实际信道条件;

无线信道条件总是随着时间的变化而随机变化，也就是说过去的测量结果并不能完全反映未来的信道条件。

鉴于此，本发明要解决的技术问题是提出一种链路自适应方法和装置，能够保证在不同的衰落信道下实现系统的吞吐量最大化，保持稳定可靠的链路质量。

为了解决以上技术问题，本发明一方面提供了一种链路自适应的方法，其包括:

对无线信道进行分类;

设置链路自适应模式集合; 以及

根据所述无线信道的类型选择对应的链路自适应模式。

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对无线信道进行分类的步骤中，是根据无线信道的时变特性进行分类的。

对无线信道进行分类的步骤中，是将无线信道分类为：

平坦信道、慢衰落信道和快衰落信道；或者

慢衰落信道和快衰落信道；或者

慢衰落信道、快衰落信道和突变信道。

所述链路自适应模式集合包括：即时值预测模式、历史值预测模式、统计分位数预测模式和突变处理模式。

根据所述无线信道的类型选择对应的链路自适应模式的步骤包括：通过分析无线信道的历史测量信息，判断得出当前无线信道的类型，根据所述当前无线信道的类型从所述链路自适应模式集合中选择对应的链路自适应模式。

根据所述无线信道的类型选择对应的链路自适应模式的步骤之后，所述方法还包括：根据所述无线信道类型和对应的链路自适应模式，得出待调度时刻的信道预测信息，选择与所述待调度时刻的信道预测信息匹配的链路速率。

本发明另一方面还提供了一种链路自适应装置，包括：

分类模块，其设置为：对无线信道进行分类；

设置模块，其设置为：设置链路自适应模式集合；以及

模式选择模块，其设置为：根据所述分类的无线信道类型从设置模块中选择对应的链路自适应模式。

所述分类模块是设置为根据无线信道的时变特性对无线信道进行分类的。

所述分类模块是设置为将无线信道分类为：

平坦信道、慢衰落信道和快衰落信道；或者

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慢衰落信道和快衰落信道；或者

慢衰落信道、快衰落信道和突变信道。

所述链路自适应模式集合包括：即时值预测模式、历史值预测模式、统计分位数预测模式和突变处理模式。

所述模式选择模块是设置为按如下方式根据所述无线信道的类型选择对应的链路自适应模式：

通过分析无线信道的历史测量信息，判断得出当前无线信道的类型，根据所述当前无线信道的类型从所述链路自适应模式集合中选择对应的链路自适应模式。

所述装置还包括：

信道学习模块，其设置为：分析处理无线信道的历史测量信息，得出当前无线信道的类型；以及

链路速率确定模块，其设置为：根据所述无线信道类型和对应的链路自适应模式，得出待调度时刻的信道预测信息，选择与所述待调度时刻的信道预测信息匹配的链路速率。

通过采用本发明的技术，根据无线信道的不同分类有针对性的选择有效的链路自适应处理模式，能够保证在不同的衰落信道下实现系统的吞吐量最大化，保持稳定可靠的链路质量。

附图概述

此处所说明的附图用来提供对本发明的进一步理解，构成本申请的一部分，本发明的示意性实施例及其说明用于解释本发明，并不构成对本发明的不当限定。在附图中：

图 1 为本发明链路自适应方法的流程图；

图 2 为本发明实施例一的链路自适应方法的流程图；

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图 3 为无线信道的一种分类示意图;

图 4 为本发明链路自适应的装置框图。

本发明的较佳实施方式

下面结合附图和实施例，对本发明的具体实施方式做详细说明。

本发明的链路自适应方法基本思想原理如图 1 所示，包括:

步骤 101，对无线信道进行分类;

步骤 102，设置链路自适应模式集合;

步骤 103，根据所述无线信道的类型来选择对应的链路自适应模式。

实施例 1

如图 2 所示，本实施例包括以下步骤:

步骤 201，对无线信道进行分类，并设置相应的链路自适应模式集合。

具体地，本实施例中，根据无线信道的时变特性将无线信道类型分为三种，如图 3 所示，为：平坦信道、慢衰落信道和快衰落信道;

进而根据信道衰落分类，设置与之相应的链路自适应模式集合;

相应的链路自适应模式集合为：即时值预测模式、历史值预测模式和统计分位数预测模式。其中:

即时值预测模式指，以最新的信道测量结果作为信道待调度时刻的链路速率选择依据。

历史值预测模式指，根据信道的历史测量结果，采用曲线拟合的方式预测待调度时刻的信道条件用于链路速率的选择。

统计分位数预测模式指，采用历史测量结果的累积分布函数的某个分位数作为待调度时刻的链路速率选择依据。例如:

（1）平坦信道：即时值预测模式下，可预测的，即预测误差在可接收的范围内;

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设:

t 时刻的信道测量结果记为 SINR(t)，当前时刻记为 t0，待调度时刻为 t0+n，其中 n 为系统处理时延与空口传输时延总和；当前时刻获得的最新测量结果为 SINR(tx)，tx⩽t0，则：即时值预测结果 SINR_estimate(t0+n)为 SINR_estimate(t0+n)=SINR(tx)，t 时刻的估计误差记为 Err(t)，则：

Err(t)= |SINR_estimate(t)-SINR(t)|

可预测的（可估计的）可能的公式表达为:

概率函数 P(Err(t)⩽Error_threhold | t = t0-w+1,t0-w+2,…,t0) ⩾P1，0⩽P1⩽1，w⩾0，其中 Error_threhold 为估计误差的门限，当 Err(t)⩽Error_threhold 表示 t 时刻估计正确，否则估计错误，Error_threhold 越小估计精度要求越高，反之则估计精度越低；P1 表示估计正确的概率门限，即正确估计的概率为 P1。当正确估计的概率大于门限值 P1 时，称信道在该预测模式下是可估计的（或称可预测的）。其中，w 表示统计时间窗长，w 越低，信道模式之间的切换就越慢，统计结果就越准确，发展模式切换就越快，判断精确性会下降。

（2）慢衰落信道：历史值预测模式下，可预测的，即预测误差在可接收的范围内。

可预测的概念同上，此处不赘述;

历史值预测模式是指，利用历史的信道测量结果 SINR(t0-w’ +1), SINR(t0-w’ +2),…, SINR(t0)，采用选取基函数 f(t)对 SINR（t），t= t0-w’ +1, t0-w’ +2,…,t0 做曲线拟合，求出 f(t)的数学表达式，使得 f(t)=SINR(t), t = t0-w’ +1, t0-w’ +2。历史值预测结果 SINR_estimate（t）= f（t）。其中 w’ 表示历史测量结果的个数；f(t)可以取任何基函数，例如三角函数、幂函数、对数函数以及多项式函数等。

（3）快衰落信道：其它情况，即，不可以预测;

对于以上两种方法均不可预测的，则判定为快衰落信道，与之对应的链路自适应模式为统计分位数预测模式;

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统计分位数预测模式，即采用概率分布函数的模式:

P(x) = P (SINR(t)<x | t =t= t0-w’ ’ +1, t0-w’ ’ +2,…,t0) ，取 P(x)的 alpha 点分位数，作为统计分位数预测结果 SINR_estimate(t)，即，SINR_estimate(t) = P^{-1}（alpha），P^{-1}(x)为 P(x)的反函数；0≤alpha≤1，alpha 越大速率越高可靠性越差，反之速率越低可靠性越高;

步骤 202，根据对无线信道的历史测量信息的分析获得无线信道的衰落类型，即通过信道学习来获得无线信道的衰落类型。

步骤 202 包括:

202.1，对历史测量结果进行去噪处理，采用一般的去噪方式即可，如:滤波方式或滑动窗口平均方式;

202.2,观察历史的 N 次测量结果,如果是在即时值预测模式下可预测的，则该信道为平坦信道；如果是在历史值预测模式下可预测的，则该信道为慢衰落信道；否则为快衰落信道。

步骤 203，根据步骤 202 中获取的无线信道衰落类型，在链路自适应模式集合中选择链路自适应模式;

如果信道为平坦信道，则选取即时值预测模式；如果信道为慢衰落信道，则选取历史值预测模式；如果信道为快衰落信道，则选取统计分位数预测模式。

步骤 204，根据无线信道的分类和链路自适应模式，给出待调度时刻的信道条件预测信息;

此处的信道条件预测信息可以包括：信干噪比（Signal Interference Noise Ratio, SINR）、误块率（Block Error Rate, BLER）等;

设，最新的测量历史值为 SINR(t)，待调度时刻为 SINR_estimate(tx);

信道分类结果对应的信道条件预测信息如下:

平坦信道下：SINR_estimate(tx)=SINR(t)

慢衰落信道下： SINR_estimate(tx)=f(tx);

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快衰落信道下：SINR_estimate(tx)=P^{-1}(tx)。

步骤 205，根据步骤 204 得到的信道条件预测信息，获得与之相匹配的链路速率；

设：信道的信干噪比（Signal Interference Noise Ratio，SINR）预测结果为 SINR1，业务的误块率（Block Error Rate,BLER）要求是 BLER1；在 SINR=SINR1，BELR=BLER1 的条件下链路所能达到的最大速率为调制编码方式 1（Modulation Code Scheme，即 MCS1），则本步骤输出结果为 MCS1。

步骤 206，链路自适应过程完成。

实施例 2

另，本发明还可以根据无线信道的时变特性将无线信道分为两种：即慢衰落信道和快衰落信道。处理方式如实施例 1，此处不赘述。

实施例 3

另，本发明还可以根据无线信道的时变特征将无线信道分为：快衰落信道、慢衰落信道和突变信道。

其中快衰落信道和慢衰落信道的处理方式如实施例 1，此处不赘述。

突变信道，即信道突然变好或变坏，对应的链路自适应模式为突变处理模式。

对于突变信道，采用突变处理模式，突变处理模式是指：清除历史信息，采用初始默认的信道预测方法，初始默认预测方法可采用历史值预测模式或即时值预测模式中的任意一种，具体选择视数据可靠性要求而定。

实施例 4

基于同一发明构思，本发明实施例中还提供了一种用于链路自适应的装置，由于该装置解决问题的原理与链路自适应的方法相似，因此该装置的实施可以参见方法的实施，重复之处不再赘述。

图 4 示出了本发明链路自适应的装置结构示意图，如图 4 所示，该装置包括分类模块、设置模块和模式选择模块。其中：

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分类模块 401 设置为：对无线信道进行分类；

设置模块 402 设置为：设置链路自适应模式集合；

模式选择模块 403 设置为：根据所述分类的无线信道类型从设置模块中选择对应的链路自适应模式。

优选地，本发明的链路自适应装置还包括信道学习模块和链路速率确定模块；其中：

信道学习模块设置为：分析处理无线信道的历史测量信息，得出当前无线信道的类型；

链路速率确定模块设置为：根据所述无线信道类型和对应的链路自适应模式，得出待调度时刻的信道预测信息，选择与之匹配的链路速率。

本领域普通技术人员可以理解上述方法中的全部或部分步骤可通过程序来指令相关硬件完成，所述程序可以存储于计算机可读存储介质中，如只读存储器、磁盘或光盘等。可选地，上述实施例的全部或部分步骤也可以使用一个或多个集成电路来实现。相应地，上述实施例中的各模块/单元可以采用硬件的形式实现，也可以采用软件功能模块的形式实现。本发明不限制于任何特定形式的硬件和软件的结合。

以上详细说明了本发明的原理，但这只是为了便于理解而举的一些实施例，并不构成对本发明保护范围的限定。在不背离本发明精神及实质的情况下，本领域技术人员当可根据本发明作出各种相应的改变和变形，但这些相应的改变和变形都属于本发明所付的权利要求的保护范围。

工业实用性

通过采用本发明的技术，根据无线信道的不同分类有针对性的选择有效的链路自适应处理模式，能够保证在不同的衰落信道下实现系统的吞吐量最大化，保持稳定可靠的链路质量。

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权 利 要 求 书

1、一种链路自适应方法，其包括:

对无线信道进行分类;

设置链路自适应模式集合; 以及

根据所述无线信道的类型选择对应的链路自适应模式。

2、根据权利要求 1 所述的方法，其中，对无线信道进行分类的步骤中，是根据无线信道的时变特性进行分类的。

3、根据权利要求 2 所述的方法，其中，对无线信道进行分类的步骤中，是将无线信道分类为:

平坦信道、慢衰落信道和快衰落信道; 或者

慢衰落信道和快衰落信道; 或者

慢衰落信道、快衰落信道和突变信道。

4、根据权利要求 1 所述的方法，其中，所述链路自适应模式集合包括: 即时值预测模式、历史值预测模式、统计分位数预测模式和突变处理模式。

5、根据权利要求 4 所述的方法，其中，根据所述无线信道的类型选择对应的链路自适应模式的步骤包括:

通过分析无线信道的历史测量信息，判断得出当前无线信道的类型，根据所述当前无线信道的类型从所述链路自适应模式集合中选择对应的链路自适应模式。

6、根据权利要求 5 所述的方法，其中，根据所述无线信道的类型选择对应的链路自适应模式的步骤之后，所述方法还包括:

根据所述无线信道类型和对应的链路自适应模式，得出待调度时刻的信

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道预测信息，获得与所述待调度时刻的信道预测信息匹配的链路速率。

7、一种链路自适应装置，其包括：

分类模块，其设置：对无线信道进行分类；

设置模块，其设置为：设置链路自适应模式集合；以及

模式选择模块，其设置为：根据所述分类的无线信道类型从设置模块中选择对应的链路自适应模式。

8、根据权利要求 7 所述的装置，其中，所述分类模块是设置为根据无线信道的时变特性对无线信道进行分类的。

9、根据权利要求 8 所述的装置，其中，所述分类模块是设置为将无线信道分类为：

平坦信道、慢衰落信道和快衰落信道；或者

慢衰落信道和快衰落信道；或者

慢衰落信道、快衰落信道和突变信道。

10、根据权利要求 7 所述的装置，其中，所述链路自适应模式集合包括：即时值预测模式、历史值预测模式、统计分位数预测模式和突变处理模式。

11、根据权利要求 10 所述的装置，其中，所述模式选择模块是设置为按如下方式根据所述无线信道的类型选择对应的链路自适应模式：

通过分析无线信道的历史测量信息，判断得出当前无线信道的类型，根据所述当前无线信道的类型从所述链路自适应模式集合中选择对应的链路自适应模式。

12、根据权利要求 7 所述的装置，其还包括：

信道学习模块，其设置为：分析处理无线信道的历史测量信息，得出当前无线信道的类型；以及

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Page #986

链路速率确定模块，其设置为：根据所述无线信道类型和对应的链路自适应模式，得出待调度时刻的信道预测信息，获得与所述待调度时刻的信道预测信息匹配的链路速率。

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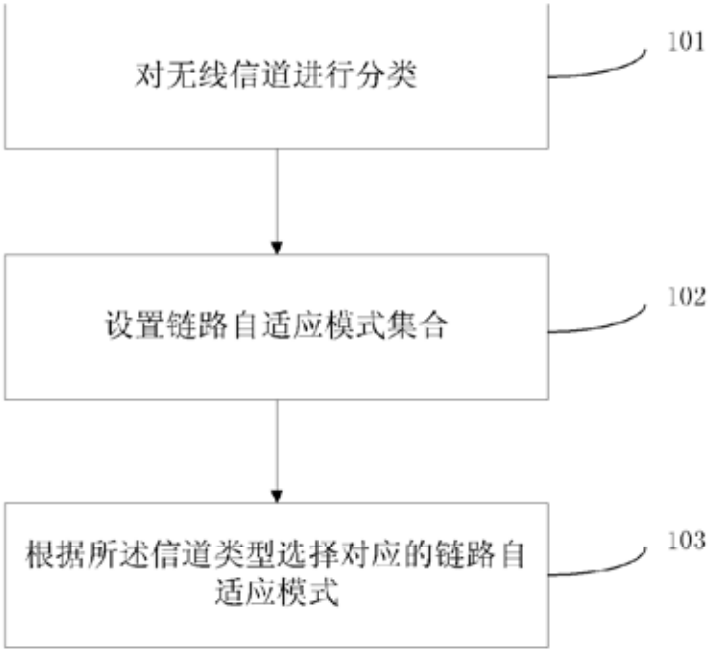


图 1

Charter Communications, Inc.
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Page #988

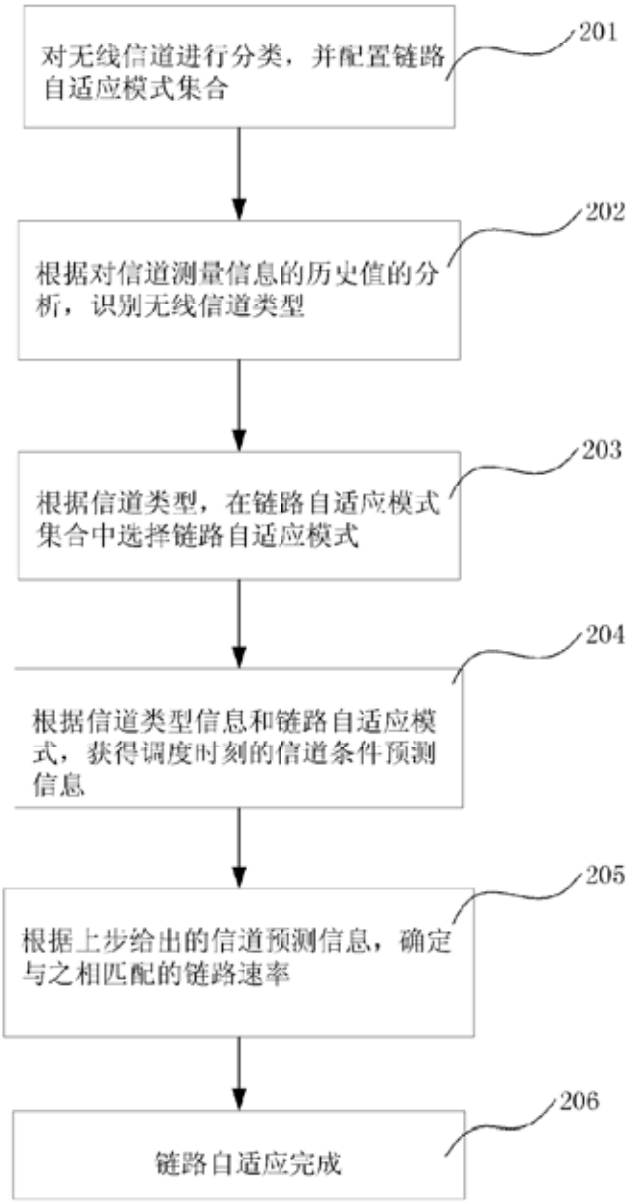


图 2

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Page #989



平坦信道



快衰落信道



慢衰落信道

图 3

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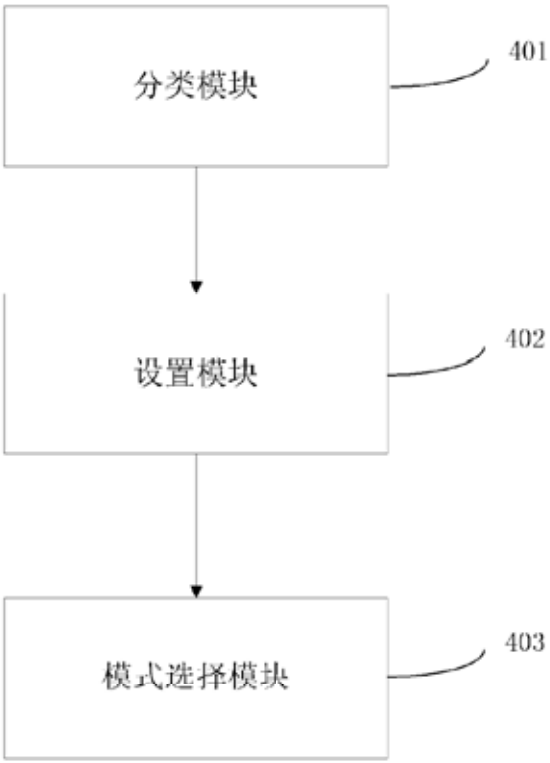


图 4

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2010/074869

A. CLASSIFICATION OF SUBJECT MATTER

H04W 28/08 (2009.01) i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: H04W H04L H04J H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

CNPAT; CNKI; WPI; EPODOC; link?, channel?, adaptation, adaptive, classif+, type?, mode?, pattern?, rate, throughput, fading, predict+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN1829113A (MATSUSHITA ELECTRIC IND CO LTD) 06 Sep. 2006 (06.09.2006)	1-3,7-9
Y	description, page 2, lines 1-7, page 3, lines 14-19, figures 3, 6	4-6,10-12
Y	CN1399436A (INTEL CORP) 26 Feb. 2003 (26.02.2003) description, page 4, line 3 to page 6, line 22, page 10, line 19 to page 11, line 31, figures 2-5	4-6,10-12
A	CN1862995A (ZHONGXING COMMUNICATION CO LTD SHENZHEN) 15 Nov. 2006 (15.11.2006) full text	1-12
A	US20090310550A1(BECEEM COMMUNICATIONS INC)17 Dec. 2009(17.12.2009) full text	1-12

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 Sep. 2010 (25.09.2010)	**28 Oct. 2010 (28.10.2010)**
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer Meng, Tiange Telephone No. (86-10)62411653

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

Charter Communications, Inc.
Exhibit 1006
Page #992

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2010/074869

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN1829113A	06.09.2006	none	
CN1399436A	26.02.2003	US2003017835A1	23.01.2003
		WO03009493A1	30.01.2003
		KR20030009140A	29.01.2003
		JP2003143065A	16.05.2003
		EP1410528A1	21.04.2004
		AU2002355087A1	03.03.2003
		TW574793A	01.02.2004
		CN1181634C	22.12.2004
		EP1410528B1	19.04.2006
		DE60210777E	24.05.2006
		JP3790723B2	28.06.2006
		SG125901A1	30.10.2006
		US7174178B2	06.02.2007
		DE602107777T2	19.04.2007
		KR100654282B1	05.12.2006
CN1862995A	15.11.2006	none	
US20090310550A1	17.12.2009	none	

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国际检索报告

国际申请号
PCT/CN2010/074869

A. 主题的分类

H04W 28/08 (2009.01) i

按照国际专利分类(IPC)或者同时按照国家分类和 IPC 两种分类

B. 检索领域

检索的最低限度文献(标明分类系统和分类号)

IPC: H04W H04L H04J H04B

包含在检索领域中的除最低限度文献以外的检索文献

在国际检索时查阅的电子数据库(数据库的名称，和使用的检索词（如使用）)

CNPAT; CNKI; WPI; EPODOC; 链路，信道，自适应，分类，类型，模式，速率，吞吐量，容量，衰落，预测; link?, channel?, adaptation, adaptive, classif+, type?, mode?, pattern?, rate, throughput, fading, predict+

C. 相关文件

类 型*	引用文件，必要时，指明相关段落	相关的权利要求
X	CN1829113A（松下电器产业株式会社）06.9 月 2006（06.09.2006）	1-3,7-9
Y	说明书第 2 页第 1-7 行，第 3 页第 14-19 行，图 3，6	4-6,10-12
Y	CN1399436A（英特尔公司）26.2 月 2003（26.02.2003） 说明书第 4 页第 3 行至第 6 页第 22 行，第 10 页第 19 行至第 11 页第 31 行，图 2-5	4-6,10-12
A	CN1862995A（中兴通讯股份有限公司）15.11 月 2006（15.11.2006） 全文	1-12
A	US20090310550A1（BECEEM COMMUNICATIONS INC）17.12 月 2009（17.12.2009）全文	1-12

☐ 其余文件在 C 栏的续页中列出。　　☒ 见同族专利附件。

* 引用文件的具体类型：

"A" 认为不特别相关的表示了现有技术一般状态的文件

"E" 在国际申请日的当天或之后公布的在先申请或专利

"L" 可能对优先权要求构成怀疑的文件，或为确定另一篇引用文件的公布日而引用的或者因其他特殊理由而引用的文件（如具体说明的）

"O" 涉及口头公开、使用、展览或其他方式公开的文件

"P" 公布日先于国际申请日但迟于所要求的优先权日的文件

"T" 在申请日或优先权日之后公布，与申请不相抵触，但为了理解发明之理论或原理的在后文件

"X" 特别相关的文件，单独考虑该文件，认定要求保护的发明不是新颖的或不具有创造性

"Y" 特别相关的文件，当该文件与另一篇或者多篇该类文件结合并且这种结合对于本领域技术人员为显而易见时，要求保护的发明不具有创造性

"&" 同族专利的文件

国际检索实际完成的日期	国际检索报告邮寄日期
25.9 月 2010（25.09.2010）	**28.10 月 2010 (28.10.2010)**
ISA/CN 的名称和邮寄地址： 中华人民共和国国家知识产权局 中国北京市海淀区蓟门桥西土城路 6 号 100088 传真号： (86-10)62019451	受权官员 孟田苹 电话号码：(86-10) **62411653**

PCT/ISA/210 表(第 2 页) (2009 年 7 月)

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Page #994

国际检索报告
关于同族专利的信息

国际申请号
PCT/CN2010/074869

检索报告中引用的专利文件	公布日期	同族专利	公布日期
CN1829113A	06.09.2006	无	
CN1399436A	26.02.2003	US2003017835A1	23.01.2003
		WO03009493A1	30.01.2003
		KR20030009140A	29.01.2003
		JP2003143065A	16.05.2003
		EP1410528A1	21.04.2004
		AU2002355087A1	03.03.2003
		TW574793A	01.02.2004
		CN1181634C	22.12.2004
		EP1410528B1	19.04.2006
		DE60210777E	24.05.2006
		JP3790723B2	28.06.2006
		SG125901A1	30.10.2006
		US7174178B2	06.02.2007
		DE60210777T2	19.04.2007
		KR100654282B1	05.12.2006
CN1862995A	15.11.2006	无	
US20090310550A1	17.12.2009	无	

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Page #995

Electronic Patent Application Fee Transmittal

Application Number:	14356581
Filing Date:	06-May-2014
Title of Invention:	METHOD, APPARATUS, AND SYSTEM FOR OPTIMIZING PERFORMANCE OF A COMMUNICATION UNIT BY A REMOTE SERVER
First Named Inventor/Applicant Name:	Wonjong Rhee
Filer:	Michael V. North/Nita Miller
Attorney Docket Number:	20145-054US

Filed as Large Entity

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

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

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	1806	1	240	240
		Total in USD ($)		**240**

Electronic Acknowledgement Receipt

EFS ID:	33428792
Application Number:	14356581
International Application Number:	
Confirmation Number:	4319
Title of Invention:	METHOD, APPARATUS, AND SYSTEM FOR OPTIMIZING PERFORMANCE OF A COMMUNICATION UNIT BY A REMOTE SERVER
First Named Inventor/Applicant Name:	Wonjong Rhee
Customer Number:	146571
Filer:	Michael V. North/Nita Miller
Filer Authorized By:	Michael V. North
Attorney Docket Number:	20145-054US
Receipt Date:	09-AUG-2018
Filing Date:	06-MAY-2014
Time Stamp:	19:02:24
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$240
RAM confirmation Number	081018INTEFSW19032300
Deposit Account	502776
Authorized User	Nita Miller
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 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)

37 CFR 1.492 (National application filing, search, and examination fees)

37 CFR 1.492(a) (Basic national fee only)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	054US_SIDS_Trans.pdf	29079 6f2b53b6c6e676b5e20a7d9613707eab9f07ec6e5	no	3
Warnings:					
Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	054US_SIDS_SB08.pdf	612675 a916718d7f64492533a8731f0fe01de0e3e51b4cbf	no	5
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Information:					
3	Foreign Reference	054US_SIDS_FR1.pdf	1742356 433071207906db526ea750116c2cba6ce416a2da	no	21
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Information:					
4	Non Patent Literature	054US_SIDS_NPL1.pdf	362371 552a6aa7853728f0af6340b26d2e4d2f0b87e591cf	no	3
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5	Non Patent Literature	054US_SIDS_NPL2.pdf	411489 9ddb325f375153e60535a76fe151f46b6935872	no	20
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6	Non Patent Literature	054US_SIDS_NPL3.pdf	1717354 d0473634e922c45cb0a6655a8bff7906f0c740825	no	22
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Information:					

7	Non Patent Literature	054US_SIDS_NPL4.pdf	474203 bc9cea53b3f180088c88c7363d13508f164ed788	no	32
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8	Non Patent Literature	054US_SIDS_NPL5.pdf	684489 016ae4580feb1544c9567455356 5f36c2b1bb53f	no	7
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Information:					
9	Non Patent Literature	054US_SIDS_NPL6.pdf	162907 b21c5f79d2bb756c7a53435a253bd83a326e4dd5	no	4
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10	Non Patent Literature	054US_SIDS_NPL7.pdf	437232 a7dfce59b82195b0f673655245d16b52f2893f9	no	36
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Information:					
13	Non Patent Literature	054US_SIDS_NPL10.pdf	150468 f931458baedc1896a8825726a97a8016cde11b7e0	no	3
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14	Non Patent Literature	054US_SIDS_NPL11.pdf	76475 0ca1f01b09ef818b72d701250cc0c137a7cf99a2	no	5
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Warnings:					
Information:					
		Total Files Size (in bytes):	7640154		

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

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s)	:	Wonjong Rhee	Confirmation No.: 4319
Appl. No.	:	14/356,581	
Filing Date	:	2014-05-06	
Title	:	METHOD, APPARATUS, AND SYSTEM FOR OPTIMIZING PERFORMANCE OF A COMMUNICATION UNIT BY A REMOTE SERVER	
Art Unit	:	2446	
Examiner	:	Boris D. Grualvalobos	
Docket No.	:	20145-054US	

CERTIFICATE OF MAILING (37 CFR §1.8)

I hereby certify, pursuant to 37 CFR §1.8, that this correspondence is being electronically transmitted via EFS-Web addressed to Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on the date shown below:

Date: 2018-08-09 By: /Nita Miller/
Nita Miller

INFORMATION DISCLOSURE STATEMENT

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

SIR or MADAM:

Filed herewith, in accordance with the provisions of 37 CFR §§ 1.56 and 1.97–1.98, listing various references for consideration by the Examiner, is an Information Disclosure Statement ("IDS").

The filing of this IDS shall not be construed as a representation that a search has been made, or regarding the completeness of the list of references, or that no other material information exists. Furthermore, the filing of this IDS shall not be construed as a representation that inclusion of a reference in this list is an admission that it is prior art or is pertinent to this application, or as an admission that the information listed is, or may be considered to be, material to the patentability of the above referenced application. The filing of this IDS shall not be construed in any manner as an admission against interest.

This IDS is being filed:

Charter Communications, Inc.
Exhibit 1006
Page #1002

☐ within three months of the filing date of a national application, other than a continued prosecution application under § 1.53(d);

☐ within three months of the date of entry of the national stage as set forth in § 1.491 in an international application;

☐ before the mailing of a first Office Action on the merits;

☐ before the mailing of a first Office Action after the filing of a request for continued examination under § 1.114;

☒ after three months of the filing date or entry into the national stage or after the mailing of a first Office action on the merits, but before the mailing date of any final action under § 1.113, a notice of allowance under §1.311, or an action that otherwise closes prosecution in the application;

AND

☒ enclosed herein is the fee set forth in 37 CFR § 1.17(p);

OR

☐ Applicant certifies pursuant to 37 CFR § 1.97(e):

☐ That each item of information contained in the information disclosure statement was first 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 information disclosure statement;

OR

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

☐ on or before the payment of the issue fee but after the mailing of a final action under § 1.113, a notice of allowance under §1.311, or an action that otherwise closes prosecution in the application;

AND

☐ enclosed herein is the fee set forth in 37 CFR § 1.17(p);

AND

☐ Applicant certifies pursuant to 37 CFR § 1.97(e):

☐ That each item of information contained in the information disclosure statement was first cited in a communication from a foreign patent office in a counterpart foreign application

Charter Communications, Inc.
Exhibit 1006
Page #1003

not more than three months prior to the filing of this information disclosure statement;

OR

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

☒ Applicant submits that the enclosed Information Disclosure Statement is timely; therefore, no fee is required.

☒ Except as provided for under 37 CFR § 1.98(a)(2), Applicant has enclosed a copy of each listed reference.

☐ The above referenced application relies upon Application No. _____, filed _____, for an earlier effective filing date under 35 U.S.C. 120. Although, pursuant to 37 CFR § 1.98(d), the references submitted herein are not required to be submitted for the Examiner to consider them, Applicant submits the references herein so that the information will be printed on the patent issuing from this application.

☐ Pursuant to 37 CFR § 1.704(d), Applicant certifies that each of the references cited herein were first cited in a communication from a foreign patent office in a counterpart application and that this communication was not received by any individual designated in 37 CFR § 1.56(c) more than thirty days prior to the filing of this Information Disclosure Statement.

Consideration of the listed references and favorable action are requested. If any additional fees are due in connection with the filing of this Information Disclosure Statement, the Commissioner is hereby authorized to charge such fees to Deposit Account 50-2776.

Respectfully submitted,

Date: 2018-08-09

By: /Michael V. North/
Michael V. North
Reg. No. 46963

Customer No.
146571
UNITED STATES PATENT AND TRADEMARK OFFICE

Charter Communications, Inc.
Exhibit 1006
Page #1004

PTO/SB/08b (07-09)
Approved for use through 07/31/2016. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Substitute for form 1449/PTO

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Use as many sheets as necessary)

Sheet 1 of 1

Complete if Known	
Application Number	14/356,581
Filing Date	2014-05-06
First Named Inventor	Wonjong Rhee
Art Unit	2446
Examiner Name	Boris D. Grualvalobos
Attorney Docket Number	20145-054US

NON PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No.[1]	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published.	T[2]
	1	Examination Report dated 2018-04-06, in Australian Patent Application No. 2017202588 (5pgs).	

Examiner Signature		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.

[1] Applicant's unique citation designation number (optional). [2] Applicant is to place a check mark here if English language Translation is attached.

This collection of information is required by 37 CFR 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 2 hours 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, 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 (1-800-786-9199) and select option 2.

Electronic Acknowledgement Receipt

EFS ID:	32929576
Application Number:	14356581
International Application Number:	
Confirmation Number:	4319
Title of Invention:	METHOD, APPARATUS, AND SYSTEM FOR OPTIMIZING PERFORMANCE OF A COMMUNICATION UNIT BY A REMOTE SERVER
First Named Inventor/Applicant Name:	Wonjong Rhee
Customer Number:	146571
Filer:	Michael V. North/Nita Miller
Filer Authorized By:	Michael V. North
Attorney Docket Number:	20145-054US
Receipt Date:	18-JUN-2018
Filing Date:	06-MAY-2014
Time Stamp:	18:29:25
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	054US_SIDS_Trans.pdf	29087 d3c878dd3ed827981b3d7d94ea71558d4cdd4ed	no	3

Warnings:

Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	054US_SIDS_SB08b.pdf	136700 5e15af761c2d6ef7d26a32e6ce9432e5547 53b8	no	1
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
3	Non Patent Literature	054US_SIDS_NPL1.pdf	172145 b87563316d9efed2f8ba179bd707cefcdcbc 0d61	no	5
Warnings:					
Information:					
		Total Files Size (in bytes):	337932		

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

New Applications Under 35 U.S.C. 111

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

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

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

New International Application Filed with the USPTO as a Receiving Office

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

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s)	:	Wonjong Rhee	Confirmation No.: 4319
Appl. No.	:	14/356,581	
Filing Date	:	2014-05-06	
Title	:	METHOD, APPARATUS, AND SYSTEM FOR OPTIMIZING PERFORMANCE OF A COMMUNICATION UNIT BY A REMOTE SERVER	
Art Unit	:	2446	
Examiner	:	Boris D. Grualvalobos	
Docket No.	:	20145-054US	

CERTIFICATE OF MAILING (37 CFR §1.8)

I hereby certify, pursuant to 37 CFR §1.8, that this correspondence is being electronically transmitted via EFS-Web addressed to Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on the date shown below:

Date: 2018-06-18 By: /Nita Miller/
Nita Miller

INFORMATION DISCLOSURE STATEMENT

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

SIR or MADAM:

Filed herewith, in accordance with the provisions of 37 CFR §§ 1.56 and 1.97–1.98, listing various references for consideration by the Examiner, is an Information Disclosure Statement ("IDS").

The filing of this IDS shall not be construed as a representation that a search has been made, or regarding the completeness of the list of references, or that no other material information exists. Furthermore, the filing of this IDS shall not be construed as a representation that inclusion of a reference in this list is an admission that it is prior art or is pertinent to this application, or as an admission that the information listed is, or may be considered to be, material to the patentability of the above referenced application. The filing of this IDS shall not be construed in any manner as an admission against interest.

This IDS is being filed:

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Page #1008

☐ within three months of the filing date of a national application, other than a continued prosecution application under § 1.53(d);

☐ within three months of the date of entry of the national stage as set forth in § 1.491 in an international application;

☐ before the mailing of a first Office Action on the merits;

☐ before the mailing of a first Office Action after the filing of a request for continued examination under § 1.114;

☒ after three months of the filing date or entry into the national stage or after the mailing of a first Office action on the merits, but before the mailing date of any final action under § 1.113, a notice of allowance under §1.311, or an action that otherwise closes prosecution in the application;

AND

☐ enclosed herein is the fee set forth in 37 CFR § 1.17(p);

OR

☒ Applicant certifies pursuant to 37 CFR § 1.97(e):

☒ That each item of information contained in the information disclosure statement was first 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 information disclosure statement;

OR

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

☐ on or before the payment of the issue fee but after the mailing of a final action under § 1.113, a notice of allowance under §1.311, or an action that otherwise closes prosecution in the application;

AND

☐ enclosed herein is the fee set forth in 37 CFR § 1.17(p);

AND

☐ Applicant certifies pursuant to 37 CFR § 1.97(e):

☐ That each item of information contained in the information disclosure statement was first cited in a communication from a foreign patent office in a counterpart foreign application

Charter Communications, Inc.
Exhibit 1006
Page #1009

not more than three months prior to the filing of this information disclosure statement;

OR

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

☒ Applicant submits that the enclosed Information Disclosure Statement is timely; therefore, no fee is required.

☒ Except as provided for under 37 CFR § 1.98(a)(2), Applicant has enclosed a copy of each listed reference.

☐ The above referenced application relies upon Application No. _____, filed _____, for an earlier effective filing date under 35 U.S.C. 120. Although, pursuant to 37 CFR § 1.98(d), the references submitted herein are not required to be submitted for the Examiner to consider them, Applicant submits the references herein so that the information will be printed on the patent issuing from this application.

☐ Pursuant to 37 CFR § 1.704(d), Applicant certifies that each of the references cited herein were first cited in a communication from a foreign patent office in a counterpart application and that this communication was not received by any individual designated in 37 CFR § 1.56(c) more than thirty days prior to the filing of this Information Disclosure Statement.

Consideration of the listed references and favorable action are requested. If any additional fees are due in connection with the filing of this Information Disclosure Statement, the Commissioner is hereby authorized to charge such fees to Deposit Account 50-2776.

Respectfully submitted,

Date: 2018-06-18

By: /Michael V. North/
Michael V. North
Reg. No. 46963

Customer No.
146571
UNITED STATES PATENT AND TRADEMARK OFFICE

Charter Communications, Inc.
Exhibit 1006
Page #1010

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No.	:	14/356,581	Confirmation No.: 4319
Inventor(s)	:	Wonjong Rhee	
Filing Date	:	2014-05-06	
Title	:	METHOD, APPARATUS, AND SYSTEM FOR OPTIMIZING PERFORMANCE OF A COMMUNICATION UNIT BY A REMOTE SERVER	
Art Unit	:	2446	
Examiner	:	Boris D. Grualvalobos	
Docket No.	:	20145-054US	

CERTIFICATE OF MAILING (37 CFR §1.8)

I hereby certify, pursuant to 37 CFR §1.8, that this correspondence is being electronically transmitted to the United States Patent and Trademark Office via EFS-Web addressed to: Mail Stop Amendment, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on the date shown below:

Dated: 2018-03-09 By: /Nita Miller/
Nita Miller

RESPONSE TO NON-FINAL OFFICE ACTION

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

Examiner Grualvalobos:

This Amendment is in response to the Non-Final Office Action dated December 29, 2017, and having a shortened statutory response period expiring March 29, 2018. Accordingly, this paper is timely filed. Further examination and reconsideration are respectfully requested in view of the Amendments and Remarks set forth below.

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

Remarks/Arguments begin on page **10** of this paper.

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AMENDMENTS TO THE CLAIMS

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

Listing of the Claims:

1. (Currently amended) A method for ~~optimizing~~ improving performance of one or more communication units ~~by a remote server~~, the method comprising:

receiving from a network monitoring device, in real-time ~~collecting, by the remote server,~~ data associated with an operation of ~~from the~~ one or more communication units, the data comprising a parameter;

processing at least one of the data and historical data;

based on the processed data, determining ~~generating by the remote server,~~ a policy for each of the one or more communication units~~, based on the collected data, wherein the policy comprises first and second algorithms and conditions for operation of the one or more communication units, and wherein the first and second algorithms are adaptable according to the conditions of operation, wherein generating the policy comprises generating a pseudo code or code for an adaption algorithm to be executed on the one or more communication units, wherein adaption algorithm is time varying and environment change dependent transmission or control strategies for the one or more communication units; and~~

communicating ~~sending, by the remote server,~~ the policy to at least~~, via a network coupled to the remote server, to each of the~~ one or more communication units that, in response to~~, wherein the one or more communication units~~ implementing

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the policy ~~according to time varying data~~ improve a performance of the one or more communication units.

2. (Cancelled)

3. (Currently amended) The method of claim 1, wherein ~~the one or more communication units are operable to receive the policy and implement one of the first and second algorithms based on the conditions~~ monitoring comprises determining a received signal strength indication.

4. (Currently amended) The method of claim 1, ~~wherein the time varying data comprises location information, current time, and/or operational data of the one or more communication units~~ further comprising, based on a change in the operation, updating the policy.

5. (Currently amended) The method of claim 1, wherein ~~the one or more communication units are operable to receive the policy and implement one of the first and second algorithms based on the conditions, wherein the first and second algorithms previously existed in the one or more communication units~~ determining the policy comprises selecting the policy from a set of policies.

6. (Cancelled)

7. (Currently amended) The method of claim 1, wherein ~~collecting data from the one or more communication units is performed periodically~~ at least one of the one or more communication units are located in a different geographical area.

8. (Currently amended) The method of claim 1, wherein the one or more communication units ~~comprises~~ comprise at least one of:

an access point (AP);

a base station;

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a wireless LAN device;

a DSLAM;

a gateway;

a performance enhancement device;

a Digital Subscriber Line (DSL) Customer Premises Equipment (CPE) modem;

an in-home powerline device;

a Home Phoneline Network Alliance (HPNA) based device;

an in-home coax distribution device;

a G.hn (Global Home Networking Standard) compatible device;

an in-home metering communication device;

an in-home appliance communicatively interfaced with the LAN;

a wireless femtocell base station;

a wireless WiFi compatible base station;

a wireless mobile device repeater;

a wireless mobile device base station;

a set-top box (STB)/set-top unit (STU) customer electronics device;

an Internet Protocol (IP) enabled television;

an IP enabled media player;

an IP enabled gaming console;

an Ethernet gateway;

a computing device connected to the LAN;

an Ethernet connected computer peripheral device;

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Page #1014

an Ethernet connected router;

an Ethernet connected wireless bridge;

an Ethernet connected network bridge; or

an Ethernet connected network switch.

9. (Currently amended) The method of claim 1, ~~wherein the conditions specify the characteristics of real-time and historical operational data for the one or more communication units to select and apply a most desired adaptation algorithm~~ further comprising, based on a change in the operation, updating the policy.

10. (Currently amended) A non-transitory machine-readable storage medium having computer executable instructions stored thereon that when executed cause a processor ~~of a remote server~~ to perform a method for ~~optimizing~~ improving performance of one or more communication units ~~by the remote server~~, the method comprising:

receiving, from a network monitoring device, in real-time ~~collecting, by the remote server~~, data associated with an operation of ~~from the~~ one or more communication units, the data comprising a parameter;

processing at least one of the data and historical data;

determining ~~generating by the remote server,~~ a policy for each of the one or more communication units, based on the processed ~~collected~~ data~~, wherein the policy comprises first and second algorithms and conditions for operation of the one or more communication units, and wherein the first and second algorithms are adaptable according to the conditions of operation, wherein generating the policy~~

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~~comprises generating a pseudo code or code for an adaption algorithm to be executed on the one or more communication units, wherein adaption algorithm is time varying and environment change dependent transmission or control strategies for the one or more communication units; and~~

communicating ~~sending, by the remote server,~~ the policy to at least~~, via a network coupled to the remote server, to each of the~~ one or more communication units that, in response to~~, wherein the one or more communication units~~ implementing the policy ~~according to time varying data~~ improve a performance of the one or more communication units.

11. (Cancelled)

12. (Currently amended) The non-transitory machine-readable storage medium of claim 10, wherein ~~the one or more communication units are operable to receive the policy and implement one of the first and second algorithms based on the conditions~~ processing comprises storing at least one of the data and the historical data in a memory device.

13. (Currently amended) The non-transitory machine-readable storage medium of claim 10, wherein ~~the time varying data comprises location information, current time, and/or operational data of the one or more communication units~~ determining the policy comprises determining a condition for communicating the policy.

14. (Currently amended) The non-transitory machine-readable storage medium of claim 10, wherein ~~the one or more communication units are operable to receive the policy and implement one of the first and second algorithms based on the conditions, wherein the first and second~~

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~~algorithms previously existed in the one or more communication units~~ monitoring comprises determining a received signal strength.

15. (Currently amended) The non-transitory machine-readable storage medium of claim 10, wherein ~~generating the policy comprises: generating a pseudo code or code for an adaption algorithm to be executed on the one or more communication units~~ wherein updating the policy comprises updating the parameter based on a change in the operation.

16. (Currently amended) The non-transitory machine-readable storage medium of claim 10, wherein ~~the conditions specify the characteristics of real time and historical operational data for the one or more communication units to select and apply a most desired adaptation algorithm~~ determining the policy comprises selecting the policy from a set of policies.

17-33. (Cancelled)

34. (Currently amended) An apparatus comprising:

a memory; and

a processor, coupled to the memory, and operable to:

receive, from a network monitoring device, in real-time, data associated with an operation of one or more communication units, the data comprising a parameter;

analyze at least one of the data and historical data ~~from one or more communication units;~~

determine ~~generate~~ a policy[[,]] for each of the one or more communication units, based on the analyzed data~~, wherein the policy comprises first and second algorithms and conditions for operation of the one or more communication units, and wherein the first and second algorithms are adaptable according to the conditions~~

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~~of operation, wherein to generate the policy comprises to generate a pseudo code or code for an adaption algorithm to be executed on the one or more communication units, wherein adaption algorithm is time varying and environment change dependent transmission or control strategies for the one or more communication units~~; and

communicate ~~send~~ the policy, via a network that is communicatively coupled to the processor, to at least ~~each of the~~ one or more communication units~~, wherein the policy comprises conditions for operation of the one or more communication units,~~

~~wherein the one or more communication units implement the policy according to time-varying data~~ that, in response to implementing the policy improve a performance of the one or more communication units.

35. (Cancelled)

36. (Currently amended) The apparatus of claim 34, ~~wherein the one or more communication units are operable to receive the policy and implement one of the first and second algorithms based on the conditions~~ further comprising a monitoring device coupled to the processor, the monitoring device determines a received signal strength.

37. (Currently amended) The apparatus of claim 34, wherein ~~the one or more communication units are operable to receive the policy and implement one of the first and second algorithms based on the conditions and the time-varying data~~ determining the policy comprises selecting the policy from a set of policies and updating the parameter.

38-52. (Cancelled)

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53. (New) The method of claim 1, wherein processing comprises storing at least one of the data and the historical data in the memory.

54. (New) The method of claim 4, wherein updating the policy comprises updating the parameter.

55. (New) The method of claim 34, wherein at least one of the one or more communication units are located in a different geographical area.

56. (New) The method of claim 34, wherein processing comprises storing at least one of the data and the historical data in the memory.

57. (New) The method of claim 34, wherein determining the policy comprises determining a condition for communicating the policy.

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REMARKS

Claims 1, 3-5, 7-10, 12-16, 34, and 36-37 were presented for examination. All pending claims were rejected by the Examiner in a Non-Final Office Action (hereinafter, "Office Action") under 35 U.S.C. §103 as being unpatentable over U.S. Pat. App. No US 2006/0187885 Roy (hereinafter "Roy") in view of U.S. Pat. 5970064, issued to Clark et al (hereinafter "Clark").

In response, Applicant hereby amends claims 1, 3-5, 7-10, 12-16, 34, 36, and 37, and adds new claims 53-57 and respectfully request reconsideration in light of the amendments to the claims and the below remarks, and the allowance of pending claims 1, 3-5, 7-10, 12-16, 34, 36, 37, and 53-57.

Applicant thanks Examiner Grijalva Lobos for the courtesy of a telephone interview on January 16, 2018. During this interview, Applicant's representative proposed amendments that the Examiner confirmed appears to overcome at the least the cited main reference, the Roy document. In light of the agreement reached during the interview, Applicant hereby amends claims 1, 3-5, 7-10, 12-16, 34, 36, and 37 to further clarify the present invention's limitation. Accordingly, Applicant respectfully requests that the current rejections be withdrawn, and that all pending claims, claims 1, 3-5, 7-10, 12-16, 34, 36-37, and 53-57 be allowed as currently amended. Support for the claim amendments may be found, for example, in paragraphs 48, 65, and 69.

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CONCLUSION

In view of the above arguments, Applicant believes that all pending claims are allowable and respectfully request that a Notice of Allowance be issued for this application in its current state. Applicant believes that more than a sufficient number of reasons have been stated to traverse all rejections. Should the Examiner believe that a telephone conference would expedite the prosecution of this application, the Examiner is invited to contact the undersigned at telephone number (650) 353-3786.

If any fees are due in connection with the filing of this amendment, the Commissioner is authorized to charge such fees to Deposit Account 50-2776.

Respectfully submitted,

Date: 2018-03-09

By: /Ali Uyanik/
Ali Uyanik
Reg. No. 67,080

Customer No.
146571
UNITED STATES PATENT & TRADEMARK OFFICE

Charter Communications, Inc.
Exhibit 1006
Page #1021

Electronic Acknowledgement Receipt

EFS ID:	32011880
Application Number:	14356581
International Application Number:	
Confirmation Number:	4319
Title of Invention:	METHOD, APPARATUS, AND SYSTEM FOR OPTIMIZING PERFORMANCE OF A COMMUNICATION UNIT BY A REMOTE SERVER
First Named Inventor/Applicant Name:	Wonjong Rhee
Customer Number:	146571
Filer:	Ali Muhammet Uyanik/Nita Miller
Filer Authorized By:	Ali Muhammet Uyanik
Attorney Docket Number:	20145-054US
Receipt Date:	09-MAR-2018
Filing Date:	06-MAY-2014
Time Stamp:	16:06:12
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		054US_RNFOA.pdf	58227 6e42f5dcf2336c7f03952c0b503d375567e3baf7a	yes	11

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Claims	2	9
	Applicant Arguments/Remarks Made in an Amendment	10	11
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New Applications Under 35 U.S.C. 111

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

PTO/SB/08a (01-10)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	14356581
Filing Date	2014-05-06
First Named Inventor	Wonjong Rhee
Art Unit	
Examiner Name	
Attorney Docket Number	20145-054US

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6430612	B1	2002-08-06	Yoshio Iizuka	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20030031180	A1	2003-02-13	Sanchalta Datta et al.	
	2	20050261915	A1	2005-11-24	Yasuomi Ooki et al.	
	3	20060126613	A1	2006-06-15	Jonathan Marcus Zweig	
	4	20070153807	A1	2007-07-05	Rene L. Cruz et al.	
	5	20080186873	A1	2008-08-07	Nicolas Pujet et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14356581
	Filing Date	2014-05-06
	First Named Inventor	Wonjong Rhee
	Art Unit	
	Examiner Name	
	Attorney Docket Number	20145-054US

	6	20100290465	A1	2010-11-18	Shashi H. Ankaiah et al.	
	7	20110013529	A1	2011-01-20	Fanxiang Bin et al.	
	8	20110182182	A1	2011-07-28	Kai-Yu Yang et al.	
	9	20110273979		2011-11-10	David A. Grabelsky et al.	

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	2004173170	JP		2004-06-17			
	2	201056898	JP		2010-11-03			

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	International Search Report and Written Opinion dated 2012-08-06, in International Patent Application No. PCT/US2011/063327 (12pgs).	

Charter Communications, Inc.
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Page #1025

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14356581
	Filing Date	2014-05-06
	First Named Inventor	Wonjong Rhee
	Art Unit	
	Examiner Name	
	Attorney Docket Number	20145-054US

	2	International Preliminary Report on Patentability dated 2014-06-10, in International Patent Application No. PCT/US2011/063327 (9pgs).	
	3	Office Action dated 2015-01-19, in Australian Patent Application No. 2011382613 (3pgs).	
	4	Office Action dated 2015-08-20, in Canadian Patent Application No. 2858030 (2pgs).	
	5	English translation of Office Action dated 2015-07-28, in Japanese Patent Application No. 2014545863 (5pgs).	X
	6	First Office Action dated 2017-02-10, in Australian Patent Application No. 2016200291 (4pgs).	☐
	7	Response filed 2017-05-24, in Australian Patent Application No. 2016200291 (36pgs).	☐
	8	Second Office Action dated 2017-06-19, in Australian Patent Application No. 2016200291 (3pgs).	☐
	9	Response filed 2017-10-17, in Australian Patent Application No. 2016200291 (28pgs).	☐
	10	Notice of Acceptance dated 2017-10-20, in Australian Patent Application No. 2016200291 (3pgs).	☐
	11	Notice of Allowance dated 2017-10-30, in European Patent Application No. 11797097.0 (7pgs).	☐

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Exhibit 1006
Page #1026

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14356581
	Filing Date	2014-05-06
	First Named Inventor	Wonjong Rhee
	Art Unit	
	Examiner Name	
	Attorney Docket Number	20145-054US

EXAMINER SIGNATURE			
Examiner Signature		Date Considered	

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

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

Charter Communications, Inc.
Exhibit 1006
Page #1027

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	14356581
	Filing Date	2014-05-06
	First Named Inventor	Wonjong Rhee
	Art Unit	
	Examiner Name	
	Attorney Docket Number	20145-054US

CERTIFICATION STATEMENT

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

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

OR

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

See attached certification statement.

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

A certification statement is not submitted herewith.

SIGNATURE

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

Signature	/Michael North/	Date (YYYY-MM-DD)	2018-03-09
Name/Print	Michael North	Registration Number	46963

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(19)日本国特許庁(JP)　(12)公開特許公報(A)　(11)特許出願公開番号
特開2004-173170
(P2004-173170A)
(43)公開日　平成16年6月17日(2004.6.17)

(51)Int.Cl.[7]	F I		テーマコード（参考）
H04L 12/56	H04L 12/56	200F	5K025
G06F 17/60	H04L 12/56	C	5K030
H04L 12/46	G06F 17/60	332	5K033
H04M 11/00	G06F 17/60	502	5K101
H04M 15/00	H04L 12/46	B	

審査請求 未請求　請求項の数 17　OL　（全 26 頁）　最終頁に続く

(21)出願番号　特願2002-339334(P2002-339334)
(22)出願日　平成14年11月22日(2002.11.22)

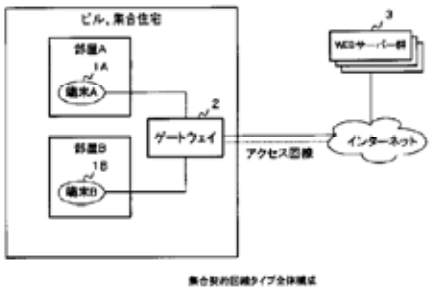
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Ｆターム(参考)　5K025 AA07　BB10　GG05

最終頁に続く

(54)【発明の名称】インターネット接続システム

(57)【要約】
【課題】集合住宅、ビルにおいてインターネットアクセスを共有する場合に、余った通信帯域を他の部屋に割り振ると同時に、使用した通信帯域によって各部屋の通信料金を設定するインターネット接続システムを提供する。
【解決手段】予め定めた複数区域の各区域から端末によりインターネットアクセスを共有するインターネット接続システムで、通信している端末が属する区域を識別し、各区域毎の使用実績通信帯域に基づいて通信料金を算出する。また、各区域毎の使用通信帯域を識別し、通信帯域が余っている区域から不足している区域へ通信帯域を動的に割り振る。
【選択図】　図１



集合契約区域タイプ全体構成

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【特許請求の範囲】
【請求項１】
予め定めた複数区域の各区域から端末によりインターネットにアクセスして接続するインターネット接続システムにおいて、
通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出することを特徴とするインターネット接続システム。
【請求項２】
予め定めた複数区域の各区域から端末によりインターネットにアクセスして接続するインターネット接続システムにおいて、
通信している端末が属する区域と、各区域毎の使用通信帯域を識別し、通信帯域が余っている区域から不足している区域へ通信帯域を動的に割り振ることを特徴とするインターネット接続システム。
【請求項３】
予め定めた複数区域の各区域に属する少なくとも１つの端末を、少なくとも２つの区域で共有する１つのゲートウェイとアクセス回線を介してインターネットに接続し、
通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出することを特徴とするインターネット接続システム。
【請求項４】
予め定めた複数区域の各区域には、前記各区域に属する少なくとも１つの端末と前記端末と接続されているゲートウェイとを有し、前記端末を各区域のゲートウェイに接続されているアクセス回線を介してインターネットに接続し、
通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出することを特徴とするインターネット接続システム。
【請求項５】
予め定めた複数区域の各区域には、前記各区域に属する少なくとも１つの端末と前記端末と接続されているゲートウェイとを有し、前記端末を各区域のゲートウェイに接続されているアクセス回線を介してインターネットに接続し、
通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出することを特徴とするインターネット接続システム。
【請求項６】
予め定めた複数区域の各区域には、前記各区域に属する少なくとも１つの端末と前記端末と接続されているゲートウェイとを有し、各区域のゲートウェイに接続されているアクセス回線を介して前記端末をインターネットに接続し、
前記各区域毎に前記ゲートウェイを介して接続されているアクセス回線の通信量を比較し、より少ない通信量のアクセス回線が接続されているゲートウェイを介して前記端末をインターネットに接続することを特徴とするインターネット接続システム。
【請求項７】
予め定めた複数区域の各区域には、前記各区域に属する少なくとも１つの端末と前記端末と接続されているゲートウェイとを有し、各区域のゲートウェイに接続されているアクセス回線を介して前記端末をインターネットに接続し、
前記各区域毎に前記ゲートウェイを介して接続されているアクセス回線の通信量を比較し、より少ない通信量のアクセス回線が接続されているゲートウェイを介して前記端末をインターネットに接続するとともに、
通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出することを特徴とするインターネット接続システム。

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【請求項８】
予め定めた複数区域の各区域の一の区域には、前記一の区域に属する少なくとも１つの無線端末と前記無線端末と無線ＬＡＮ接続された無線ＬＡＮ基地局を有し、
前記一の区域に隣接する他の区域には、前記一の区域に属する無線ＬＡＮ基地局と無線ＬＡＮ接続された少なくとも１つの無線端末を有し、
前記無線ＬＡＮ基地局に接続されているゲートウェイと、このゲートウェイに接続されているアクセス回線を介して前記無線端末をインターネットに接続することを特徴とするインターネット接続システム。
【請求項９】
予め定めた複数区域の各区域の一の区域には、前記一の区域に属する少なくとも１つの無線端末と前記無線端末と無線ＬＡＮ接続された無線ＬＡＮ基地局を有し、
前記一の区域に隣接する他の区域には、前記一の区域に属する無線ＬＡＮ基地局と無線ＬＡＮ接続された少なくとも１つの無線端末を有し、
前記無線ＬＡＮ基地局に接続されているゲートウェイと、このゲートウェイに接続されているアクセス回線を介して前記無線端末をインターネットに接続するとともに、
通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出することを特徴とするインターネット接続システム。
【請求項１０】
予め定めた複数区域のそれぞれの区域には、少なくとも１つの無線端末と、この無線端末と無線ＬＡＮ接続された無線ＬＡＮ基地局を有し、
前記各無線端末は、自己の属する区域以外の他の区域の無線ＬＡＮ基地局とも無線ＬＡＮ接続され、
前記複数の区域に属する無線ＬＡＮ基地局が共通のゲートウェイに接続され、前記ゲートウェイに接続されているアクセス回線を介してインターネットに接続され、
通信中の無線端末とこの通信中の無線端末に無線ＬＡＮ接続された他の区域に属する無線ＬＡＮ基地局との通信速度を測定し、より高速な通信速度が測定された無線ＬＡＮ基地局とゲートウェイ及びアクセス回線を介して前記無線端末をインターネットに接続することを特徴とするインターネット接続システム。
【請求項１１】
予め定めた複数区域のそれぞれの区域には、少なくとも１つの無線端末と、この無線端末と無線ＬＡＮ接続された無線ＬＡＮ基地局を有し、
前記各無線端末は、自己の属する区域以外の他の区域の無線ＬＡＮ基地局とも無線ＬＡＮ接続され、
前記複数の区域に属する無線ＬＡＮ基地局が共通のゲートウェイに接続され、前記ゲートウェイに接続されているアクセス回線を介してインターネットに接続され、
通信中の無線端末とこの通信中の無線端末に無線ＬＡＮ接続された他の区域に属する無線ＬＡＮ基地局との通信速度を測定し、より高速な通信速度が測定された無線ＬＡＮ基地局とゲートウェイ及びアクセス回線を介して前記無線端末をインターネットに接続するとともに、
通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出することを特徴とするインターネット接続システム。
【請求項１２】
予め定めた複数区域のそれぞれの区域には、少なくとも１つの無線端末と、前記無線端末と無線ＬＡＮ接続された無線ＬＡＮ基地局を有し、
前記各無線端末は、自己の属する区域以外の他の区域の無線ＬＡＮ基地局とも無線ＬＡＮ接続され、
前記複数の区域に属する無線ＬＡＮ基地局がそれぞれゲートウェイに接続され、前記ゲートウェイに接続されているアクセス回線を介してインターネットに接続され、

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通信中の無線端末とこの通信中の無線端末に無線ＬＡＮ接続された他の区域に属する無線ＬＡＮ基地局との通信速度を測定し、より高速な通信速度が測定された無線ＬＡＮ基地局とゲートウェイ及びアクセス回線を介して前記無線端末をインターネットに接続することを特徴とするインターネット接続システム。

【請求項１３】

予め定めた複数区域のそれぞれの区域には、少なくとも１つの無線端末と、前記無線端末と無線ＬＡＮ接続された無線ＬＡＮ基地局を有し、

前記各無線端末は、自己の属する区域以外の他の区域の無線ＬＡＮ基地局とも無線ＬＡＮ接続され、

前記複数の区域に属する無線ＬＡＮ基地局がそれぞれゲートウェイに接続され、前記ゲートウェイに接続されているアクセス回線を介してインターネットに接続され、

通信中の無線端末とこの通信中の無線端末に無線ＬＡＮ接続された他の区域に属する無線ＬＡＮ基地局との通信速度を測定し、より高速な通信速度が測定された無線ＬＡＮ基地局とゲートウェイ及びアクセス回線を介して前記無線端末をインターネットに接続するとともに、

通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出することを特徴とするインターネット接続システム。

【請求項１４】

前記各区域毎に最大通信速度が予め設定され、前記端末が属する区域における通信帯域の合計が前記最大通信速度を超えたときには、通信動作を待ち状態とし、前記最大通信速度以下になったときに、通信動作を再開させることを特徴とする請求項１乃至１３のいずれかに記載のインターネット接続システム。

【請求項１５】

一の区域のユーザが他の区域のユーザの通信帯域分を使用し、前記一の区域のユーザは、その使用分の料金を前記他の区域のユーザに支払うことを特徴とする請求項１乃至１４のいずれかに記載のインターネット接続システム。

【請求項１６】

予め登録されたＭＡＣアドレスを有する端末のみ通信を可能とする信号を出力するとともに、前記ＭＡＣアドレス、前記端末の属する区域番号、前記端末の総通信量、全区域の総通信量に対する当該端末の総通信量の比、前記比率の配分で料金を算出することを特徴とする請求項１乃至１５のいずれかに記載のインターネット接続システム。

【請求項１７】

前記区域は、部屋であることを特徴とする請求項１乃至１６のいずれかに記載のインターネット接続システム。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】

本発明は、インターネット接続システムに関し、例えば、通信帯域が異なるにもかかわらず、集合住宅、ビル等におけるインターネット接続共有時の使用料金が一定であるという、ユーザの不満を解消し、インターネットアクセス回線業者もしくは、集合住宅、ビルの経営者の収益向上を図るインターネット接続システムに関する。

【０００２】

【従来の技術】

従来のこの種のインターネット接続システムでは、複数の部屋の各部屋の端末は１つのインターネットアクセス回線を１つのゲートウェイによって共用している。これまでは、このようにインターネットアクセス回線を共有する場合、各部屋の最大通信帯域を固定にして、均一なサービスを一定の料金で提供していた。

【０００３】

【発明が解決しようとする課題】

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かかるインターネット接続システムにおいては、集合住宅、ビルにおいて、インターネットアクセスを共有する場合に、各部屋の使用用途（住居、オフィス、店舗等）や人員構成によりインターネット使用頻度、最多使用時間帯がばらばらであるにも関わらず、従来の方法では各部屋に固定の通信帯域しか割り振られず、使用料金も各部屋共通で一定であった。そのため、通信帯域をあまり使っていない場合でも、通信帯域を使いきった場合でも利用料金が一定となり不公平感が多かった。また時間帯や混雑度によって一時的に通信帯域が不足している場合でも、他の時間帯や混雑していない場合には逆に通信帯域が余っている場合もあり、帯域を効率的に利用できていない不満があった。

【０００４】

そこで、本発明の目的は、集合住宅、ビルにおいてインターネットアクセスを共有する場合に、余った通信帯域を他の部屋に割り振り公平な帯域配分を可能とするインターネット接続システムを提供することにある。

【０００５】

本発明の他の目的は、使用した通信帯域によって各部屋の通信料金を公平に設定するインターネット接続システムを提供することにある。

【０００６】

【課題を解決するための手段】

前述の課題を解決するため、本発明によるインターネット接続システムは、次のような特徴的な構成を採用している。

【０００７】

（１）予め定めた複数区域の各区域から端末によりインターネットにアクセスして接続するインターネット接続システムにおいて、

通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出するインターネット接続システム。

【０００８】

（２）予め定めた複数区域の各区域から端末によりインターネットにアクセスして接続するインターネット接続システムにおいて、

通信している端末が属する区域と、各区域毎の使用通信帯域を識別し、通信帯域が余っている区域から不足している区域へ通信帯域を動的に割り振るインターネット接続システム。

【０００９】

（３）予め定めた複数区域の各区域に属する少なくとも１つの端末を、少なくとも２つの区域で共有する１つのゲートウェイとアクセス回線を介してインターネットに接続し、

通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出するインターネット接続システム。

【００１０】

（４）予め定めた複数区域の各区域には、前記各区域に属する少なくとも１つの端末と前記端末と接続されているゲートウェイとを有し、前記端末を各区域のゲートウェイに接続されているアクセス回線を介してインターネットに接続し、通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出するインターネット接続システム。

【００１１】

（５）予め定めた複数区域の各区域には、前記各区域に属する少なくとも１つの端末と前記端末と接続されているゲートウェイとを有し、前記端末を各区域のゲートウェイに接続されているアクセス回線を介してインターネットに接続し、

通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出するインターネット接続システム。

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【００１２】
（６）予め定めた複数区域の各区域には、前記各区域に属する少なくとも１つの端末と前記端末と接続されているゲートウェイとを有し、各区域のゲートウェイに接続されているアクセス回線を介して前記端末をインターネットに接続し、
前記各区域毎に前記ゲートウェイを介して接続されているアクセス回線の通信量を比較し、より少ない通信量のアクセス回線が接続されているゲートウェイを介して前記端末をインターネットに接続するインターネット接続システム。
【００１３】
（７）予め定めた複数区域の各区域には、前記各区域に属する少なくとも１つの端末と前記端末と接続されているゲートウェイとを有し、各区域のゲートウェイに接続されているアクセス回線を介して前記端末をインターネットに接続し、
前記各区域毎に前記ゲートウェイを介して接続されているアクセス回線の通信量を比較し、より少ない通信量のアクセス回線が接続されているゲートウェイを介して前記端末をインターネットに接続するとともに、
通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出するインターネット接続システム。
【００１４】
（８）予め定めた複数区域の各区域の一の区域には、前記一の区域に属する少なくとも１つの無線端末と前記無線端末と無線ＬＡＮ接続された無線ＬＡＮ基地局を有し、
前記一の区域に隣接する他の区域には、前記一の区域に属する無線ＬＡＮ基地局と無線ＬＡＮ接続された少なくとも１つの無線端末を有し、
前記無線ＬＡＮ基地局に接続されているゲートウェイと、このゲートウェイに接続されているアクセス回線を介して前記無線端末をインターネットに接続するインターネット接続システム。
【００１５】
（９）予め定めた複数区域の各区域の一の区域には、前記一の区域に属する少なくとも１つの無線端末と前記無線端末と無線ＬＡＮ接続された無線ＬＡＮ基地局を有し、
前記一の区域に隣接する他の区域には、前記一の区域に属する無線ＬＡＮ基地局と無線ＬＡＮ接続された少なくとも１つの無線端末を有し、
前記無線ＬＡＮ基地局に接続されているゲートウェイと、このゲートウェイに接続されているアクセス回線を介して前記無線端末をインターネットに接続するとともに、
通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出するインターネット接続システム。
【００１６】
（１０）予め定めた複数区域のそれぞれの区域には、少なくとも１つの無線端末と、この無線端末と無線ＬＡＮ接続された無線ＬＡＮ基地局を有し、
前記各無線端末は、自己の属する区域以外の他の区域の無線ＬＡＮ基地局とも無線ＬＡＮ接続され、
前記複数の区域に属する無線ＬＡＮ基地局が共通のゲートウェイに接続され、前記ゲートウェイに接続されているアクセス回線を介してインターネットに接続され、
通信中の無線端末とこの通信中の無線端末に無線ＬＡＮ接続された他の区域に属する無線ＬＡＮ基地局との通信速度を測定し、より高速な通信速度が測定された無線ＬＡＮ基地局とゲートウェイ及びアクセス回線を介して前記無線端末をインターネットに接続するインターネット接続システム。
【００１７】
（１１）予め定めた複数区域のそれぞれの区域には、少なくとも１つの無線端末と、この無線端末と無線ＬＡＮ接続された無線ＬＡＮ基地局を有し、
前記各無線端末は、自己の属する区域以外の他の区域の無線ＬＡＮ基地局とも無線ＬＡＮ

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接続され、
前記複数の区域に属する無線ＬＡＮ基地局が共通のゲートウェイに接続され、前記ゲートウェイに接続されているアクセス回線を介してインターネットに接続され、
通信中の無線端末とこの通信中の無線端末に無線ＬＡＮ接続された他の区域に属する無線ＬＡＮ基地局との通信速度を測定し、より高速な通信速度が測定された無線ＬＡＮ基地局とゲートウェイ及びアクセス回線を介して前記無線端末をインターネットに接続するとともに、
通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出するインターネット接続システム。

【００１８】
（１２）予め定めた複数区域のそれぞれの区域には、少なくとも１つの無線端末と、前記無線端末と無線ＬＡＮ接続された無線ＬＡＮ基地局を有し、
前記各無線端末は、自己の属する区域以外の他の区域の無線ＬＡＮ基地局とも無線ＬＡＮ接続され、
前記複数の区域に属する無線ＬＡＮ基地局がそれぞれゲートウェイに接続され、前記ゲートウェイに接続されているアクセス回線を介してインターネットに接続され、
通信中の無線端末とこの通信中の無線端末に無線ＬＡＮ接続された他の区域に属する無線ＬＡＮ基地局との通信速度を測定し、より高速な通信速度が測定された無線ＬＡＮ基地局とゲートウェイ及びアクセス回線を介して前記無線端末をインターネットに接続するインターネット接続システム。

【００１９】
（１３）予め定めた複数区域のそれぞれの区域には、少なくとも１つの無線端末と、前記無線端末と無線ＬＡＮ接続された無線ＬＡＮ基地局を有し、
前記各無線端末は、自己の属する区域以外の他の区域の無線ＬＡＮ基地局とも無線ＬＡＮ接続され、
前記複数の区域に属する無線ＬＡＮ基地局がそれぞれゲートウェイに接続され、前記ゲートウェイに接続されているアクセス回線を介してインターネットに接続され、
通信中の無線端末とこの通信中の無線端末に無線ＬＡＮ接続された他の区域に属する無線ＬＡＮ基地局との通信速度を測定し、より高速な通信速度が測定された無線ＬＡＮ基地局とゲートウェイ及びアクセス回線を介して前記無線端末をインターネットに接続するとともに、
通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出するインターネット接続システム。

【００２０】
（１４）前記各区域毎に最大通信速度が予め設定され、前記端末が属する区域における通信帯域の合計が前記最大通信速度を超えたときには、通信動作を待ち状態とし、前記最大通信速度以下になったときに、通信動作を再開させることを特徴とする上記（１）乃至（１３のいずれかのインターネット接続システム。

【００２１】
（１５）一の区域のユーザが他の区域のユーザの通信帯域分を使用し、前記一の区域のユーザは、その使用分の料金を前記他の区域のユーザに支払う上記（１）乃至（１４）のいずれかのインターネット接続システム。

【００２２】
（１６）予め登録されたＭＡＣアドレスを有する端末のみ通信を可能とする信号を出力するとともに、前記ＭＡＣアドレス、前記端末の属する区域番号、前記端末の総通信量、全区域の総通信量に対する当該端末の総通信量の比、前記比率の配分で料金を算出する上記（１）乃至（１５）のいずれかのインターネット接続システム。

【００２３】

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（１７）前記区域は、部屋である上記（１）乃至（１６）のいずれかのインターネット接続システム。

【００２４】

【発明の実施の形態】

以下、本発明によるインターネット接続システムの好適実施形態例を添付図に基づいて説明する。

【００２５】

本発明は、基本的に、例えば、集合住宅、ビル等においてインターネットアクセスを共有する場合に、余った通信帯域を他の部屋に割り振ると同時に、使用した通信帯域によって各部屋の通信料金を変動させるようにしたものである。

【００２６】

図１は本発明によるインターネット接続システムの第１の実施形態例を示すシステム構成図である。

【００２７】

図１において、部屋Ａの端末１Ａと部屋Ｂの端末１Ｂは、ＷＥＢサーバー群３に対する１つのインターネットアクセス回線を１つのゲートウェイ２によって共用している。

【００２８】

従来は、このようにインターネットアクセス回線を共有する場合、各部屋の最大通信帯域を固定にして均一サービスを一定料金で提供していたが、本発明では、通信中の端末の利用者の部屋を識別し、各部屋毎に使用通信帯域（送受データ量）を記録しておき、これらの情報に基づいて各部屋毎に使用通信帯域に応じて通信料金を算出する。

【００２９】

本発明では、各部屋の使用用途（住居、オフィス、店舗等）や人員構成により、使用頻度や最多使用時間帯がばらばらな場合でも、通信帯域が余っている部屋から不足している部屋へ通信帯域を動的に割り振り、トータルの使用通信帯域の大小により料金を割り振ることにより、公平な帯域の配分を可能とする。したがって、帯域をあまり使用しなかった部屋は通信料金が下がり、帯域が不足していた部屋は多少通信料金が上がっても不足していた帯域を補うことが可能となる。

【００３０】

図１に示す実施形態は、一例として部屋Ａと部屋Ｂからなる建築物で、１つのインターネットアクセス回線を共通のゲートウェイ２で共有して使用する場合を想定している。また、部屋Ａにはインターネットアクセスするための端末１Ａを含み、部屋Ｂにはインターネットアクセスするための端末１Ｂを含む。本実施形態では説明を簡単化するため、各部屋における端末の数を１としているが、これらは各々複数あっても構わない。

【００３１】

尚、以下の説明では、部屋は通常使われている意味での部屋だけでなく、所定の定義で区分けされた区域を含むことは当然である。

【００３２】

端末１Ａは、図２に示すように構成され、アプリケーション部１１１と、通信制御部１１２と、無線ＬＡＮ　Ｉ／Ｆ部１１３とを含む。これらの処理部はそれぞれ概略次のように動作する。

【００３３】

アプリケーション部１１１は、ユーザへの画面表示やユーザからの入力検出と、通信制御部１１２への通信開始、停止の指示を行う。通信制御部１１２は、ＬＡＮ　Ｉ／Ｆ部１１３から受信したデータのアプリケーション部１１１への送信、アプリケーション部から送信要求されたデータのＬＡＮ　Ｉ／Ｆ部１１３への送信を行う。ＬＡＮ　Ｉ／Ｆ部１１３はＬＡＮ回線上のデータの送受信を行う。

【００３４】

ゲートウェイ２は、図３に示すように構成され、ＬＡＮ　Ｉ／Ｆ部Ａ２１１と、ＬＡＮ　Ｉ／Ｆ部Ｂ２１２と、ＷＡＮ　Ｉ／Ｆ部２１３と、通信制御部２１４と、認証要求・ゲー

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ト管理部２１５とを含む。これらの処理部はそれぞれ概略次のように動作する。

【００３５】

ＬＡＮ　Ｉ／Ｆ部Ａ２１１は部屋ＡのＬＡＮ回線上のデータの送受信を、ＬＡＮ　Ｉ／Ｆ部Ｂ２１２は部屋ＢのＬＡＮ回線上のデータの送受信を、ＷＡＮ　Ｉ／Ｆ部２１３はインターネット回線を通じてインターネット上の各種サーバー（ＷＥＢサーバー群）３とのデータ送受信を行う。

【００３６】

通信制御部２１４は、ＬＡＮ　Ｉ／Ｆ部Ａ２１１とＷＡＮ　Ｉ／Ｆ部２１３の間、及びＬＡＮ　Ｉ／Ｆ部Ｂ２１２とＷＡＮ　Ｉ／Ｆ部２１３の間の通信制御を行う。　認証要求・ゲート管理部２１５は、登録されたＭＡＣアドレスを持つ端末のみインターネット通信を行えるようにするもので、通信制御部２１４を介して参照される。また、後述するように、インターネットアクセスした端末の総通信量と課金管理を行う。

【００３７】

認証要求・ゲート管理部２１５は、内部テーブルとして図４に示されるテーブル情報を格納する。テーブル７１に登録された端末のＭＡＣアドレス、テーブル７２にその端末の使用者の部屋番号、７３にその端末がその月に使用した総通信量、テーブル７４に全部屋のその月の総通信量に対するその端末の総通信量の比率、テーブル７５にインターネットアクセス回線の月額使用料金をテーブル７４の比率で配分した料金をそれぞれ格納する。

【００３８】

次に、本実施形態の動作について具体的に説明する。

先ず、部屋Ａと部屋Ｂで使用する端末１Ａ及び端末１Ｂは、予めゲートウェイ２内の認証要求・ゲート管理部２１５のテーブル７１にＭＡＣアドレスを、テーブル７２に部屋番号を登録しておく。総通信量のテーブル７３、比率のテーブル７４、料金のテーブル７５は月末の決済時にクリアされる。

【００３９】

部屋Ａの端末１Ａがインターネット上のサーバーに対して通信を開始したとする。端末１Ａのアプリケーション部１１１は、通信制御部１１２に対してゲートウェイ２経由でインターネット上のサーバーとの通信を開始するように指示する。通信制御部１１２は、ＬＡＮ　Ｉ／Ｆ部１１３を制御し、ゲートウェイ経由でインターネット上のサーバーとデータの送受信を開始する。

【００４０】

ゲートウェイ２が端末１Ａからデータを受信すると、ＬＡＮ　Ｉ／Ｆ部Ａ２１１が先ずデータを受信し、通信制御部２１４に送信する。通信制御部２１４は、受信したデータに含まれる送信元端末のＭＡＣアドレスで認証要求・ゲート管理部２１５のテーブル７１のエントリを検索する。端末１Ａは使用端末として登録されているため、一致するエントリが見つかる。見つかった該当エントリのテーブル７３にそのデータのサイズ（受信データ量）を追加し、それにより再計算した比率、料金をそれぞれテーブル７４、７５に格納した後、そのデータをＷＡＮＩ／Ｆ部２１３を通じてアクセス回線経由でインターネット上のサーバーに対して送信する。なお、一致するエントリがない場合はデータを廃棄する。

【００４１】

ゲートウェイ２がインターネット上のサーバーから端末１Ａ宛のデータを受信すると、ＷＡＮ　Ｉ／Ｆ部２１３が先ずデータを受信し、通信制御部２１４に送信する。通信制御部２１４は、受信したデータに含まれる送信先端末のＩＰアドレスから送信先端末のＭＡＣアドレスを求め、ＭＡＣアドレスで認証要求・ゲート管理部２１５のテーブル７１のエントリを検索する。端末１Ａは使用端末として登録されているため、一致するエントリが見つかる。

【００４２】

見つかった該当エントリのテーブル７３にデータのサイズを追加し、それにより再計算した比率、料金をそれぞれテーブル７４、７５に格納した後、そのデータをＬＡＮ　Ｉ／Ｆ部２１１を通じて端末１Ａに送信する。なお、一致するエントリがない場合はデータを廃

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業する。
【００４３】
端末１Ｂとの送受信もＭＡＣアドレス検索で一致するエントリが別である点を除けば端末１Ａの場合と同様である。
【００４４】
月末等の決済日には、部屋番号で、認証要求・ゲート管理部のテーブル７２を検索し、一致する全てのエントリのテーブル７５を加算することで各部屋の月額料金を決定して、各部屋に請求される。
【００４５】
上述実施形態では、通信帯域が異なるにもかかわらず、集合住宅、ビル等におけるインターネット接続共有時の使用料金が一定であるという、ユーザの不満を解消することができ、インターネットアクセス回線業者もしくは、集合住宅、ビルの経営者の収益向上を図ることができる。
【００４６】
次に、本発明の第２の実施形態について説明する。
前述の実施形態ではビル、集合住宅で一つのインターネットアクセス回線を契約し共有していたが、本実施形態では、既存の電話線を利用したＡＤＳＬ回線など、すでに各部屋に直接インターネットアクセス回線が引き込まれている場合には対応できない。そこで、各部屋のインターネットアクセス回線どうしを接続し共有するようにしてもよい。
【００４７】
本実施形態は図５に示すように構成され、部屋Ａには、インターネットアクセスするための端末１Ａと、アクセス回線Ａへのゲートウェイ２Ａを含む。部屋Ｂには、インターネットアクセスするための端末１Ｂと、アクセス回線Ｂへのゲートウェイ２Ｂを含む。ビル、集合住宅の共用部分には課金サーバー４を含む。本実施形態では説明を簡単化するため、各部屋における端末の数を１としているが、これらは各々複数あっても構わない。
【００４８】
ゲートウェイ２Ａは、図６に示すように構成され、ＬＡＮ　Ｉ／Ｆ部２２１と、ＬＡＮ　Ｉ／Ｆ部２２２と、ＷＡＮ　Ｉ／Ｆ部２２３と、通信制御部２２４と、認証要求・ゲート管理部２２５と、ゲートウェイ間帯域調整部２２６とを含む。これらの処部はそれぞれ概略次のように動作する。
【００４９】
ＬＡＮ　Ｉ／Ｆ部Ａ２２１は部屋Ａにおけるｌａｎ回線上のデータの送受信を、ＬＡＮ　Ｉ／Ｆ部Ｂ２２２は部屋Ｂのゲートウェイ２Ｂとのデータ送受信を、ＷＡＮ　Ｉ／Ｆ部２２３はインターネット（アクセス）回線を通じてインターネット上の各種サーバーとのデータ送受信を行う。
【００５０】
通信制御部２２４は、ＬＡＮ　Ｉ／Ｆ部Ａ２２１とＷＡＮ　Ｉ／Ｆ部２２３の間、及びＬＡＮ　Ｉ／Ｆ部Ｂ２２２とＷＡＮ　Ｉ／Ｆ部２２３の間の通信制御を行う。
【００５１】
認証要求・ゲート管理部２２５は、登録されたＭＡＣアドレスを持つ端末のみインターネット通信を行えるようにするもので、通信制御部２２４を介して参照されると、ＬＡＮ　Ｉ／Ｆ部Ｂ　２２２を通じて課金サーバー４を参照して返答する。
【００５２】
ゲートウェイ間帯域調整部２２６は、通信制御部２２４及びゲートウェイ２Ｂから参照され、アクセス回線Ａの現在の通信量と、ＬＡＮ　Ｉ／Ｆ部Ｂ２２２経由でアクセス回線Ｂの現在の通信量を把握し、端末１Ａからのインターネット上サーバーへのデータ送信要求を、より通信量の少ないアクセス回線に接続されているゲートウェイ２Ａまたはゲートウェイ２Ｂに振り分ける。
【００５３】
ここで、ゲートウェイ間帯域調整部２２６は一方のゲートウェイに設置しても良いし、両

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方に設置しても良い。
【００５４】
課金サーバー４は、図７に示すように構成され、ＬＡＮ　Ｉ／Ｆ部４１１はゲートウェイ２Ａ及びゲートウェイ２Ｂとのデータ送受信を行う。
【００５５】
通信制御部４１２は、ＬＡＮ　Ｉ／Ｆ部４１１と認証要求・ゲート管理部４１３の間の通信制御を行う。
【００５６】
認証要求・ゲート管理部４１３は、内部テーブルとして前述の図４に示される情報を格納する。テーブル７１に登録された端末のＭＡＣアドレス、テーブル７２にその端末の使用者の部屋番号、テーブル７３にその端末がその月に使用した総通信量、テーブル７４に全部屋のその月の総通信量に対するその端末の総通信量の比率、テーブル７５にインターネットアクセス回線ＡとＢの合計月額使用料金をテーブル７４の比率で配分した料金をそれぞれ格納する。
【００５７】
次に本実施形態の動作を具体的に説明する。
先ず、部屋Ａと部屋Ｂで使用する端末１Ａ及び端末１Ｂは、予め課金サーバーの認証要求・ゲート管理部４１３のテーブル７１にＭＡＣアドレスを、テーブル７２に部屋番号を登録しておく。総通信量のテーブル７３、比率のテーブル７４、料金のテーブル７５は前述と同様に月末の決済時にクリアされる。
【００５８】
部屋Ａの端末１Ａがインターネット上のサーバーに対して通信を開始したとする。端末１Ａのアプリケーション部１１１は、通信制御部１１２に対してゲートウェイ２Ａ経由でインターネット上のサーバーとの通信を開始するように指示する。通信制御部１１２は、ＬＡＮ　Ｉ／Ｆ部１１３を制御し、ゲートウェイ２Ａ経由でインターネット上のサーバーとデータ送受信を開始する。
【００５９】
ゲートウェイ２Ａが端末１Ａからデータを受信すると、ＬＡＮ　Ｉ／Ｆ部Ａ２２１が先ずデータを受信し、通信制御部２２４に送信する。通信制御部２２４は、データに含まれる送信元端末のＭＡＣアドレスで認証要求・ゲート管理部２２５に対して認証要求を送信する。認証要求・ゲート管理部２２５は、ＬＡＮ　Ｉ／Ｆ部Ｂ２２２を通じて課金サーバー４にそのデータのサイズとともに認証要求を転送する。
【００６０】
課金サーバー４は、ゲートウェイ２Ａから認証要求をＬＡＮ　Ｉ／Ｆ部４１１を介して受信し、通信制御部４１２経由で認証要求・ゲート管理部４１３に送信する。
【００６１】
認証要求・ゲート管理部４１３は、テーブル７１のエントリを検索する。端末１Ａは使用端末として登録されているため、一致するエントリが見つかる。見つかった該当エントリのテーブル７３にそのデータのサイズを追加し、それにより再計算した比率、料金をそれぞれテーブル７４、７５に格納した後、認証許可通知を通信制御部４１２を通じてＬＡＮ　Ｉ／Ｆ部４１１からゲートウェイ２Ａに送信する。
【００６２】
ゲートウェイ２Ａの認証要求・ゲート管理部２２５は、ＬＡＮ　Ｉ／Ｆ部２２２、通信制御部２２４経由で認証許可通知を受信する。受信後、ゲートウェイ間帯域調整部２２６に対してゲート選択要求を送出する。ゲートウェイ間帯域調整部２２６は、定期的に通信制御部２２４及びゲートウェイ２Ｂの通信制御部２２４とＷＡＮ　Ｉ／Ｆ部２２３間の現在の通信量、ゲートウェイ２Ｂの通信制御部２２４とＷＡＮ　Ｉ／Ｆ部２２３間の現在の通信量を収集する。
【００６３】
ゲート選択要求を受信したゲートウェイ間帯域調整部２２６は、その収集した通信量を基

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に、通信量が低いゲートウェイを選択し、認証要求・ゲート管理部２２５に回答する。本実施形態では、ゲートウェイ２Ａの通信量のほうが低かったとし、認証要求・ゲート管理部２２５に対してゲートウェイ２Ａを選択するように回答されたとする。

【００６４】

認証要求・ゲート管理部２２５は、この回答に従い、端末１Ａからの受信データをゲートウェイ２Ａの通信制御部２２４とＷＡＮ　Ｉ／Ｆ部２２３経由、アクセス回線Ａ経由でインターネット上のサーバーに送信する。

【００６５】

ゲートウェイ２Ａがインターネット上のサーバーから端末１Ａ宛のデータをアクセス回線Ａ経由で受信すると、ＷＡＮ　Ｉ／Ｆ部２２３が先ずデータを受信し、通信制御部２２４に送信する。通信制御部２２４は、データに含まれる送信先端末のＩＰアドレスから送信先端末のＭＡＣアドレスを求め、ＭＡＣアドレスで認証要求・ゲート管理部２２５に対して認証要求を送信する。

【００６６】

認証要求・ゲート管理部２２５は、ＬＡＮ　Ｉ／Ｆ部２２２を通じて課金サーバー４に認証要求を転送する。課金サーバー４は、ゲートウェイ２Ａから認証要求をＬＡＮ　Ｉ／Ｆ部４１１で受信し通信制御部４１２経由で認証要求・ゲート管理部４１３に送信する。

【００６７】

認証要求・ゲート管理部４１３は、テーブル７１のエントリを検索する。端末１Ａは使用端末として登録されているため、一致するエントリが見つかる。見つかった該当エントリのテーブル７３にそのデータのサイズを追加し、それにより再計算した比率、料金をそれぞれテーブル７４、７５に格納した後、認証許可通知を通信制御部４１２を通じてＬＡＮ　Ｉ／Ｆ部４１１からゲートウェイ２Ａに送信する。

【００６８】

認証要求・ゲート管理部２２５は、ＬＡＮ　Ｉ／Ｆ部２２２、通信制御部２２４経由で認証許可通知を受信すると、端末１Ａ宛の受信データを通信制御部２２４、ＬＡＮ　Ｉ／Ｆ部２２１経由で端末１Ａに送信する。

【００６９】

端末１Ｂとの送受信も最初に端末１Ｂからインターネット上サーバーへの送信データを受信するゲートウェイがゲートウェイ２Ｂである点と、認証要求時にＭＡＣアドレス検索で一致するエントリが別である点を除けば端末１Ａの場合と同様である。

【００７０】

月末等の決済日には、部屋番号で、課金サーバーの認証要求・ゲート管理部のテーブル７２を検索し、一致する全てのエントリのテーブル７５を加算することで各部屋の月額料金を決定して、各部屋に請求される。

【００７１】

次に、本発明の第３の実施形態について説明する。

前述の図４の実施形態では、隣接する各部屋において、その隣接する部屋の総合使用帯域が、アクセス回線１つ分の帯域でまかなえる場合でも、各部屋個別にアクセス回線を契約するしかなく非効率であった。そこで、本実施形態では、アクセス回線を引き込んでいる１つの部屋の無線ＬＡＮ基地局を隣接する部屋の無線端末が利用して契約回線数を減らす。ここで、通信をしている端末の利用者の部屋を識別し、各部屋毎の使用通信帯域を記録し、各部屋毎に使用通信帯域に応じて通信料金を算出する。

【００７２】

図８を参照すると、部屋Ａには、インターネットアクセスするための無線端末１１Ａと、無線端末１１Ａと通信をする無線ＬＡＮ基地局１２Ａとを含む。部屋Ｂには、インターネットアクセスするための無線端末１１Ｂを含む。本実施形態では説明を簡単化するため、各部屋における端末の数を１としているが、これらは各々複数あっても構わない。

【００７３】

無線端末１１Ａ、１１Ｂは、図９に示すように構成され、アプリケーション部１３１と、

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基地局検出部１３２と、通信制御部１３３と、無線ＬＡＮ　Ｉ／Ｆ部１３４と、通信速度検出部１３５とを含む。これらの処理部はそれぞれ概略次のように動作する。

【００７４】

アプリケーション部１３１は、ユーザへの画面表示やユーザからの入力検出と、基地局検出部１３２で検出された複数の基地局の平均速度比較と最適な接続先基地局の判断、通信制御部１３３への通信開始、停止の指示を行う。

【００７５】

基地局検出部１３２は、無線ＬＡＮ　Ｉ／Ｆ部１３４から受信した信号から無線ＬＡＮ基地局のビーコン信号を識別することで通信可能な無線ＬＡＮ基地局を検出しアプリケーション部１３１に通知する。

【００７６】

通信制御部１３３は、無線ＬＡＮ　Ｉ／Ｆ部１３４から受信したデータのアプリケーション部１３１への送信、アプリケーション部から送信要求されたデータの無線ＬＡＮ　Ｉ／Ｆ部１３４への送信を行う。

【００７７】

無線ＬＡＮ　Ｉ／Ｆ部１３４は、基地局とデータの送受信を行う。無線ＬＡＮ基地局Ａは、図１０に示すように構成され、有線ＬＡＮ　Ｉ／Ｆ部１２１と、通信制御部１２２と、無線ＬＡＮ　Ｉ／Ｆ部１２３を含み、これらの処理部はそれぞれ概略次のように動作する。

【００７８】

有線ＬＡＮ　Ｉ／Ｆ部１２１は、有線ＬＡＮとのデータ送受信を行う。通信制御部１２２は、無線ＬＡＮ　Ｉ／Ｆ１２３から受信したデータの有線ＬＡＮ　Ｉ／Ｆ１２１への送信、有線ＬＡＮ　Ｉ／Ｆ部１２１から受信したデータの無線ＬＡＮ　Ｉ／Ｆ部１２３への送信を制御する。無線　ＬＡＮ　Ｉ／Ｆ部１２３は、無線端末とのデータ送受信を行う。

【００７９】

ゲートウェイ２１は、前述の図３に示すように構成され、ＬＡＮ　Ｉ／Ｆ部２１１と、ＬＡＮ　Ｉ／Ｆ部２１２と、ＷＡＮ　Ｉ／Ｆ部２１３と、通信制御部２１４と、認証要求・ゲート管理部２１５とを含む。ＬＡＮ　Ｉ／Ｆ部２１２は、本実施形態では使用しない。これらの処部はそれぞれ概略次のように動作する。

【００８０】

ＬＡＮ　Ｉ／Ｆ部２１１は部屋ＡのＬＡＮ回線上のデータ送受信を、ＷＡＮ　Ｉ／Ｆ部２１３はインターネット回線を通じてインターネット上の各種サーバーとのデータ送受信を行う。

【００８１】

通信制御部２１４は、ＬＡＮ　Ｉ／Ｆ部２１１とＷＡＮ　Ｉ／Ｆ部２１３の間の通信制御を行う。

【００８２】

認証要求・ゲート管理部２１５は、登録されたＭＡＣアドレスを持つ端末のみインターネット通信を行えるように通信制御部２１４から参照される。また、インターネットアクセスした端末の総通信量と課金管理を行う。認証要求・ゲート管理部２１５は、内部テーブルとして図４に示される情報を格納する。

テーブル７１に登録された端末のＭＡＣアドレス、テーブル７２にその端末の使用者の部屋番号、テーブル７３にその端末がその月に使用した総通信量、テーブル７４に全部屋のその月の総通信量に対するその端末の総通信量の比率、テーブル７５にインターネットアクセス回線の月額使用料金をテーブル７４の比率で配分した料金を格納する。

【００８３】

次に、本実施形態の動作について具体的に説明する。

先ず、部屋Ａと部屋Ｂで使用する無線端末１１Ａ及び無線端末１１Ｂは、予めゲートウェイの認証要求・ゲート管理部のテーブル７１にＭＡＣアドレスを、テーブル７２に部屋番号を登録しておく。総通信量のテーブル７３、比率のテーブル７４、料金のテーブル７５

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は月末の決済時にクリアされる。

【００８４】

部屋Ｂの無線端末１１Ｂがインターネット上のサーバーに対して通信を開始したとする。先ず、無線端末１１Ｂの無線ＬＡＮ　Ｉ／Ｆ部１３５が周囲の無線ＬＡＮ基地局のビーコン（通信信号）を受信しようとする。無線端末１１Ｂは、図８に示すように、無線ＬＡＮ基地局１２Ａのビーコン到達範囲に含まれる。無線ＬＡＮ基地局の発したビーコンを無線ＬＡＮ端末の無線ＬＡＮ　Ｉ／Ｆ部１３５が受信すると、基地局検出部１３２はそれを検知しアプリケーション部１３１に通知する。アプリケーション部１３１は、通信制御部１３４、無線ＬＡＮ　Ｉ／Ｆ部１３５を通じて無線ＬＡＮ基地局１２Ａにデータを送信する。

【００８５】

無線ＬＡＮ基地局１２Ａは、その通信データを無線ＬＡＮ　Ｉ／Ｆ部１２３、通信新制御部１２２、有線ＬＡＮ　Ｉ／Ｆ部１２１を通じてゲートウェイ２１に対して転送する。

【００８６】

ゲートウェイ２１が端末１１Ｂからデータを受信すると、前述の図３に示すＬＡＮ　Ｉ／Ｆ部２１１が先ずデータを受信し、通信制御部２１４に送信する。通信制御部２１４は、データに含まれる送信元端末のＭＡＣアドレスで認証要求・ゲート管理部のテーブル７１のエントリを検索する。無線端末１１Ｂは使用端末として登録されているため、一致するエントリが見つかる。見つかった該当エントリのテーブル７３にそのデータのサイズを追加し、それにより再計算した比率、料金をそれぞれテーブル７４、７５に格納した後、そのデータをＷＡＮ　Ｉ／Ｆ部２１３を通じてアクセス回線経由でインターネット上のサーバーに対して送信する。なお、一致するエントリがない場合はデータを廃棄する。

【００８７】

ゲートウェイ２１がインターネット上のサーバーから無線端末１１Ｂ宛のデータを受信すると、ＷＡＮ　Ｉ／Ｆ部２１３が先ずデータを受信し、通信制御部２１４に送信する。通信制御部２１４はデータに含まれる送信先端末のＩＰアドレスから送信先端末のＭＡＣアドレスを求め、ＭＡＣアドレスで認証要求・ゲート管理部２１５のテーブル７１のエントリを検索する。無線端末１１Ｂは使用端末として登録されているため、一致するエントリが見つかる。

【００８８】

見つかった該当エントリのテーブル７３にデータのサイズを追加し、それにより再計算した比率、料金をそれぞれテーブル７４、７５に格納した後、そのデータをＬＡＮ　Ｉ／Ｆ部２１１を通じて無線ＬＡＮ基地局経由で無線端末１１Ｂに送信する。なお、一致するエントリがない場合はデータを廃棄する。

【００８９】

無線端末１１Ａとの送受信もＭＡＣアドレス検索で一致するエントリが別である点を除けば無線端末１１Ｂの場合と同様である。

【００９０】

月末等の決済日には、部屋番号で、認証要求・ゲート管理部のテーブル７２を検索し、一致する全てのエントリのテーブル７５を加算することで各部屋の月額料金を決定して、各部屋に請求される。

【００９１】

次に、本発明の第４の実施形態について説明する。

前述の図１の実施形態では、部屋によってはアクセス回線の速度に比してゲートウェイ⇔端末間の最大伝送速度が、障害物の存在等により遅い場合や、ゲートウェイ⇔無線ＬＡＮ基地局⇔無線端末という接続形態を採用した場合に、無線ＬＡＮ基地局⇔無線端末間の最大伝送速度がアクセス回線や、ゲートウェイ⇔無線ＬＡＮ基地局間の最大伝送速度に比して遅い場合、そこがボトルネックとなりアクセス回線の通信帯域を最大まで使用できない場合があった。

【００９２】

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そこで本実施形態では、各部屋に無線ＬＡＮ基地局と無線端末を設置し、無線端末が室内の基地局の混雑度合（通信速度）と隣接した部屋の基地局の混雑度合（通信速度）を比較する手段と、無線端末が隣接した部屋の基地局経由でゲートウェイにアクセスする。ここで、アクセス回線へのゲートウェイ部分において、通信をしている端末の利用者の部屋を識別し、各部屋毎に使用通信帯域を記録し、各部屋毎に使用通信帯域に応じて通信料金を算出する。

【００９３】

図１１を参照すると、部屋Ａには、インターネットアクセスするための無線端末１１Ａと、無線端末１１Ａと通信する無線ＬＡＮ基地局１２Ａを含む。部屋Ｂには、インターネットアクセスするための無線端末１１Ｂと、無線端末１１Ｂと通信する無線ＬＡＮ基地局１２Ｂを含む。本実施形態では説明を簡単化するため、各部屋における端末の数を１としているが、これらは各々複数あっても構わない。

【００９４】

無線端末１１Ａ、１１Ｂは、図１２に示すように構成され、アプリケーション部１３１と、基地局検出部１３２と、通信速度検出部１３５と、通信制御部１３３と、無線ＬＡＮ　Ｉ／Ｆ部１３４と、通信速度検出部１３５とを含む。これらの処理部はそれぞれ概略次のように動作する。通信速度検出部１３５は、必ずしも無線端末内に設けなくとも良い。

【００９５】

アプリケーション部１３１は、ユーザへの画面表示やユーザからの入力検出と、基地局検出部１３２で検出された複数の基地局の平均速度比較と最適な接続先基地局の判断、通信制御部１３３への通信開始、停止の指示を行う。

【００９６】

基地局検出部１３２は、無線ＬＡＮ　Ｉ／Ｆ部１３４から受信した信号から無線ＬＡＮ基地局のビーコン信号を識別することで通信可能な無線ＬＡＮ基地局を検出しアプリケーション部１３１に通知する。

【００９７】

通信速度検出部１３５は、通信制御部１３３を監視し現通信速度の算出、通信速度の算出を行う。通信制御部１３３は、無線ＬＡＮ　Ｉ／Ｆ部１３４から受信したデータのアプリケーション部１３１への送信、アプリケーション部から送信要求されたデータの無線ＬＡＮ　Ｉ／Ｆ部１３４への送信を行う。

【００９８】

無線ＬＡＮ　Ｉ／Ｆ部１３４は、基地局とデータの送受信を行う。無線ＬＡＮ基地局１２Ａ、１２Ｂは、前述の図１０に示すように構成され、有線ＬＡＮ　Ｉ／Ｆ部１２１と、通信制御部１２２と、無線ＬＡＮ　Ｉ／Ｆ部１２３を含む。これらの処理部はそれぞれ概略次のように動作する。

【００９９】

有線ＬＡＮ　Ｉ／Ｆ部１２１は、有線ＬＡＮとのデータ送受信を行う。通信制御部１２２は無線ＬＡＮ　Ｉ／Ｆ１２３から受信したデータの有線ＬＡＮ　Ｉ／Ｆ１２１への送信、有線ＬＡＮ　Ｉ／Ｆ部１２１から受信したデータの無線ＬＡＮ　Ｉ／Ｆ部１２３への送信を制御する。無線　ＬＡＮ　Ｉ／Ｆ部１２３は、無線端末とのデータ送受信を行う。

【０１００】

ゲートウェイ２１は、前述の図３に示すように構成され、ＬＡＮ　Ｉ／Ｆ部２１１と、ＬＡＮ　Ｉ／Ｆ部２１２と、ＷＡＮ　Ｉ／Ｆ部２１３と、通信制御部２１４と、認証要求・ゲート管理部２１５とを含む。これらの処部はそれぞれ概略次のように動作する。

【０１０１】

ＬＡＮ　Ｉ／Ｆ部２１１は部屋ＡのＬＡＮ回線上のデータ送受信を、ＬＡＮ　Ｉ／Ｆ部２１２は、部屋ＢのＬＡＮ回線上のデータ送受信を、ＷＡＮ　Ｉ／Ｆ部２１３はインターネット回線を通じてインターネット上の各種サーバーとのデータ送受信を行う。

【０１０２】

通信制御部２１４は、ＬＡＮ　Ｉ／Ｆ部２１１とＷＡＮ　Ｉ／Ｆ部２１３の間と、ＬＡＮ

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Ｉ／Ｆ部２１１とＬＡＮ　Ｉ／Ｆ部２１２の間と、ＬＡＮ　Ｉ／Ｆ部２１２とＷＡＮ　Ｉ／Ｆ部２１３の間の通信制御を行う。

【０１０３】

認証要求・ゲート管理部２１５は、登録されたＭＡＣアドレスを持つ端末のみインターネット通信を行えるように通信制御部２１４から参照される。また、インターネットアクセスした端末の総通信量と課金管理を行う。認証要求・ゲート管理部２１５は内部テーブルとして図７に示される情報を格納する。

【０１０４】

テーブル７１に登録された端末のＭＡＣアドレス、テーブル７２にその端末の使用者の部屋番号、テーブル７３にその端末がその月に使用した総通信量、テーブル７４に全部屋のその月の総通信量に対するその端末の総通信量の比率、テーブル７５にインターネットアクセス回線の月額使用料金を７４の比率で配分した料金を格納する。

【０１０５】

次に、本実施形態の動作について具体的に説明する。

先ず、部屋Ａと部屋Ｂで使用する無線端末１１Ａ及び無線端末１１Ｂは、予めゲートウェイ２１の認証要求・ゲート管理部２１５のテーブル７１にＭＡＣアドレスを、テーブル７２に部屋番号を登録しておく。総通信量のテーブル７３、比率のテーブル７４、料金のテーブル７５は月末の決済時にクリアされる。

【０１０６】

先ず、無線端末１１Ｂが起動すると、無線端末１１Ｂの無線ＬＡＮ　Ｉ／Ｆ部１３４が周囲の無線ＬＡＮ基地局のビーコン（通信信号）を受信しようとする。無線端末１１Ｂは、図１１に示すように、無線ＬＡＮ基地局１２Ａと無線ＬＡＮ基地局１２Ｂのビーコン到達範囲に含まれる。ここでは、無線ＬＡＮ基地局１２Ａの発したビーコンを先に無線ＬＡＮ　Ｉ／Ｆ部１３４が受信したとする。

【０１０７】

基地局検出部１３２は、それを検知しアプリケーション部１３１に通知する。アプリケーション部１３１は、通信制御部１３３、無線ＬＡＮ　Ｉ／Ｆ部１３４を通じて通信速度測定用のダミーデータを基地局１２Ａと送受信し、通信速度検出部１３５がその平均速度を計算してアプリケーション部１３１に通知する。

【０１０８】

次に、無線ＬＡＮ　Ｉ／Ｆ部１３４が他の無線ＬＡＮ基地局のビーコン（通信信号）を受信しようとし、無線ＬＡＮ基地局１２Ｂのビーコンを受信し、基地局検出部１３２はそれを検知しアプリケーション部１３１に通知する。アプリケーション部１３１は、通信制御部１３３、無線ＬＡＮ　Ｉ／Ｆ部１３４を通じて通信速度測定用のダミーデータを基地局１２Ｂと送受信し、通信速度検出部１３５がその平均速度を計算してアプリケーション部１３１に通知する。基地局１２Ａと１２Ｂ以外からはビーコンが到達しないため、基地局１２Ａと１２Ｂの計測した平均通信速度を比較する。

【０１０９】

比較した結果、無線ＬＡＮ基地局１２Ａとの平均通信速度が無線ＬＡＮ基地局１２Ｂとの平均通信速度よりも速かったとし、アプリケーション部は通信制御部１３３、無線ＬＡＮ　Ｉ／Ｆ部１３４を通じて無線ＬＡＮ基地局１２Ａに対して通信を開始する。

【０１１０】

無線ＬＡＮ基地局１２Ａは、その通信データを無線ＬＡＮ　Ｉ／Ｆ部１２３、通信制御部１２２、有線ＬＡＮ　Ｉ／Ｆ部１２１を通じてゲートウェイに対して転送する。

【０１１１】

ゲートウェイ２１が無線端末１１Ｂからデータを受信すると、ＬＡＮ　Ｉ／Ｆ部２１１が先ずデータを受信し、通信制御部２１４に送信する。通信制御部２１４は、データに含まれる送信元端末のＭＡＣアドレスで認証要求・ゲート管理部のテーブル７１のエントリを検索する。無線端末１１Ｂは使用端末として登録されているため、一致するエントリが見つかる。見つかった該当エントリのテーブル７３にそのデータのサイズを追加し、それに

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より再計算した比率、料金をそれぞれテーブル７４、７５に格納した後、そのデータをＷＡＮ　Ｉ／Ｆ部２１３を通じてアクセス回線経由でインターネット上のサーバーに対して送信する。なお、一致するエントリがない場合はデータを廃棄する。

【０１１２】

ゲートウェイ２１がインターネット上のサーバーから無線端末１１Ｂ宛のデータを受信すると、ＷＡＮ　Ｉ／Ｆ部２１３が先ずデータを受信し、通信制御部２１４に送信する。通信制御部２１４は、データに含まれる送信先端末のＩＰアドレスから送信先端末のＭＡＣアドレスを求め、ＭＡＣアドレスで認証要求・ゲート管理部のテーブル７１のエントリを検索する。

【０１１３】

無線端末１１Ｂは使用端末として登録されているため、一致するエントリが見つかる。見つかった該当エントリのテーブル７３にデータのサイズを追加し、それにより再計算した比率、料金をそれぞれテーブル７４、７５に格納した後、そのデータをＬＡＮ　Ｉ／Ｆ部２１１を通じて無線ＬＡＮ基地局１２Ａ経由で無線端末１１Ｂに送信する。なお、一致するエントリがない場合はデータを廃棄する。

【０１１４】

無線端末１１Ａとの送受信もＭＡＣアドレス検索で一致するエントリが別である点を除けば端末１１Ｂの場合と同様である。

【０１１５】

月末等の決済日には、部屋番号で、認証要求・ゲート管理部のテーブル７２を検索し、一致する全てのエントリのテーブル７５を加算することで各部屋の月額料金を決定して、各部屋に請求される。

【０１１６】

次に、本発明の第５の実施形態について説明する。

前述の図４の実施形態では、２つのアプリケーションを同時に使用したりして部屋によってはアクセス回線Ａ＋Ｂの速度に比してゲートウェイＡまたはＢ⇔端末間の最大伝送速度が遅い場合や、ゲートウェイ⇔無線ＬＡＮ基地局⇔無線端末という接続形態を採用した場合に、無線ＬＡＮ基地局⇔無線端末間の最大伝送速度がアクセス回線Ａ＋Ｂや、ゲートウェイ⇔無線ＬＡＮ基地局間の最大伝送速度に比して遅い場合、そこがボトルネックとなりアクセス回線の通信帯域を最大まで使用できない場合があった。

【０１１７】

そこで、本実施形態では、各部屋に無線ＬＡＮ基地局と無線端末を設置し、無線端末が室内の基地局の混雑度合と隣接した部屋の基地局の混雑度合を比較する。無線端末が隣接した部屋の基地局経由でゲートウェイにアクセスする。アクセス回線へのゲートウェイ部分において、通信をしている端末の利用者の部屋を識別し、各部屋毎に使用通信帯域を記録し、各部屋毎に使用通信帯域に応じて通信料金を算出する。

【０１１８】

図１３を参照すると、部屋Ａには、インターネットアクセスするための無線端末１１Ａと、無線端末と通信する無線ＬＡＮ基地局１２Ａと、アクセス回線Ａへのゲートウェイ２１Ａを含む。部屋Ｂには、インターネットアクセスするための端末１１Ｂと、無線端末と通信する無線ＬＡＮ基地局１２Ｂと、アクセス回線Ｂへのゲートウェイ２１Ｂを含む。ビル、集合住宅の共用部分には課金サーバー４１を含む。本実施形態では説明を簡単化するため、各部屋における端末の数を１としているが、これらは各々複数あっても構わない。

【０１１９】

無線端末１１Ａ、１１Ｂは、前述の図１２に示すように構成され、アプリケーション部１３１と、基地局検出部１３２と、通信制御部１３３と、無線ＬＡＮ　Ｉ／Ｆ部１３４と、通信速度検出部１３５とを含む。これらの処理部はそれぞれ概略次のように動作する。

【０１２０】

アプリケーション部１３１は、ユーザへの画面表示やユーザからの入力検出と、基地局検出部１３２で検出された複数の基地局の平均速度比較と最適な接続先基地局の判断、通信

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制御部１３３への通信開始、停止の指示を行う。

【０１２１】

基地局検出部１３２は、無線ＬＡＮ　Ｉ／Ｆ部１３４から受信した信号から無線ＬＡＮ基地局のビーコン信号を識別することで通信可能な無線ＬＡＮ基地局を検出しアプリケーション部１３１に通知する。

【０１２２】

通信速度検出部１３５は、通信制御部１３３を監視し現通信速度の算出、通信速度の算出を行う。通信制御部１３３は、無線ＬＡＮ　Ｉ／Ｆ部１３４から受信したデータのアプリケーション部１３１への送信、アプリケーション部から送信要求されたデータの無線ＬＡＮ　Ｉ／Ｆ部１３４への送信を行う。

【０１２３】

無線ＬＡＮ　Ｉ／Ｆ部１３４は基地局とデータの送受信を行う。無線ＬＡＮ基地局１２Ａ、１２Ｂは、前述の図１０に示すように構成され、有線ＬＡＮ　Ｉ／Ｆ部１２１と、通信制御部１２２と、無線ＬＡＮ　Ｉ／Ｆ部１２３を含む。これらの処理部はそれぞれ概略次のように動作する。

【０１２４】

有線ＬＡＮ　Ｉ／Ｆ部１２１は有線ＬＡＮとのデータ送受信を行う。通信制御部１２２は、無線ＬＡＮ　Ｉ／Ｆ１２３から受信したデータの有線ＬＡＮ　Ｉ／Ｆ１２１への送信、有線ＬＡＮ　Ｉ／Ｆ部１２１から受信したデータの無線ＬＡＮ　Ｉ／Ｆ部１２３への送信を制御する。無線　ＬＡＮ　Ｉ／Ｆ部１２３は、無線端末とのデータ送受信を行う。

【０１２５】

ゲートウェイ２１Ａは、図６に示すように構成され、ＬＡＮ　Ｉ／Ｆ部２２１と、ＬＡＮ　Ｉ／Ｆ部２２２と、ＷＡＮ　Ｉ／Ｆ部２２３と、通信制御部２２４と、認証要求・ゲート管理部２２５と、ゲートウェイ間帯域調整部２２６とを含む。これらの処部はそれぞれ概略次のように動作する。

【０１２６】

ＬＡＮ　Ｉ／Ｆ部２２１は部屋ＡのＬＡＮ回線上のデータの送受信を、ＬＡＮ　Ｉ／Ｆ部２２２は部屋Ｂのゲートウェイ２１Ｂとのデータ送受信を、ＷＡＮ　Ｉ／Ｆ部２２３はインターネット回線を通じてインターネット上の各種サーバーとのデータ送受信を行う。

【０１２７】

通信制御部２２４は、ＬＡＮ　Ｉ／Ｆ部２２１とＷＡＮ　Ｉ／Ｆ部２２３の間、及びＬＡＮ　Ｉ／Ｆ部２２２とＷＡＮ　Ｉ／Ｆ部２２３の間の通信制御を行う。

【０１２８】

認証要求・ゲート管理部２２５は、登録されたＭＡＣアドレスを持つ端末のみインターネット通信を行えるように通信制御部２２４から参照されると、ＬＡＮＩ／Ｆ部２２２を通じて課金サーバーを参照し返答する。

【０１２９】

ゲートウェイ間帯域調整部２２６は、通信制御部２２４及びゲートウェイ２１Ｂから参照され、アクセス回線Ａの現在の通信量とＬＡＮ　Ｉ／Ｆ部２２２経由でアクセス回線Ｂの現在の通信量を把握し端末１Ａからのインターネット上サーバーへのデータ送信要求をゲートウェイ２１Ａとゲートウェイ２１Ｂに振り分ける。

【０１３０】

課金サーバーは、前述の図７に示すように構成され、ＬＡＮ　Ｉ／Ｆ部４１１はゲートウェイ２１Ａ及びゲートウェイ２１Ｂとのデータ送受信を行う。

【０１３１】

通信制御部４１２は、ＬＡＮ　Ｉ／Ｆ部４１１と認証要求・ゲート管理部４１３の間の通信制御を行う。

【０１３２】

認証要求・ゲート管理部４１３は、内部テーブルとして前述の図４に示される情報を格納する。テーブル７１に登録された端末のＭＡＣアドレス、テーブル７２にその端末の使用

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者の部屋番号、テーブル７３にその端末がその月に使用した総通信量、テーブル７４に全部屋のその月の総通信量に対するその端末の総通信量の比率、テーブル７５にインターネットアクセス回線ＡとＢの合計月額使用料金をテーブル７４の比率で配分した料金を格納する。

【０１３３】

次に動作を具体的に説明する。

先ず、部屋Ａと部屋Ｂで使用する無線端末１１Ａ及び無線端末１１Ｂは、予め課金サーバーの認証要求・ゲート管理部のテーブル７１にＭＡＣアドレスを、テーブル７２に部屋番号を登録しておく。総通信量のテーブル７３、比率のテーブル７４、料金のテーブル７５は月末の決済時にクリアされる。

【０１３４】

無線端末１１Ｂが起動すると、無線端末１１Ｂの無線ＬＡＮ　Ｉ／Ｆ部１３５が周囲の無線ＬＡＮ基地局のビーコン（通信信号）を受信しようとする。無線端末１１Ｂは、図１３に示すように、無線ＬＡＮ基地局１２Ａと無線ＬＡＮ基地局１２Ｂのビーコン到達範囲に含まれる。ここでは、無線ＬＡＮ基地局１２Ａの発したビーコンを先に無線ＬＡＮ　Ｉ／Ｆ部１３５が受信したとする。

【０１３５】

基地局検出部１３２は、それを検知しアプリケーション部１３１に通知する。アプリケーション部１３１は、通信制御部１３３、無線ＬＡＮ　Ｉ／Ｆ部１３４を通じて通信速度測定用のダミーデータを基地局１２Ａと送受信し、通信速度検出部１３５がその平均速度を計算してアプリケーション部１３１に通知する。

【０１３６】

次に、無線ＬＡＮ　Ｉ／Ｆ部１３４が他の無線ＬＡＮ基地局のビーコン（通信信号）を受信しようとし、無線ＬＡＮ基地局１２Ｂのビーコンを受信し、基地局検出部１３２はそれを検知しアプリケーション部１３１に通知する。アプリケーション部１３１は、通信制御部１３３、無線ＬＡＮ　Ｉ／Ｆ部１３４を通じて通信速度測定用のダミーデータを基地局Ｂと送受信し、通信速度検出部１３５がその平均速度を計算してアプリケーション部１３１に通知する。

【０１３７】

基地局１２Ａと１２Ｂ以外からはビーコンが到達しないため、基地局１２Ａと１２Ｂの計測した平均通信速度を比較する。比較した結果、無線ＬＡＮ基地局１２Ａとの平均通信速度が無線ＬＡＮ基地局１２Ｂとの平均通信速度よりも速かったとし、アプリケーション部は通信制御部１３３、無線ＬＡＮ　Ｉ／Ｆ部１３４を通じて無線ＬＡＮ基地局１２Ａに対して通信を開始する。

【０１３８】

無線ＬＡＮ基地局１２Ａは、その通信データを無線ＬＡＮ　Ｉ／Ｆ部１２３、通信新制御部１２２、有線ＬＡＮ　Ｉ／Ｆ部１２１を通じてゲートウェイ２１Ａに対して転送する。

【０１３９】

ゲートウェイ２１Ａが無線端末１１Ｂからデータを受信すると、ＬＡＮ　Ｉ／Ｆ部２２１が先ずデータを受信し、通信制御部２２４に送信する。通信制御部２２４はデータに含まれる送信元端末のＭＡＣアドレスで認証要求・ゲート管理部２２５に対して認証要求を送信する。認証要求・ゲート管理部２２５は、ＬＡＮＩ／Ｆ部２２２を通じてそのデータサイズとともに課金サーバーに認証要求を転送する。

【０１４０】

課金サーバーは、ゲートウェイ２１Ａから認証要求をＬＡＮ　Ｉ／Ｆ部４１１で受信し通信制御部４１２経由で認証要求・ゲート管理部４１３に送信する。認証要求・ゲート管理部４１３は、テーブル７１のエントリを検索する。無線端末１１Ｂは使用端末として登録されているため、一致するエントリが見つかる。見つかった該当エントリのテーブル７３にそのデータのサイズを追加し、それにより再計算した比率、料金をそれぞれテーブル７４、７５に格納した後、認証許可通知を通信制御部４１２を通じてＬＡＮ　Ｉ／Ｆ部４１

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１からゲートウェイ２１Ａに送信する。
【０１４１】
ゲートウェイ２１Ａの認証要求・ゲート管理部２２５は、ＬＡＮ　Ｉ／Ｆ部２２２、通信制御部２２４経由で認証許可通知を受信する。受信後、ゲートウェイ間帯域調整部２２６に対してゲート選択要求を送出する。ゲートウェイ間帯域調整部２２６は、定期的に通信制御部２２４及び、ゲートウェイ２１Ｂの通信制御部２２４と通信しゲートウェイ２１Ａの通信制御部２２４とＷＡＮ　Ｉ／Ｆ部２２３間の現在の通信量、ゲートウェイ２１Ｂ通信制御部２２４とＷＡＮ　Ｉ／Ｆ部２２３間の現在の通信量（現在通信している通信速度）を収集している。
【０１４２】
ゲート選択要求を受信したゲートウェイ間帯域調整部２２６は、その収集した通信量をもとに、通信量が低いゲートウェイを選択し、認証要求・ゲート管理部２２５に回答する。本実施形態ではゲートウェイ２１Ａの通信量のほうが低かったとし、認証要求・ゲート管理部２２５に対してゲートウェイ２１Ａを選択するように回答されたとする。
【０１４３】
認証要求・ゲート管理部２２５は、回答に従い、無線端末１１Ｂからの受信データをゲートウェイ２１Ａの通信制御部２２４とＷＡＮ　Ｉ／Ｆ部２２３経由、アクセス回線Ａ経由でインターネット上のサーバーに送信する。
【０１４４】
ゲートウェイ２１Ａがインターネット上のサーバーから無線端末１１Ｂ宛のデータをアクセス回線Ａ経由で受信すると、ＷＡＮ　Ｉ／Ｆ部２２３が先ずデータを受信し、通信制御部２２４に送信する。通信制御部２２４は、データに含まれる送信先端末のＩＰアドレスから送信先端末のＭＡＣアドレスを求め、ＭＡＣアドレスで認証要求・ゲート管理部２２５に対して認証要求を送信する。認証要求・ゲート管理部２２５は、ＬＡＮ　Ｉ／Ｆ部Ｂ　２２２を通じて課金サーバーにそのデータサイズとともに認証要求を転送する。
【０１４５】
課金サーバーは、ゲートウェイ２１Ａから認証要求をＬＡＮ　Ｉ／Ｆ部４１１で受信し通信制御部４１２経由で認証要求・ゲート管理部４１３に送信する。認証要求・ゲート管理部４１３は、テーブル７１のエントリを検索する。無線端末１１Ｂは、使用端末として登録されているため、一致するエントリが見つかる。見つかった該当エントリのテーブル７３にそのデータのサイズを追加し、それにより再計算した比率、料金をそれぞれテーブル７４、７５に格納した後、認証許可通知を通信制御部４１２を通じてＬＡＮ　Ｉ／Ｆ部４１１からゲートウェイ２１Ａに送信する。
【０１４６】
認証要求・ゲート管理部２２５は、ＬＡＮ　Ｉ／Ｆ部２２２、通信制御部２２４経由で認証許可通知を受信すると、端末１１Ａ宛の受信データを通信制御部２２４、ＬＡＮ　Ｉ／Ｆ部２２１経由で無線端末１１Ｂに送信する。
【０１４７】
月末等の決済日には、部屋番号で、課金サーバーの認証要求・ゲート管理部のテーブル７２を検索し、一致する全てのエントリのテーブル７５を加算することで各部屋の月額料金を決定して、各部屋に請求される。
【０１４８】
次に、本発明の第６の実施形態について説明する。
前述の図１、図５、図８、図１１及び図１３の実施形態では、共用している他方の混在度合により通信帯域が変動するため、一定した通信帯域を確保したい場合に対応できない。
【０１４９】
そこで本実施形態では、ある部屋の通信帯域を一定速度以上に保つ手段と、その一定速度を時間帯によって変更する手段を設ける。
【０１５０】
具体的に説明すると、図１、図８及び図１１の実施形態において、ゲートウェイの認証要

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求・ゲート管理部２１５の内部テーブルを図１４に示される情報を格納するようにする。テーブル８１に部屋に登録された端末のＭＡＣアドレス、テーブル８２にその端末の部屋番号、テーブル８３に時間帯、テーブル８４にその時間帯毎の最大通信帯域、テーブル８５に全時間を合計した１日の最大通信量が、アクセス回線の１日の最大通信量に占める割合、８６にアクセス回線の月額使用料金をテーブル８５の比率で配分した料金を格納する。

【０１５１】

また、通信制御部２１４の動作を以下のように変更する。

通信制御部２１４は、インターネットへの送信データを受信すると、データに含まれる送信元端末のＭＡＣアドレスで認証要求・ゲート管理部のテーブル８２のエントリを検索する。見つかった該当エントリのテーブル８３から現在時刻と合致するエントリを検索し、その時間の最大通信帯域をテーブル８４から読み取り、その端末の所属する部屋の全端末の現在の通信帯域合計がその最大通信帯域以上だったら、その送信データを待ち行列に格納し、最大通信帯域以下になるまで送信しない。その状態で次の送信データが送られてきたら、現在の待ち行列の最後尾にそのデータも格納する。最大通信帯域以下になったら順次待ち行列からアクセス回線に対して送信する。

【０１５２】

また、月末等の決済日には、部屋番号で、認証要求・ゲート管理部のテーブル８２を検索し、一致するエントリのテーブル８６の額を各部屋の月額料金として、各部屋に請求される。

【０１５３】

図４と図１２の実施形態においては、課金サーバーの認証要求・ゲート管理部４１３の内部テーブルを図１４に示される情報を格納するようにする。テーブル８２に部屋番号、テーブル８１にその部屋に登録された端末のＭＡＣアドレス、テーブル８３に時間帯、テーブル８４にその時間帯毎の最大通信帯域、テーブル８５に全時間を合計した１日の最大通信量が、アクセス回線の１日の最大通信量に占める割合、テーブル８６に全アクセス回線の月額使用料金をテーブル８５の比率で配分した料金を格納する。

【０１５４】

また、課金サーバーの認証要求・ゲート管理部４１３の動作を以下のように変更する。

【０１５５】

認証要求・ゲート管理部４１３は、認証要求を受信すると、テーブル８２のエントリを検索する。認証要求データに含まれる送信元端末のＭＡＣアドレスで認証要求・ゲート管理部４１３のテーブル８１のエントリを検索する。見つかった該当エントリのテーブル８３から現在時刻と合致するエントリを検索し、その時間の最大通信帯域をテーブル８４から読み取り、認証許可通知とともに通信制御部４１２を通じてＬＡＮ　Ｉ／Ｆ部４１１からゲートウェイ２Ａ、２１Ａもしくは２Ｂ、２１Ｂに送信する。

【０１５６】

ゲートウェイ２Ａ、２１Ａもしくは２Ｂ、２１Ｂの認証要求・ゲート管理部２２５は、ＬＡＮ　Ｉ／Ｆ部２２２、通信制御部２２４経由で認証許可通知を受信する。受信後、ゲートウェイ間帯域調整部２２６に対してゲート選択要求を送出する。ゲートウェイ間帯域調整部２２６は、定期的に通信制御部２２４及び、他のゲートウェイの通信制御部２２４と通信し自ゲートウェイの通信制御部２２４とＷＡＮ　Ｉ／Ｆ部２２３間の現在の通信量、他ゲートウェイの通信制御部２２４とＷＡＮ　Ｉ／Ｆ部２２３間の現在の通信量を収集している。ゲート選択要求を受信したゲートウェイ間帯域調整部２２６はその収集した通信量をもとに、通信量が低いゲートウェイを選択する。

【０１５７】

ただし、その端末の所属する部屋の全端末の現在の通信帯域合計が、認証許可通知とともに送られてきたその時間の端末が所属する部屋の最大通信帯域以上だったら、その送信データを待ち行列に格納し、最大通信帯域以下になるまで認証要求・ゲート管理部２２５に回答しない。その状態で次の送信データが送られてきたら、現在の待ち行列の最後尾にそ

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のデータも格納する。
【０１５８】
最大通信帯域以下になったら、再度通信量の低いゲートウェイを選択しなおしたのち、順次待ち行列から認証要求・ゲート管理部２２５にゲート選択結果とともに送信する。
【０１５９】
また、月末等の決済日には、部屋番号で、認証要求・ゲート管理部４１３のテーブル８１を検索し、一致するエントリのテーブル８６の額を各部屋の月額料金として、各部屋に請求される。
【０１６０】
次に、本発明の第７の実施形態について説明する。
前述の図１、図５、図８、図１１及び図１３に示す実施形態では、一部の部屋の使用用途が店舗である場合、その店舗の売り上げをのばすビジネスモデルがない。
【０１６１】
そこで本実施形態では、店舗の通信料金の一部を希望する住居世帯主に負担してもらい、その料金に一定割合の額を上乗せした額相当のクーポンをその住居世帯主に支払う仕組みを設ける。ここで、当該額相当の料金を支払っても良い。
【０１６２】
具体的に説明すると、図１、図８及び図１１に示す実施形態において、月末等の決済日に、店舗の部屋番号で、認証要求・ゲート管理部のテーブル８２を検索し、一致するエントリのテーブル８６の額の一部を、クーポンを希望する部屋のテーブル８６に均等に割り振り、店舗には割り振った額を一定割合増加した額に相当するクーポンの発行依頼を送信する。その後通常の決済処理を行う。ここで、勿論、当該額相当の料金を支払っても良い。
【０１６３】
図５及び図１３に示す実施形態においては、月末等の決済日に、店舗の部屋番号で、認証要求・ゲート管理部４１３のテーブル８２を検索し、一致するエントリのテーブル８６の額の一部を、クーポンを希望する部屋のテーブル８６に均等に割り振り、店舗には割り振った額を一定割合増加した額に相当するクーポンの発行依頼を送信する。その後通常の決済処理を行う。
【０１６４】
以上、本発明によるインターネット接続システムの好適実施形態の構成及び動作を詳述した。しかし、斯かる実施形態は、本発明の単なる例示に過ぎず、何ら本発明を限定するものではない。本発明の要旨を逸脱することなく、特定用途に応じて種々の変形変更が可能であること、当業者には容易に理解できよう。
【０１６５】
【発明の効果】
以上説明したように、本発明においては、各部屋の使用用途（住居、オフィス、店舗等）や人員構成により、使用頻度や最多使用時間帯がばらばらな場合でも、通信帯域が余っている部屋から不足している部屋へ通信帯域を動的に割り振り、トータルの使用通信帯域の大小により料金を割り振っているので公平な帯域の配分が可能となる。したがって、帯域をあまり使用しなかった部屋は通信料金が下がり、帯域が不足していた部屋は多少通信料金があがっても不足していた帯域を補うことが可能となる。
【図面の簡単な説明】
【図１】本発明によるインターネット接続システムの第１の実施形態例を示すシステム構成図である。
【図２】本発明の第１の実施形態における端末の構成図である。
【図３】本発明の第１の実施形態におけるゲートウェイの構成図である。
【図４】本発明の第１の実施形態における認証要求・ゲート管理部の内部テーブルを示す図である。
【図５】本発明によるインターネット接続システムの第２の実施形態例を示すシステム構成図である。

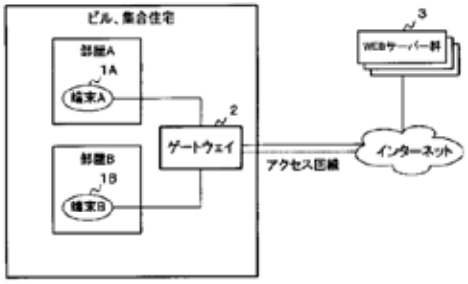
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【図６】本発明の第２の実施形態におけるゲートウェイの構成図である。
【図７】本発明の第２の実施形態における課金サーバーの構成図である。
【図８】本発明によるインターネット接続システムの第３の実施形態例を示すシステム構成図である。
【図９】本発明の第３の実施形態における無線端末の構成図である。
【図１０】本発明の第３の実施形態における基地局の構成図である。
【図１１】本発明によるインターネット接続システムの第４の実施形態例を示すシステム構成図である。
【図１２】本発明の第４の実施形態における無線端末の構成図である。
【図１３】本発明によるインターネット接続システムの第５の実施形態例を示すシステム構成図である。
【図１４】本発明の第５の実施形態における認証要求・ゲート管理部の内部テーブルを示す図である。
【符号の説明】

１Ａ、１Ｂ	端末
１１Ａ、１１Ｂ	無線端末
２、２Ａ、２Ｂ、２１、２１Ａ、２１Ｂ	ゲートウェイ
３	ＷＥＢサーバー群
４	課金サーバー
１２Ａ、１２Ｂ	無線ＬＡＮ基地局
１１１、１３１	アプリケーション部
１１２、１２２、１３４、２１４、２２４、４１２	通信制御部
１１３、２１１、２１２、２２１、２２２、４１１	ＬＡＮ　Ｉ／Ｆ部
１２１	有線ＬＡＮ　Ｉ／Ｆ部
１２３	無線ＬＡＮ　Ｉ／Ｆ部
１３２	基地局検出部
１３３	通信速度検出部
２１３、２２３	ＷＡＮ　Ｉ／Ｆ部
２１５、２２５、４１３	認証要求・ゲート管理部
２２６	ゲートウェイ間帯域調整部

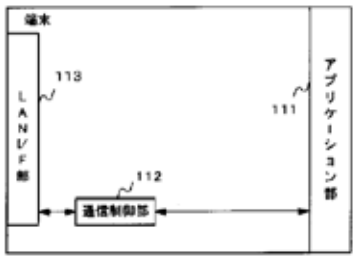
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【図１】



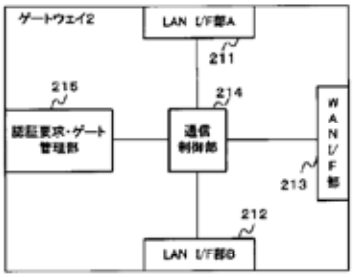
集合契約回線タイプ全体構成

【図２】



端末の内部構成

【図３】



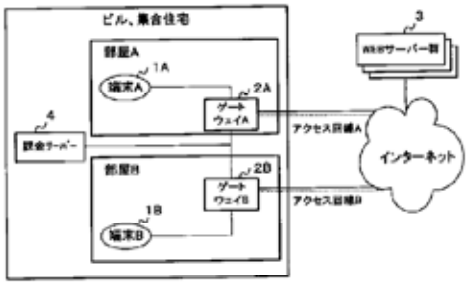
ゲートウェイの内部構成

【図４】

71 MACアドレス	72 部屋番号	73 現在の転送流量	74 全部屋の転送流量に対する比率	75 料金
※	例: 101	例: 161 KByte	例: 1%	例: ¥1500
※	例: 102	例: 680 KByte	例: 1%	例: ¥1500
…	…	…	…	…

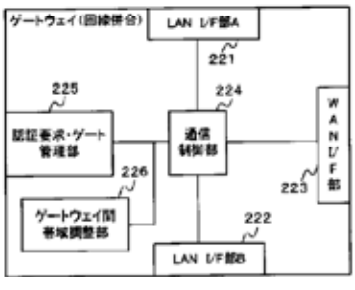
認証要求・ゲート管理部のテーブル（ベストエフォート）

【図５】



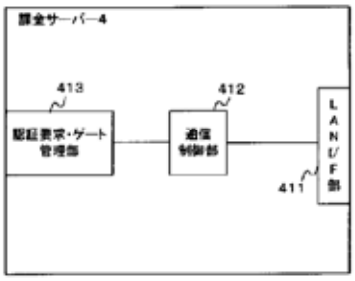
個別契約回線タイプ（回線併合）全体構成

【図６】



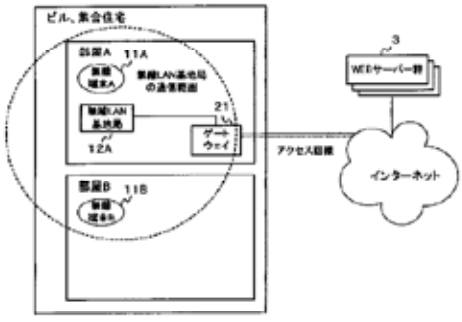
ゲートウェイ（回線併合）の内部構成

【図７】



課金サーバーの内部構成

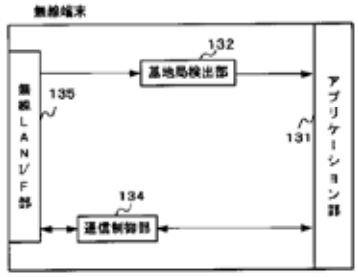
【図８】



個別契約回線タイプ（共有）全体構成例

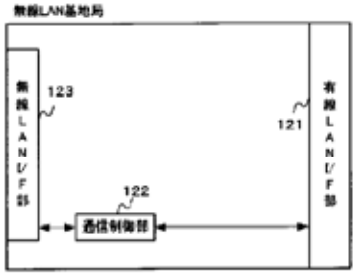
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【図９】



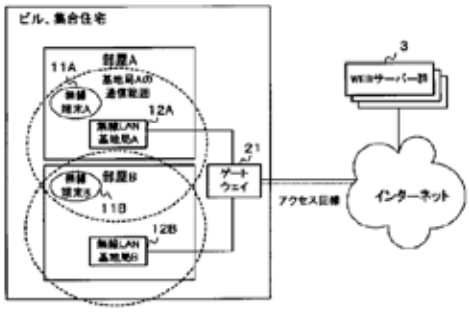
無線端末の内部構成

【図１０】



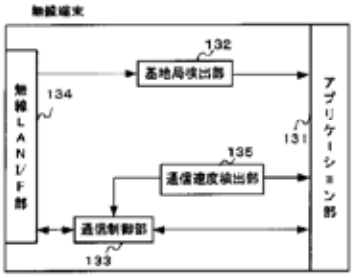
無線LAN基地局の内部構成

【図１１】



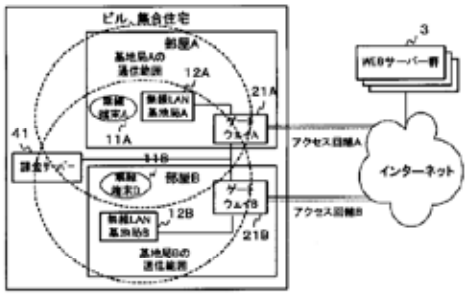
集合契約回線タイプ（無線端末）全体構成

【図１２】



無線端末の内部構成

【図１３】



個別契約回線タイプ（回線住合_無線端末）全体構成

【図１４】

81 MACアドレス	82 部屋番号	83 時間帯	84 時間帯毎の帯域	85 全部屋の総通信量に対する比率	86 料金
例 11.21.32.44.45.66	例：101	例	例：161 KByte	例：1%	例：¥1500
例 22.33.44.55.66.77	例：102	例	例：680 KByte	例：1%	例：¥1500
…	…	…	…	…	…

認証基地・ゲート管理部のテーブル（時間帯別帯域保障）

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フロントページの続き

(51)Int.Cl.[7]	F I	テーマコード（参考）
	H04M 11/00 302	
	H04M 15/00 Z	

Fターム(参考) 5K030 GA03 GA20 HA08 HB08 HC13 HD03 KX30 LC01 MB02 MB09
MC08
5K033 AA01 DA06 DA17 DB18 EC03
5K101 KK20 NN48

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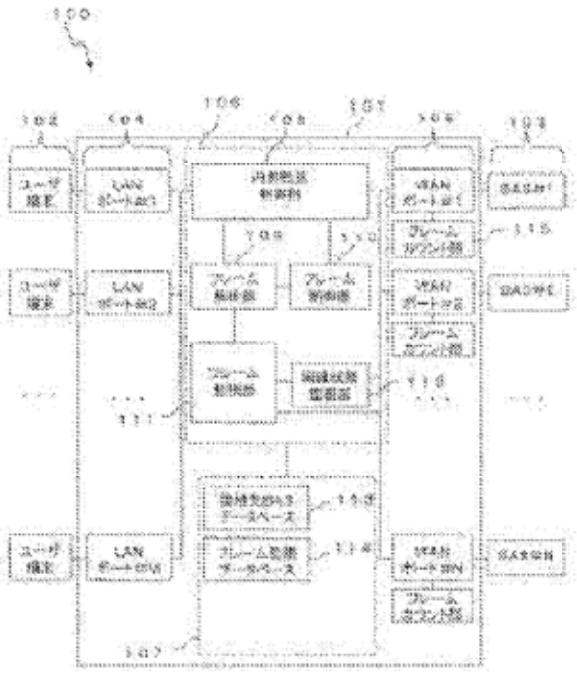
Abstract of JP2010056898 (A)

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図1



PROBLEM TO BE SOLVED: To provide a relay technology of distributing a communication load in consideration of a band. SOLUTION: This relay device used for relaying communication between a terminal device and a plurality of server devices each providing a network connection service to the terminal device includes: a reception part receiving connection request information transmitted from the terminal device; a measurement part measuring traffic to the terminal device for each server device; and a control part specifying the server device whose traffic measured in a predetermined period is smallest as a device to receive the connection request information, to transmit the connection request information to the specified server device. When receiving a new connection request, the relay device relays the connection request to the devices to distribute the load based on a band used by a connected port. ;COPYRIGHT: (C)2010,JPO&INPIT

(19)日本国特許庁(JP)　(12)公開特許公報(A)　(11)特許出願公開番号
特開2010-56898
(P2010-56898A)
(43)公開日　平成22年3月11日(2010.3.11)

(51)Int.Cl.	F I			テーマコード（参考）
H04L 12/56 (2006.01)	H04L	12/56	100Z	5K030
	H04L	12/56	200Z	

審査請求 未請求　請求項の数 10　OL　（全 22 頁）

(21)出願番号　特願2008-219831 (P2008-219831)
(22)出願日　平成20年8月28日 (2008.8.28)

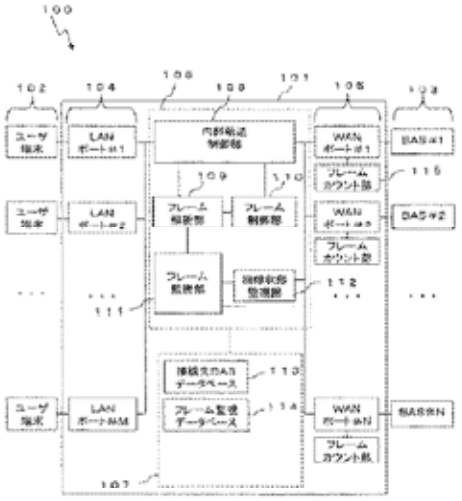
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株式会社日立製作所
東京都千代田区丸の内一丁目６番６号
(74)代理人　110000198
特許業務法人湘洋内外特許事務所
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最終頁に続く

(54)【発明の名称】中継装置、中継方法

(57)【要約】　（修正有）
【課題】帯域を考慮して通信負荷の分散を行う中継技術を提供する。
【解決手段】端末装置と、前記端末装置に対してネットワーク接続サービスを提供する複数のサーバ装置との間の通信を中継する中継装置であって、前記端末装置から送信された接続要求情報を受け付ける受付部と、前記端末装置との間の通信量を前記サーバ装置ごとに計測する計測部と、前記接続要求情報の送信先として、所定の期間に計測された通信量が最も少ない前記サーバ装置を特定して、特定したサーバ装置へ前記接続要求情報を送信する制御部と、を備える。中継装置は、新たに接続要求を受け付けると、既に接続済みのポートの使用帯域に基づいて負荷を分散するように接続先を分散させて中継する。
【選択図】図１

図1



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【特許請求の範囲】
【請求項1】
端末装置と、前記端末装置に対してネットワーク接続サービスを提供する複数のサーバ装置と、の間の通信を中継する中継装置であって、
前記端末装置から送信された接続要求情報を受け付ける受付部と、
前記端末装置との間の通信量を前記サーバ装置ごとに計測する計測部と、
前記接続要求情報の送信先として、所定の期間に計測された通信量が最も少ない前記サーバ装置を特定して、特定したサーバ装置へ前記接続要求情報を送信する制御部と、
を備えることを特徴とする中継装置。
【請求項2】
請求項１に記載の中継装置であって、
前記制御部は、前記通信量が最も少ないサーバ装置が複数存在する場合には、前記通信量が最も少ないサーバ装置のうち、所定の期間において通信を行った端末装置の数が少ないサーバ装置を前記送信先として特定する、
ことを特徴とする中継装置。
【請求項3】
請求項２に記載の中継装置であって、
前記制御部は、所定の期間においてＥｃｈｏフレームを受信した数を、前記通信を行った端末装置の数とする、
ことを特徴とする中継装置。
【請求項4】
請求項１～３のいずれか一項に記載の中継装置であって、
前記通信量は、予め定められた方向へ送信された通信量である、
ことを特徴とする中継装置。
【請求項5】
請求項１に記載の中継装置であって、さらに、
前記端末装置ごとに接続条件を記憶する記憶部を備え、
前記制御部は、前記接続条件を満たす前記サーバ装置から、前記所定の期間に計測された通信量が最も少ないサーバ装置を特定し、前記接続要求情報の送信先とする、
ことを特徴とする中継装置。
【請求項6】
請求項５に記載の中継装置であって、
前記接続条件は、前記端末装置に応じて通信を優先する方向と、所望帯域と、を含み、
前記制御部は、前記所望帯域を満たす前記サーバ装置について、前記通信を優先する方向の前記所定の期間に計測された前記通信量を特定し、特定した前記通信量が最も少ないサーバ装置を前記接続要求情報の送信先とする、
ことを特徴とする中継装置。
【請求項7】
請求項６に記載の中継装置であって、
前記制御部は、前記所望帯域を満たす前記サーバ装置が存在しない場合には、前記複数のサーバ装置について、前記通信を優先する方向の前記所定の期間に計測された前記通信量を特定し、特定した前記通信量が最も少ないサーバ装置を前記接続要求情報の送信先として特定する、
ことを特徴とする中継装置。
【請求項8】
請求項１～７のいずれか一項に記載の中継装置であって、さらに、
前記複数のサーバ装置のうちいずれかに論理障害の発生を検知すると、前記論理障害が発生したサーバ装置を前記制御部に伝える論理障害検出部を備え、
前記制御部は、前記論理障害が発生したサーバ装置を除いて前記接続要求情報の送信先

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を特定する、
　ことを特徴とする中継装置。
【請求項9】
　請求項８に記載の中継装置であって、
　前記論理障害検出部は、前記サーバ装置の生存確認の応答通信が途絶えたことを検知すると、論理障害が発生したと判定する、
　ことを特徴とする中継装置。
【請求項10】
　端末装置と、前記端末装置に対してネットワーク接続サービスを提供する複数のサーバ装置と、の間の通信を中継する中継装置の中継方法であって、
　前記中継装置は、
　前記端末装置から送信された接続要求情報を受け付ける手順と、
　前記端末装置との間の通信量を前記サーバ装置ごとに計測する手順と、
　前記接続要求情報の送信先として、所定の期間に計測された通信量が最も少ない前記サーバ装置を特定して、特定したサーバ装置へ前記接続要求情報を送信する手順と、
　を実施することを特徴とする中継方法。
【発明の詳細な説明】
【技術分野】
【0001】
　本発明は、通信を中継する技術に関する。
【背景技術】
【0002】
　従来、端末装置からＢＡＳサーバ装置への通信を中継する技術として、中継装置が、端末装置から接続要求を受信した順に回線利用可能なフレーム送信部の利用を割り当てることで、フレーム送信部に接続されたＢＡＳサーバ装置の通信負荷を分散させて中継する技術が特許文献１に示されている。
【0003】
【特許文献1】特開２００７－２０８３５２号公報
【発明の開示】
【発明が解決しようとする課題】
【0004】
　上記特許文献１に記載の技術では、接続後はＢＡＳ（Broadband Access Server）と中継装置の物理帯域は複数のユーザ間で共有されるため、ユーザの通信量に応じて負荷の偏りが発生する。そのため、接続後の通信帯域の使用量に応じた適切な負荷の分散には対応できない。
【0005】
　そこで、本発明は、帯域を考慮して通信負荷の分散を行う中継技術の提供を目的とする。
【課題を解決するための手段】
【0006】
　本願に係る中継装置は、上記課題を解決するため、新たに接続要求を受け付けると、既に接続済みのポートの使用帯域に基づいて負荷を分散するように接続先を分散させて中継する。
【0007】
　例えば、端末装置と、前記端末装置に対してネットワーク接続サービスを提供する複数のサーバ装置と、の間の通信を中継する中継装置であって、前記端末装置から送信された接続要求情報を受け付ける受付部と、前記端末装置との間の通信量を前記サーバ装置ごとに計測する計測部と、前記接続要求情報の送信先として、所定の期間に計測された通信量が最も少ない前記サーバ装置を特定して、特定したサーバ装置へ前記接続要求情報を送信する制御部と、を備えることを特徴とする。
【発明の効果】

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【0008】
本発明によれば、通信資源を有効に利用する技術を提供することが可能となる。
【発明を実施するための最良の形態】
【0009】
図１は、本発明の技術を適用した第一の実施形態である中継システム１００を示す図である。
【0010】
中継システム１００は、中継装置１０１と、中継装置１０１と通信可能な複数のユーザ端末１０２と、中継装置１０１と通信可能な複数のＢＡＳ（Broadband Access Server）１０３と、を有する。
【0011】
中継装置１０１は、複数のユーザ端末１０２と通信を行う複数のＬＡＮ（Local Area Network）ポート１０４と、複数のＢＡＳ１０３と通信を行う複数のＷＡＮ（Wide Area Network）ポート１０５と、ＬＡＮポート１０４とＷＡＮポート１０５との間の通信を制御する制御部１０６と、記憶部１０７と、を備える。
【0012】
ユーザ端末１０２は、中継装置１０１に接続されたパーソナルコンピュータ等の情報処理装置である。例えば、ユーザ端末１０２は、一般家庭等においてユーザが使用するパーソナルコンピュータであり、中継装置１０１のＬＡＮポート１０４と、ＡＤＳＬ（Asymmetric Digital Subscriber Line）やＦＴＴＨ（Fiber To The Home）などの通信手段を介してＰＰＰｏＥ（PPP Over Ethernet：Ethernetは登録商標）接続し、中継装置１０１を介してＢＡＳ１０３と接続することで、ＢＡＳ１０３に接続されたＩＳＰ（Internet Service Provider）との接続を確立し、インターネットに接続する。
【0013】
ＢＡＳ１０３は、ＩＳＰへの接続サービスを提供するサーバ装置であり、例えば回線事業者等が準備するサーバ装置である。
【0014】
ＬＡＮポート１０４は、ＡＤＳＬ、ＦＴＴＨ等の通信ケーブルを接続するポートであり、通信ケーブルを介してポートに接続された複数のユーザ端末１０２間の通信を中継してＬＡＮを構成する。
【0015】
ＷＡＮポート１０５は、ＡＤＳＬ、光ファイバー等の通信ケーブルを接続するポートであり、ポートに接続された複数のＢＡＳ１０３間の通信を中継してＷＡＮを構成する。また、ＷＡＮポート１０５は、それぞれ、ＷＡＮポート１０５を通過した送信フレームの数と受信フレームの数とをカウントしそれぞれ記憶するフレームカウント部１１５を備える。
【0016】
制御部１０６は、単数または複数のＬＡＮポート１０４から受信した通信情報を単数または複数のＷＡＮポート１０５へ転送し、単数または複数のＷＡＮポート１０５から受信した通信情報を単数または複数のＬＡＮポート１０４へ転送する。
【0017】
制御部１０６は、内部転送制御部１０８と、フレーム解析部１０９と、フレーム制御部１１０と、フレーム監視部１１１と、を有する。
【0018】
内部転送制御部１０８は、ＬＡＮポート１０４およびＷＡＮポート１０５から受信した通信のフレームをフレーム解析部１０９へ転送し、フレーム制御部１１０からの転送指示に基づいて指示されたＬＡＮポート１０４または指示されたＷＡＮポート１０５にフレームを転送する。
【0019】
フレーム解析部１０９は、受信した通信のフレームを解析してその種類を特定し、特定

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した種類をフレーム制御部１１０へ通知する。
【0020】
また、フレーム解析部１０９は、ＬＣＰ（Linklayer Control Protocol）のＥｃｈｏフレームの受信数をＷＡＮポート１０５ごとに計上し、フレーム監視データベース１１４に記憶させる。
【0021】
フレーム制御部１１０は、フレーム解析部１０９から通知された通信のフレームの種類に応じて、受け付けたフレームを転送する対象となるＬＡＮポート１０４またはＷＡＮポート１０５を特定し、内部転送制御部１０８に転送指示を出す。
【0022】
例えば、フレームがＰＡＤＩ（PPPoE Active Discovery Initiation）等の接続要求フレームであれば、フレーム制御部１１０は、接続先ＢＡＳデータベース１１３を用いて、中継装置１０１に対し予め定められた送信又は受信の通信帯域に余裕があるＷＡＮポート１０５を接続先として特定し、特定したＷＡＮポート１０５へ接続要求フレームを転送するよう内部転送制御部１０８に指示する。
【0023】
フレーム監視部１１１は、複数のＷＡＮポート１０５が備えるフレームカウント部１１５から送信フレーム数と受信フレーム数の情報を取得して、フレーム監視データベース１１４に記憶させる。また、フレーム監視データベース１１４の情報を用いて、接続先のＢＡＳを選択するための情報を算出し、接続先ＢＡＳデータベース１１３に記憶させる。
【0024】
回線状態監視部１１２は、ＷＡＮポート１０５のハードウェア故障を検知すると、故障のあったＷＡＮポートが接続不可であることを接続先ＢＡＳデータベース１１３に記憶させる。また、ＷＡＮポート１０５のハードウェア故障が復旧したことを検知すると、復旧したＷＡＮポートが接続可であることを接続先ＢＡＳデータベース１１３に記憶させる。
【0025】
記憶部１０７は、接続先ＢＡＳデータベース１１３と、回線状態監視部１１２と、フレーム監視データベース１１４と、を有する。
【0026】
接続先ＢＡＳデータベース１１３は、接続先のＢＡＳを特定するための情報を記憶するデータベースである。
【0027】
図２に、接続先データベース１１３の構成例を示す。
【0028】
接続先データベース１１３は、ＷＡＮポート番号欄２０１と、送信変動欄２０２と、受信変動欄２０３と、回線状態欄２０４と、を有する。
【0029】
ＷＡＮポート番号欄２０１には、ＷＡＮポート１０５を識別するための情報である識別番号が記憶される。例えば、中継装置１０１がＷＡＮポート１０５を８個備える場合には、ＷＡＮポート番号欄２０１には、８個のＷＡＮポート１０５に対応する「１」、「２」、・・・、「８」の値が記憶される。
【0030】
送信変動欄２０２には、ＷＡＮポート１０５ごとに、所定期間のアップロード送信量、すなわちユーザ端末１０２からＢＡＳ１０３に対して送信されたフレームの数が記憶される。例えばＷＡＮポート１０５の「１」について、送信変動欄２０２の情報が「１００」であれば、「１」で識別されるＷＡＮポート１０５は、計測した期間の送信フレーム数が「１００」であることを示す。
【0031】
受信変動欄２０３には、ＷＡＮポート１０５ごとに、所定期間のダウンロード送信量、すなわちＢＡＳ１０３からユーザ端末１０２に対して送信されたフレームの数が記憶され

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る。
【0032】
例えばＷＡＮポート１０５の「１」について、受信変動欄２０３の情報が「５００」であれば、「１」で識別されるＷＡＮポート１０５は、計測した期間の受信フレーム数が「５００」であることを示す。
【0033】
回線状態欄２０４には、ＷＡＮポート番号欄２０１の情報により識別されるＷＡＮポート１０５が接続可能であるか否かを示す情報が記憶される。例えば、接続可能であれば「接続可」、接続不可能であれば「接続不可」という情報が記憶される。
【0034】
以上が、接続先データベース１１３の構成例である。
【0035】
フレーム監視データベース１１４は、複数のＷＡＮポート１０５の稼働情報を記憶するデータベースである。
【0036】
図３に、フレーム監視データベース１１４の構成例を示す。
【0037】
フレーム監視データベース１１４は、ＷＡＮポート番号欄３０１と、送信フレーム数欄３０２と、旧送信フレーム数欄３０３と、受信フレーム数欄３０４と、旧受信フレーム数欄３０５と、ＬＣＰＥｃｈｏフレーム数欄３０６と、論理障害検出時刻欄３０７と、を有する。
【0038】
ＷＡＮポート番号欄３０１には、ＷＡＮポート１０５を識別するための情報である識別番号が記憶される。例えば、中継装置１０１がＷＡＮポート１０５を８個備える場合には、ＷＡＮポート番号欄３０１には、８個のＷＡＮポート１０５に対応する「１」、「２」、・・・、「８」の値が記憶される。
【0039】
送信フレーム数欄３０２には、ＷＡＮポート１０５ごとに、累積アップロード送信量、すなわちユーザ端末１０２からＢＡＳ１０３に対して送信されたフレームの累積数が記憶される。例えばＷＡＮポート１０５の「１」について、送信フレーム数欄３０２の情報が「２００」であれば、累積した送信フレーム数が「２００」であることを示す。
【0040】
旧送信フレーム数欄３０３には、ＷＡＮポート１０５ごとに、前回の記録時点での累積アップロード送信量、すなわちユーザ端末１０２からＢＡＳ１０３に対して送信されたフレームの累積数が記憶される。例えばＷＡＮポート１０５の「１」について、旧送信フレーム数欄３０３の情報が「１００」であれば、前回記録した累積の送信フレーム数は「１００」であったことを示す。
【0041】
受信フレーム数欄３０４には、ＷＡＮポート１０５ごとに、累積ダウンロード送信量、すなわちＢＡＳ１０３からユーザ端末１０２に対して送信されたフレームの累積数が記憶される。例えばＷＡＮポート１０５の「１」について、受信フレーム数欄３０４の情報が「５５００」であれば、累積した受信フレーム数が「５５００」であることを示す。
【0042】
旧受信フレーム数欄３０５には、ＷＡＮポート１０５ごとに、前回の記録時点での累積ダウンロード送信量、すなわちＢＡＳ１０３からユーザ端末１０２に対して送信されたフレームの累積数が記憶される。例えばＷＡＮポート１０５の「１」について、旧受信フレーム数欄３０５の情報が「５０００」であれば、前回記録した累積の受信フレーム数は「５０００」であったことを示す。
【0043】
ＬＣＰＥｃｈｏフレーム数欄３０６には、ＬＣＰのＥｃｈｏ　Ｒｅｑｕｅｓｔフレーム

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と、Ｒｅｐｌｙフレームと、をフレーム解析部１０９が受信した数が記憶される。例えば、ＷＡＮポート番号「１」で識別されるＷＡＮポート１０５のＬＣＰＥｃｈｏフレーム数欄３０６に記憶された値が「２０」であれば、「１」に該当するＷＡＮポート１０５はＬＣＰＥｃｈｏ　Ｒｅｑｕｅｓｔフレームと Ｒｅｐｌｙフレームを合計２０個受信したことを示す。

【0044】

一般に、ＬＣＰのＥｃｈｏフレームは、サービスの生死監視に用いられるフレームである。対象装置に送信したＬＣＰのＥｃｈｏ　Ｒｅｑｕｅｓｔフレームに対して、対象装置からＬＣＰのＥｃｈｏ　Ｒｅｐｌｙフレームによる応答が送信されれば、対象装置は稼働状態であると判断できる。

【0045】

つまり、本実施例においては、ＬＣＰのＥｃｈｏ　Ｒｅｐｌｙフレームは、ユーザ端末１０２からＷＡＮポート番号欄３０１の情報により識別されるＷＡＮポート１０５に接続されたＢＡＳ１０３に向けて送信されたＬＣＰのＥｃｈｏ　Ｒｅｑｕｅｓｔフレームに対する応答である。

【0046】

論理障害検出時刻欄３０７には、ＷＡＮポート１０５に発生した論理障害、例えばＢＡＳ１０３からの応答が無いなどの障害をフレーム監視部１１１が検出した時刻が記憶される。

【0047】

以上が、フレーム監視データベース１１４の構成例である。

【0048】

次に、本実施形態における接続要求受付処理のフローについて、図４を用いて説明する。

【0049】

図４は、ユーザ端末１０２からＢＡＳ１０３への接続要求の受付処理の流れを示すフロー図である。

【0050】

まず、フレーム解析部１０９は、受信したフレームがブロードキャストフレームであるか否かを判定する（ステップＳ１０１）。

【0051】

具体的には、ユーザ端末１０２から送信されたフレームがＬＡＮポート１０４を介して内部転送制御部１０８へ到達すると、内部転送制御部１０８は、受信したフレームをフレーム解析部１０９に受け渡す。そして、フレーム解析部１０９は、受け渡されたフレームがブロードキャストフレームであるか否かを判定する。

【0052】

ブロードキャストフレームである場合（ステップＳ１０１にて「Ｙｅｓ」）、フレーム解析部１０９は、受け渡されたフレームがＰＡＤＩフレームであるか否かを判定する（ステップＳ１０２）。

【0053】

具体的には、フレーム解析部１０９は、受け渡されたフレームのイーサネットヘッダ（イーサネットは登録商標）のタイプフィールド値を読み出し、その値がＰＡＤＩを示す値（０ｘ８８６３）と一致するか否かを判定する。

【0054】

受け渡されたフレームがＰＡＤＩフレームであれば（ステップＳ１０２にて「Ｙｅｓ」）、フレーム解析部１０９は、受け渡されたＰＡＤＩフレームとＷＡＮポート選択指示とをフレーム制御部１１０に送信する（ステップＳ１０３）。

【0055】

次に、フレーム制御部１１０は、ＷＡＮポート選択指示に従って、後述するＷＡＮポートの選択処理を実施する（ステップＳ１０４）。

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【0056】
次に、フレーム制御部１１０は、ステップＳ１０４にて選択したＷＡＮポートに対して受け取ったＰＡＤＩフレームを転送するよう内部転送制御部１０８へ指示する（ステップＳ１０５）。
【0057】
次に、内部転送制御部１０８は、ＰＡＤＩフレームを指示されたＷＡＮポートへ転送する（ステップＳ１０６）。
【0058】
ステップＳ１０２において、受け渡されたフレームがＰＡＤＩフレームでない場合（ステップＳ１０２にて「Ｎｏ」）、フレーム解析部１０９は、受け渡されたＰＡＤＩフレームをフレーム制御部１１０に送信する（ステップＳ１０７）。
【0059】
次に、フレーム制御部１１０は、全てのＷＡＮポート１０５に対して受け取ったＰＡＤＩフレームを転送するよう内部転送制御部１０８へ指示する（ステップＳ１０８）。
【0060】
次に、内部転送制御部１０８は、ＰＡＤＩフレームを全てのＷＡＮポート１０５へ転送（ブロードキャスト）する（ステップＳ１０９）。
【0061】
また、フレーム解析部１０９が受け渡されたフレームがブロードキャストフレームではない場合（ステップＳ１０１にて「Ｎｏ」）、フレーム解析部１０９は、受け渡されたフレームがＷＡＮポート１０５にて受信したか否かを判定する（ステップＳ１１０）。
【0062】
具体的には、フレーム解析部１０９は、受け渡されたフレームに含まれる「受信回線」の情報がＷＡＮポート１０５のいずれかと一致するか否かを判定する。
【0063】
受け渡されたフレームがＷＡＮポート１０５にて受信したものでなければ（ステップＳ１１０にて「Ｎｏ」）、フレーム解析部１０９は、後述するステップＳ１１３以降の処理を実施する。
【0064】
受け渡されたフレームが、ＷＡＮポート１０５にて受信したものであれば（ステップＳ１１０にて「Ｙｅｓ」）、フレーム解析部１０９は、受け渡されたフレームがＬＣＰのＥｃｈｏフレームのＲｅｑｕｅｓｔまたはＲｅｐｌｙフレームのいずれかであるか否かを判定する（ステップＳ１１１）。
【0065】
具体的には、フレーム解析部１０９は、受け渡されたフレームのＬＣＰヘッダーに含まれるコードフィールドの値を取得し、ＬＣＰ　Ｅｃｈｏ　Ｒｅｑｕｅｓｔ（０ｘ０９）またはＬＣＰ　Ｅｃｈｏ　Ｒｅｐｌｙ（０ｘ０ａ）であるか否かを判定する。
【0066】
受け渡されたフレームがＬＣＰのＥｃｈｏフレームのＲｅｑｕｅｓｔまたはＲｅｐｌｙフレームのいずれかである場合には（ステップＳ１１１にて「Ｙｅｓ」）、フレーム解析部１０９は、フレーム監視データベース１１４のＬＣＰＥｃｈｏフレーム数欄３０６の値をインクリメントして更新する（ステップＳ１１２）。
【0067】
受け渡されたフレームがＬＣＰのＥｃｈｏフレームのＲｅｑｕｅｓｔまたはＲｅｐｌｙフレームのいずれでもない場合には（ステップＳ１１１にて「Ｎｏ」）、フレーム解析部１０９は、後述するステップＳ１１３以降の処理を実施する。
【0068】
次に、フレーム解析部１０９は、受け渡されたフレームをフレーム制御部１０９に送信する（ステップＳ１１３）。
【0069】

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次に、フレーム制御部１０９は、受け取ったフレームをＷＡＮポート１０５に転送するよう内部転送制御部１０８へ指示する（ステップＳ１１４）。

【0070】

次に、内部転送制御部１０８は、フレームをあて先に指定されたＭＡＣアドレスを有するＢＡＳ１０３に接続されたＷＡＮポート１０５へ転送する（ステップＳ１１５）。

【0071】

以上が、接続要求受付処理の処理フローである。

【0072】

接続要求受付処理により、受け付けたフレームの種類に応じて処理内容を特定することが可能となる。

【0073】

次に、図４の接続要求受付処理のステップＳ１０４にて実施するＷＡＮポート選択処理の処理フローを図５に示す。

【0074】

まず、フレーム制御部１０９は、接続先ＢＡＳデータベース１１３から回線接続が可能な回線を抽出してリスト化する（ステップＳ２０１）。

【0075】

具体的には、フレーム制御部１０９は、接続先ＢＡＳデータベース１１３の回線状態欄２０４の値を参照し、「接続可」であるレコードを抽出してリスト化する。

【0076】

次に、フレーム制御部１０９は、ステップＳ２０１で抽出したリストが空であるか否かを判定する（ステップＳ２０２）。

【0077】

空である場合（ステップＳ２０２にて「Ｎｏ」）、フレーム制御部１０９は処理を終了する。すなわち、転送するＷＡＮポートを指定しない。

【0078】

空ではない場合（ステップＳ２０２にて「Ｙｅｓ」）、フレーム制御部１０９は、予め中継装置１０１に設定された接続ポリシーが受信優先であるか否かを判定する（ステップＳ２０３）。

【0079】

接続ポリシーが受信優先である場合（ステップＳ２０３にて「Ｙｅｓ」）、フレーム制御部１０９は、ステップＳ２０１にて作成したリストから受信変動欄２０３の値が小さいＷＡＮポートを転送先として選択する（ステップＳ２０４）。

【0080】

接続ポリシーが送信優先である場合（ステップＳ２０３にて「Ｎｏ」）、フレーム制御部１０９は、ステップＳ２０１にて作成したリストから送信変動欄２０２の値が小さいＷＡＮポートを転送先として選択する（ステップＳ２０５）。

【0081】

以上が、ＷＡＮポート選択処理の処理フローである。

【0082】

このように、ＷＡＮポート選択処理により、送信変動量または受信変動量の少ないＷＡＮポート、すなわち帯域の使用量が少ないＷＡＮポートを転送先に設定することが可能となる。また、接続することのできる回線がない場合には、フレームをＷＡＮポートに転送しないため、ユーザ端末１０２からは無応答であると認識することができ、エラーの発生をユーザに伝えることができる。

【0083】

次に、フレーム監視処理について、図６を用いて説明する。

【0084】

フレーム監視処理は、中継装置１０１の起動を契機として処理を開始し、中継装置１０１が稼働を停止するまで継続する。

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【0085】
フレーム監視処理は、中継装置１０１が中継するフレームを監視し、送受信量の多少をＷＡＮポート１０５ごとに算出して負荷分散の元となる帯域の情報を作成し、ＷＡＮポート１０５に接続された他の機器、例えばＢＡＳ１０３等に論理障害が発生した場合には障害が発生した旨を記録する処理である。
【0086】
まず、フレーム監視部１１１は、図示しないフレーム監視タイマを起動し、フレーム監視タイマが満了するまで処理を待機する（ステップＳ３０１）。
【0087】
具体的には、フレーム監視タイマは、時間を計時し、所定の時間（例えば１０秒間）で満了するタイマである。
【0088】
次に、フレーム監視タイマが満了すると、フレーム監視部１１１は、ＷＡＮポート１０５ごとにフレーム監視データベース１１４の送信フレーム数欄３０２に記憶された情報を旧送信フレーム数欄３０３に複製する（ステップＳ３０２）。
【0089】
そして、フレーム監視部１１１は、ＷＡＮポート１０５ごとに、ＷＡＮポート１０５のフレームカウンタ１１４から送信フレーム数の累計を取得し、送信フレーム数欄３０２の情報を更新する（ステップＳ３０３）。
【0090】
次に、フレーム監視部１１１は、ＷＡＮポート１０５ごとにフレーム監視データベース１１４の受信フレーム数欄３０４に記憶された情報を旧受信フレーム数欄３０５に複製する（ステップＳ３０４）。
【0091】
そして、フレーム監視部１１１は、ＷＡＮポート１０５ごとに、ＷＡＮポート１０５のフレームカウンタ１１４から受信フレーム数の累計を取得し、受信フレーム数欄３０４の情報を更新する（ステップＳ３０５）。
【0092】
次に、フレーム監視部１１１は、ＷＡＮポート１０５ごとに、フレーム監視データベース１１４に基づいて送信変動と受信変動の値を算出する（ステップＳ３０６）。
【0093】
具体的には、フレーム監視部１１１は、ＷＡＮポート１０５ごとに、フレーム監視データベース１１４を参照し、送信フレーム数欄３０２に記憶された値から旧送信フレーム数欄３０３に記憶された値を減算して送信変動の値とする。そして、フレーム監視部１１１は、受信フレーム数欄３０４に記憶された値から旧受信フレーム数欄３０５に記憶された値を減算して受信変動の値とする。
【0094】
次に、フレーム監視部１１１は、ステップＳ３０６にて算出した受信変動の値が０であるか、またはフレーム監視データベース１１４のＬＣＰＥｃｈｏフレーム数欄３０６に記憶された値が０であるか、のいずれかに一致するか否かを判定する（ステップＳ３０７）。
【0095】
いずれにも一致しない場合には（ステップＳ３０７にて「Ｎｏ」）、フレーム監視部１１１は、接続先ＢＡＳデータベース１１３の送信変動欄２０２の値と受信変動欄２０３の値とをそれぞれステップＳ３０６で算出した送信変動と受信変動の値により更新する（ステップＳ３０８）。
【0096】
そして、フレーム監視部１１１は、フレーム監視データベース１１４のＬＣＰＥｃｈｏフレーム数欄３０６の値を「０」に更新し、ステップＳ３０１に処理を戻す。
【0097】

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受信変動の値が０であるか、またはフレーム監視データベース１１４のＬＣＰＥｃｈｏフレーム数欄３０６に記憶された値が０であるか、のいずれかに一致する場合（ステップＳ３０７にて「Ｙｅｓ」）、フレーム監視部１１１は、接続先ＢＡＳデータベース１１３の回線状態欄２０４の値を「接続不可」に更新する（ステップＳ３１０）。

【0098】

次に、フレーム監視部１１１は、フレーム監視データベース１１４の論理障害検出時刻欄３０７にステップＳ３１０の処理時点の時刻を設定する（ステップＳ３１１）。

【0099】

次に、フレーム監視部１１１は、図示しない回線デッドタイマを起動し、満了まで待機する（ステップＳ３１２）。

【0100】

具体的には、回線デッドタイマは、時間を計時し、所定の時間（例えば１分間）で満了するタイマである。

【0101】

次に、回線デッドタイマが満了すると、フレーム監視部１１１は、接続先ＢＡＳデータベース１１３の回線状態欄２０４の値を「接続可」に更新する（ステップＳ３１３）。

【0102】

次に、フレーム監視部１１１は、フレーム監視データベース１１４の論理障害検出時刻欄３０７に初期値（例えば「０」）を設定し、ステップＳ３０１に処理を戻す（ステップＳ３１４）。

【0103】

以上が、フレーム監視処理の処理フローである。

【0104】

このように、フレーム監視処理により、送信変動量または受信変動量の少ないＷＡＮポート、すなわち帯域の使用量が少ないＷＡＮポートを算出するための基礎となる情報をデータベース等に記録することが可能となる。また、論理障害が発生した場合にはそれを検知し、ＷＡＮポートの使用を不可とすることができる。

【0105】

次に、回線監視処理について、図７を用いて説明する。

【0106】

回線監視処理は、中継装置１０１の起動を契機として処理を開始し、中継装置１０１が稼働を停止するまで継続する。

【0107】

回線監視処理は、中継装置１０１のＷＡＮポート１０５についての物理障害（主にハードウェアエラー）を監視し、ＷＡＮポート１０５の利用可否をＷＡＮポート１０５ごとに検知する処理である。

【0108】

まず、回線状態監視部１１２は、ＷＡＮポート１０５のいずれかから割り込み情報を受信するまで監視を続け、割り込み情報を受信する（ステップＳ４０１）。

【0109】

なお、割り込み情報は、少なくともＷＡＮポートを識別する値と、割り込み契機を示す値と、を有する。

【0110】

次に、回線状態監視部１１２は、ステップＳ４０１で受信した割り込み情報がリンクダウンに基づくものか否かを判定する（ステップＳ４０２）。

【0111】

具体的には、ステップＳ４０１にて受信した割り込み情報に含まれる割り込み契機の情報を読み取り、リンクダウンを示す情報か否かを判定する。

【0112】

割り込み情報がリンクダウンに基づくものであれば（ステップＳ４０２にて「Ｙｅｓ」

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）、回線状態監視部１１２は、接続先ＢＡＳデータベース１１３の回線状態を接続不可に更新する（ステップＳ４０３）。

【0113】

具体的には、回線状態監視部１１２は、接続先ＢＡＳデータベース１１３のＷＡＮポート番号欄２０１に記憶された値がステップＳ４０１にて受信した割り込み情報に含まれるＷＡＮポート１０５を識別する値と一致するレコードについて、回線状態欄２０４に「接続不可」の値を設定する。

【0114】

次に、回線状態監視部１１２は、フレーム制御部１０９にリンクダウンを通知し、処理をステップＳ４０１に戻す（ステップＳ４０４）。

【0115】

割り込み情報がリンクダウンに基づくものでなければ（ステップＳ４０２にて「Ｎｏ」）、回線状態監視部１１２は、ステップＳ４０１で受信した割り込み情報がリンクアップに基づくものか否かを判定する（ステップＳ４０５）。

【0116】

具体的には、ステップＳ４０１にて受信した割り込み情報に含まれる割り込み契機の情報を読み取り、リンクアップを示す情報か否かを判定する。

【0117】

割り込み情報がリンクアップに基づくものでなければ（ステップＳ４０５にて「Ｎｏ」）、回線状態監視部１１２は、ステップＳ４０１に処理を戻す。

【0118】

割り込み情報がリンクアップに基づくものであれば（ステップＳ４０５にて「Ｙｅｓ」）、回線状態監視部１１２は、接続先ＢＡＳデータベース１１３の回線状態を接続可に更新する（ステップＳ４０６）。

【0119】

具体的には、回線状態監視部１１２は、接続先ＢＡＳデータベース１１３のＷＡＮポート番号欄２０１に記憶された値がステップＳ４０１にて受信した割り込み情報に含まれるＷＡＮポート１０５を識別する値と一致するレコードについて、回線状態欄２０４に「接続可」の値を設定する。

【0120】

次に、回線状態監視部１１２は、フレーム制御部１０９にリンクアップを通知し、処理をステップＳ４０１に戻す（ステップＳ４０７）。

【0121】

以上が、回線監視処理の処理フローである。

【0122】

このように、回線監視処理により、ＷＡＮポート１０５についての物理障害（主にハードウェアエラー）を監視し、ＷＡＮポート１０５の利用可否をＷＡＮポート１０５ごとにデータベース等に記録することが可能となる。そのため、物理障害が発生した場合にはそれを検知し、ＷＡＮポートの使用を不可とすることができる。

【0123】

以上が、本発明の第一の実施形態である。

【0124】

第一の実施形態により、中継装置１０１は、常時監視している論理障害と物理障害の情報、および使用帯域量に基づいて、ユーザ端末１０２からのＢＡＳ１０３への接続要求の負荷分散を行うことが可能となる。

【0125】

そのため、中継装置１０１を用いる接続事業者は、ネットワーク資源を有効に利用することが可能となる。また、論理障害について迅速に検知することが可能であるため、ユーザに与える障害の影響を抑えることが可能となる。

【0126】

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なお、例えば、第一の実施形態の中継装置１０１は、接続事業者によりＰＰＰｏＥ方式を用いたＡＤＳＬやＦＴＴＨによるブロードバンドインターネット接続サービスを提供する際に用いることができる。

【0127】

本実施形態におけるＢＡＳ１０３は、ＰＰＰ（Point to Point Protocol）、ＬＣＰ、ＩＰＣＰ（Internet Protocol Control Protocol）を終端してユーザに対してインターネット接続を提供する場合であっても、Ｌ２ＴＰ（Layer2 Tunneling Protocol）のＬＡＣ（L2TP Access Concentrator）として動作してユーザに対してインターネット接続を提供する場合であっても適用することが可能である。

【0128】

いずれの場合であっても、ユーザ端末１０２はＰＰＰｏＥにおける接続要求フレームであるＰＡＤＩフレームをブロードキャスト送信し、応答するＢＡＳ１０３がＰＡＤＯ（PPPoE Active Discovery Offer）フレームをユーザ端末１０２宛にユニキャストで送信し、接続後はユーザ端末１０２がＬＣＰによるＥｃｈｏフレームを送信して生存確認を行うためである。

【0129】

以上、本発明について、実施の形態に基づき具体的に説明したが、これに限定されるものではなく、その要旨を逸脱しない範囲で種々の変更が可能である。

【0130】

以下に、本発明の第一の変形例について、図８～図１０を用いて説明する。

【0131】

本発明の第一の変形例は、上記した第一の実施形態とほぼ同じ構成を備えるが、図８、図９、図１０に示すように一部構成が相違する。

【0132】

以下、その相違について説明する。

【0133】

図８は、第一の変形例における接続先ＢＡＳデータベース１１３の構成例を示す図である。

【0134】

第一の変形例における接続先ＢＡＳデータベース１１３は、第一の実施形態における接続先ＢＡＳデータベース１１３の各欄に加え、ＬＣＰＥｃｈｏ数欄２０５を備える。

【0135】

ＬＣＰＥｃｈｏ数欄２０５には、ＬＣＰのＥｃｈｏ　ＲｅｑｕｅｓｔフレームとＲｅｐｌｙフレームと、をフレーム解析部１０９が受信した数が記憶される。例えば、ＷＡＮポート番号「１」にて識別されるＷＡＮポート１０５のＬＣＰＥｃｈｏフレーム数欄３０６に記憶された値が「２０」であれば、「１」に該当するＷＡＮポート１０５はＬＣＰＥｃｈｏ　ＲｅｑｕｅｓｔフレームとＲｅｐｌｙフレームを合計２０個受信したことを示す。

【0136】

以上が、接続先ＢＡＳデータベース１１３に関する相違点である。

【0137】

図９は、第一の変形例における接続要求受付処理の処理フローを示す図である。

【0138】

第一の変形例における接続要求受付処理は、第一の実施形態における接続要求受付処理のステップＳ１１２に該当する処理を、以下に示すステップＳ５１２に変更したものである。

【0139】

受け渡されたフレームがＬＣＰのＥｃｈｏフレームのＲｅｑｕｅｓｔまたはＲｅｐｌｙフレームのいずれかである場合には（ステップＳ１１１にて「Ｙｅｓ」）、フレーム解析部１０９は、フレーム監視データベース１１４のＬＣＰＥｃｈｏフレーム数欄３０６の値

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をインクリメントして更新するとともに、接続先ＢＡＳデータベース１１３のＬＣＰＥｃｈｏ数欄２０５に複製する（ステップＳ５１２）。

【0140】

以上が、接続要求受付処理に関する相違点である。

【0141】

第一の変形例における接続要求受付処理のステップＳ５１２により、ＬＣＰＥｃｈｏフレームをフレーム解析部１０９が受信すると、接続先ＢＡＳデータベース１１３のＬＣＰＥｃｈｏ数欄２０５の値を最新の値に更新することが可能となる。

【0142】

図１０は、第一の変形例における接続要求受付処理のステップＳ１０４にて実施されるＷＡＮポート選択処理の処理フローを示す図である。

【0143】

第一の変形例におけるＷＡＮポート選択処理は、第一の実施形態におけるＷＡＮポート選択処理に、以下のステップＳ２０６とステップＳ２０７と、を加えたものである。

【0144】

フレーム制御部１０９は、ステップＳ２０４またはステップＳ２０５において選択されたＷＡＮポートが一つであるか否かを判定する（ステップＳ２０６）。

【0145】

選択されたＷＡＮポートが一つであれば（ステップＳ２０６にて「Ｙｅｓ」）、フレーム制御部１０９はＷＡＮポート選択処理を終了する。

【0146】

選択されたＷＡＮポートが一つでなければ（ステップＳ２０６にて「Ｎｏ」）、フレーム制御部１０９は、選択されたＷＡＮポートのうち、ＬＣＰＥｃｈｏフレーム数の小さいＷＡＮポート１０５を選択する（ステップＳ２０７）。

【0147】

具体的には、フレーム制御部１０９は、選択されたＷＡＮポート１０５に該当するレコードを接続先ＢＡＳデータベース１１３から特定し、特定したレコードのＬＣＰＥｃｈｏ数欄２０５に記憶された値を比較する。そして、フレーム制御部１０９は、ＬＣＰＥｃｈｏ数が最も小さいＷＡＮポート１０５を一つ選択する。

【0148】

以上が、ＷＡＮポート選択処理に関する相違点である。

【0149】

このようにすることで、ＷＡＮポート選択処理において変動量が同一のＷＡＮポートがある場合に、ＬＣＰＥｃｈｏフレームの受信量が少ないことをＷＡＮポートの第二の選択基準とすることが可能となる。

【0150】

以上が、第一の変形例である。

【0151】

第一の変形例によれば、中継装置１０１は、より適切な負荷分散を行うことが可能となる。ＬＣＰＥｃｈｏフレームの受信数が少ないＷＡＮポートは、すなわちＢＡＳ１０３に接続しているユーザ端末１０２の数が少ないことを意味し、そのため、ＢＡＳ１０３の処理負荷が他のＢＡＳ１０３よりも低い可能性が高いと予想されるためである。

【0152】

以下に、本発明の第二の変形例について、図１１～図１３を用いて説明する。

【0153】

本発明の第二の変形例は、上記した第一の実施形態とほぼ同じ構成を備えるが、図１１、図１２、図１３に示すように一部構成が相違する。

【0154】

以下、その相違について説明する。

【0155】

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図１１は、本発明の技術を適用した第二の変形例である中継システム１００を示す図である。

【0156】

第二の変形例における中継装置１０１の制御部１０６は、第一の実施形態における制御部１０６の各機能部に加え、ＬＡＮポートポリシーデータベース１１６を備える。

【0157】

ＬＡＮポートポリシーデータベース１１６は、ＬＡＮポート１０４ごとに接続するＢＡＳ１０３を選択する条件が記憶されるデータベースである。

【0158】

ＬＡＮポートポリシーデータベース１１６は、図１２に示すとおり、ＬＡＮポート番号欄４０１と、優先帯域欄４０２と、受信利用帯域欄４０３と、送信利用帯域欄４０４と、を有する。

【0159】

ＬＡＮポート番号欄４０１には、ＬＡＮポート１０４それぞれに対応する番号が記憶される。例えば、中継装置１０１がＬＡＮポート１０４を１６個備える場合には、ＬＡＮポート番号欄４０１には、１６個のＬＡＮポート１０４に対応する「１」、「２」、・・・、「１６」の値が記憶される。

【0160】

優先帯域欄４０２には、ＬＡＮポート１０４ごとに、優先する帯域が記憶される。

【0161】

例えばＬＡＮポート１０４の「１」について、優先帯域欄４０２に記憶された情報が「受信」であれば、ＬＡＮポート１０４の「１」は受信帯域の確保を優先することを示す。また、ＬＡＮポート１０４の「３」について、優先帯域欄４０２の情報が「送信」であれば、ＬＡＮポート１０４の「３」は送信帯域の確保を優先することを示す。

【0162】

受信利用帯域欄４０３には、ＬＡＮポート１０４ごとに、受信側、すなわちＢＡＳ１０３からユーザ端末１０２に対して送信される情報の通信に利用する帯域の目標値が記憶される。

【0163】

例えばＬＡＮポート１０４の「１」について、受信利用帯域欄４０３に記憶された情報が「１Ｍ（メガ）ｂｐｓ（ビット毎秒）」であれば、ＬＡＮポート１０４の「１」は受信帯域として「１Ｍｂｐｓ」以上の帯域を希望するユーザにより接続されることを示す。

【0164】

送信利用帯域欄４０４には、ＬＡＮポート１０４ごとに、送信側、すなわちユーザ端末１０２からＢＡＳ１０３に対して送信される情報の通信に利用する帯域の目標値が記憶される。

【0165】

例えばＬＡＮポート１０４の「１」について、送信利用帯域欄４０４に記憶された情報が「０．５Ｍ（メガ）ｂｐｓ（ビット毎秒）」であれば、ＬＡＮポートの「１」は送信帯域として「０．５Ｍｂｐｓ」以上の帯域を希望するユーザにより接続されることを示す。

【0166】

なお、これらの優先帯域欄４０２、受信利用帯域欄４０３と、送信利用帯域欄４０４と、に記憶される情報は、例えば中継装置１０１の管理者である回線事業者と、ユーザとの接続契約等に基づいて設定される。

【0167】

以上が、ＬＡＮポートポリシーデータベース１１６の構成例である。

【0168】

図１３は、第二の変形例におけるＷＡＮポート選択処理の処理フローを示す図である。

【0169】

まず、フレーム制御部１０９は、受け渡されたフレームを受信したＬＡＮポート１０４

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の優先帯域が「受信」であるか否かを判定する（ステップＳ６０１）。

【0170】

具体的には、フレーム制御部１０９は、受け渡されたフレームを受信したＬＡＮポート１０４に対応するＬＡＮポートポリシーデータベース１１６の優先帯域欄４０２に記憶された値が「受信」であるか否かを判定する。

【0171】

優先帯域が「受信」であれば（ステップＳ６０１にて「Ｙｅｓ」）、フレーム制御部１０９は、接続先ＢＡＳデータベース１１３に基づき、ＷＡＮポート１０５を受信変動の小さなものから順に整列させる（ステップＳ６０２）。

【0172】

具体的には、フレーム制御部１０９は、接続先データベース１１３のレコードについて、受信変動欄２０３の値を昇順にソートし、その順にＷＡＮポート番号欄２０１の値を取得する。

【0173】

優先帯域が「受信」でなければ（ステップＳ６０１にて「Ｎｏ」）、フレーム制御部１０９は、接続先ＢＡＳデータベース１１３に基づき、ＷＡＮポート１０５を送信変動の小さなものから順に整列させる（ステップＳ６０３）。

【0174】

具体的には、フレーム制御部１０９は、接続先データベース１１３のレコードについて、送信変動欄２０２の値を昇順にソートし、その順にＷＡＮポート番号欄２０１の値を取得する。

【0175】

次に、フレーム制御部１０９は、優先帯域（送信または受信）について、利用帯域以上の帯域で使用可能なＷＡＮポート１０５が存在するか否かを判定する（ステップＳ６０４）。

【0176】

具体的には、フレーム制御部１０９は、ＬＡＮポートポリシーデータベース１１６の優先帯域欄４０２に記憶された値が「受信」であれば、ＬＡＮポリシーデータベース１１６の受信利用帯域欄４０３に記憶された値以上の帯域で使用可能なＷＡＮポート１０５がステップＳ６０２にて整列させたレコードに存在するか否かを判定する。または、フレーム制御部１０９は、ＬＡＮポートポリシーデータベース１１６の優先帯域欄４０２に記憶された値が「送信」であれば、ＬＡＮポリシーデータベース１１６の送信利用帯域欄４０４に記憶された値以上の帯域で使用可能なＷＡＮポート１０５がステップＳ６０３にて整列させたレコードに存在するか否かを判定する。

【0177】

利用帯域以上の帯域で使用可能なＷＡＮポート１０５が存在しない場合には（ステップＳ６０４にて「Ｎｏ」）、フレーム制御部１０９は、ステップＳ６０２またはステップＳ６０３にて整列させた順の先頭に該当するＷＡＮポート１０５を、接続するＷＡＮポート１０５として選択し、処理を終了する（ステップＳ６０５）。

【0178】

利用帯域以上の帯域で使用可能なＷＡＮポート１０５が存在する場合には（ステップＳ６０４にて「Ｙｅｓ」）、フレーム制御部１０９は、ステップＳ６０２またはステップＳ６０３にて整列させた順の先頭に該当するＷＡＮポート１０５から順に、利用帯域以上の帯域を使用することが可能であって、かつ、回線状態が接続可であるＷＡＮポート１０５を抽出し、リスト化する（ステップＳ６０６）。

【0179】

次に、フレーム制御部１０９は、ステップＳ６０６にて作成したリストの最後尾から先頭に向かって、つまり変動が大きい順に、優先でない帯域において利用帯域以上の帯域での使用が可能なＷＡＮポート１０５を抽出する（ステップＳ６０７）。

【0180】

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具体的には、フレーム制御部１０９は、優先でない帯域、すなわちＬＡＮポートポリシーデータベース１１６の優先帯域欄４０２に記憶された値が「受信」であれば「送信」帯域、記憶された値が「送信」であれば「受信」帯域、について利用帯域以上の帯域での使用が可能なＷＡＮポート１０５を抽出する。

【0181】

次に、フレーム制御部１０９は、ステップＳ６０７で抽出したＷＡＮポート１０５が一つ以上あるか否かを判定する（ステップＳ６０８）。

【0182】

抽出したＷＡＮポート１０５が一つ以上ある場合には（ステップＳ６０８にて「Ｙｅｓ」）、フレーム制御部１０９は、抽出したＷＡＮポート１０５のうち変動の値が大きいＷＡＮポート１０５を選択し処理を終了する（ステップＳ６０９）。

【0183】

抽出したＷＡＮポートが一つも無い場合には（ステップＳ６０８にて「Ｎｏ」）、フレーム制御部１０９は、ステップＳ６０６にて作成したリストの最後尾のＷＡＮポート１０５、すなわち変動の値が最も大きいＷＡＮポート１０５を選択し処理を終了する（ステップＳ６１０）。

【0184】

以上が、第二の変形例におけるＷＡＮポート選択処理の処理フローである。

【0185】

このように、第二の変形例によれば、中継装置１０１はＬＡＮポートポリシーデータベース１１６のポリシーに従ってＷＡＮポート１０５を選択するようＷＡＮポート選択処理を行うため、ユーザとの接続契約の内容に合うよう、帯域を考慮した負荷分散を行うことができる。

【0186】

また、本発明の第一の実施形態およびその変形例においては、中継装置１０１のＷＡＮポート１０５に接続される装置をＢＡＳ１０３としたが、これに限らず、他の計算機やネットワーク機器であってもよい。また、ユーザ端末１０２についても、他の計算機やネットワーク機器であってもよい。

【0187】

なお、上記の中継システム１００は、システムとして取引対象とするだけでなく、中継装置１０１、または中継装置１０１の動作を実現するプログラム部品単位で取引対象とすることも可能である。

【図面の簡単な説明】

【0188】

【図1】本実施形態の中継システムの構成図である。

【図2】本実施形態における接続先ＢＡＳデータベースのデータ構造を示す図である。

【図3】本実施形態におけるフレーム監視データベースのデータ構造を示す図である。

【図4】本実施形態における接続要求受付処理の処理フローを示す図である。

【図5】本実施形態におけるＷＡＮポート選択処理の処理フローを示す図である。

【図6】本実施形態におけるフレーム監視処理の処理フローを示す図である。

【図7】本実施形態における回線監視処理の処理フローを示す図である。

【図8】本実施形態の第一の変形例における接続先ＢＡＳデータベースのデータ構造を示す図である。

【図9】本実施形態の第一の変形例における接続要求受付処理の処理フローを示す図である。

【図10】本実施形態の第一の変形例におけるＷＡＮポート選択処理の処理フローを示す図である。

【図11】本実施形態の第二の変形例における中継システムの構成図である。

【図12】本実施形態の第二の変形例におけるＬＡＮポートポリシーデータベースのデータ構造を示す図である。

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【図13】本実施形態の第二の変形例におけるＷＡＮポート選択処理の処理フローを示す図である。

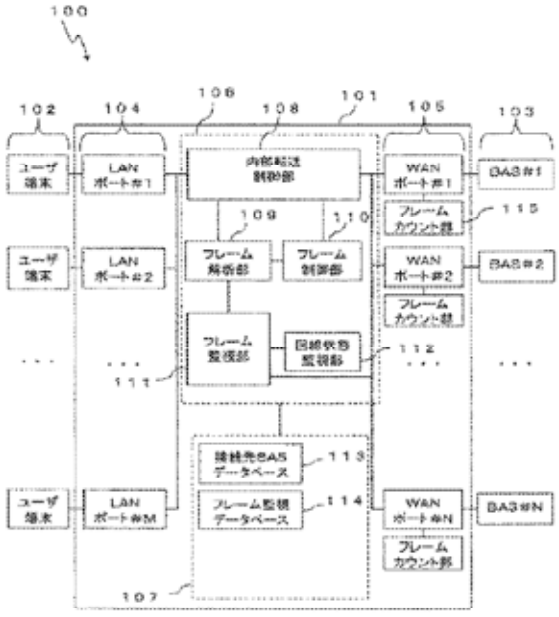
【符号の説明】

【0189】

１００：中継システム、１０１：中継装置、１０２：ユーザ端末、１０３：ＢＡＳ、１０４：ＬＡＮポート、１０５：ＷＡＮポート、１０６：制御部、１０７：記憶部、１０８：内部転送制御部、１０９：フレーム解析部、１１０：フレーム制御部、１１１：フレーム監視部、１１２：回線状態監視部、１１３：接続先ＢＡＳデータベース、１１４：フレーム監視データベース、１１５：フレームカウント部、１１６：ＬＡＮポートポリシーデータベース

【図1】

図1



【図2】

図2

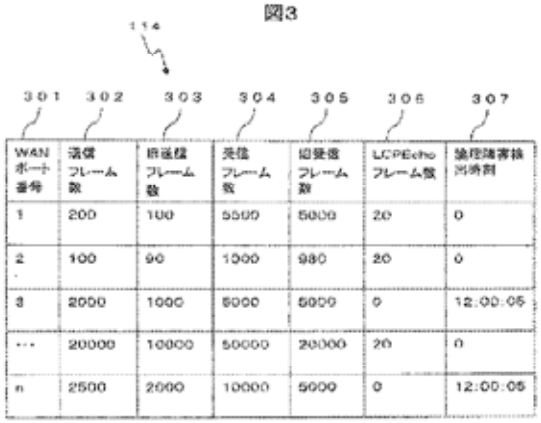


WANポート番号	送信変動	受信変動	回線状態
1	100	500	接続可
2	10	20	接続可
3	1000	0	接続不可
…	10000	30000	接続可
n	500	5000	接続不可

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Page #1074

【図3】

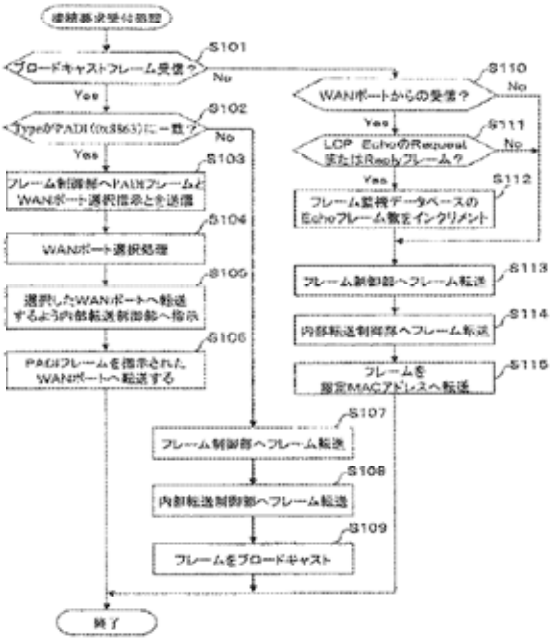
図3



WANポート番号	送信フレーム数	再送信フレーム数	受信フレーム数	再受信フレーム数	LCPEchoフレーム数	論理障害検出時刻
1	200	100	5500	5000	20	0
2	100	90	1000	980	20	0
3	2000	1000	6000	5000	0	12:00:05
・・・	20000	10000	50000	20000	20	0
n	2500	2000	10000	5000	0	12:00:05

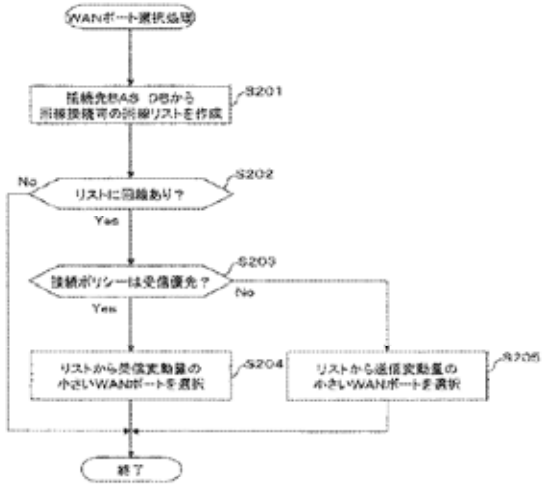
【図4】

図4



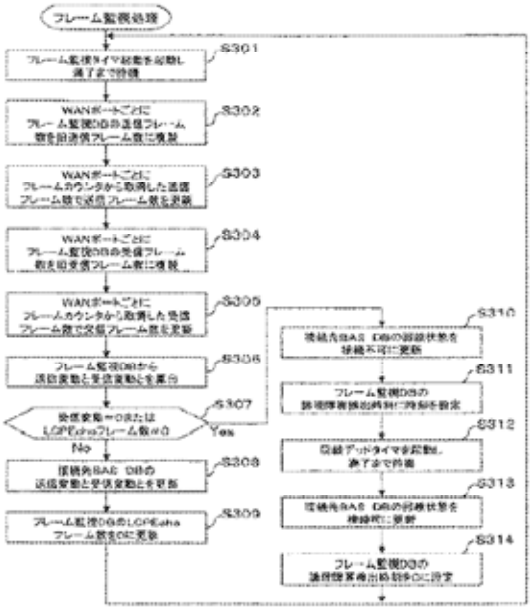
【図5】

図5



【図6】

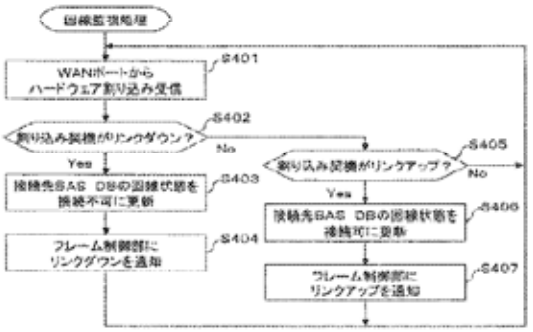
図6



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Page #1075

【図7】

図7



【図8】

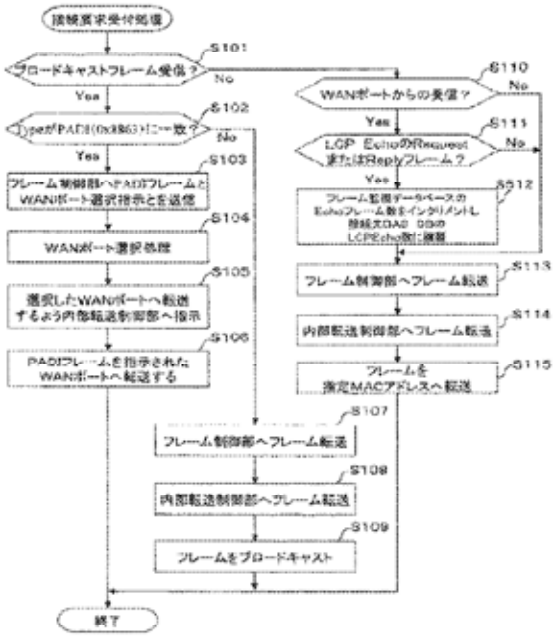
図8

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201 WANポート番号	202 送信実動	203 受信実動	204 回線状態	205 LCPEcho数
1	100	500	接続可	20
2	10	20	接続可	20
3	1000	0	接続不可	0
・・・	10000	30000	接続可	20
n	500	5000	接続不可	0

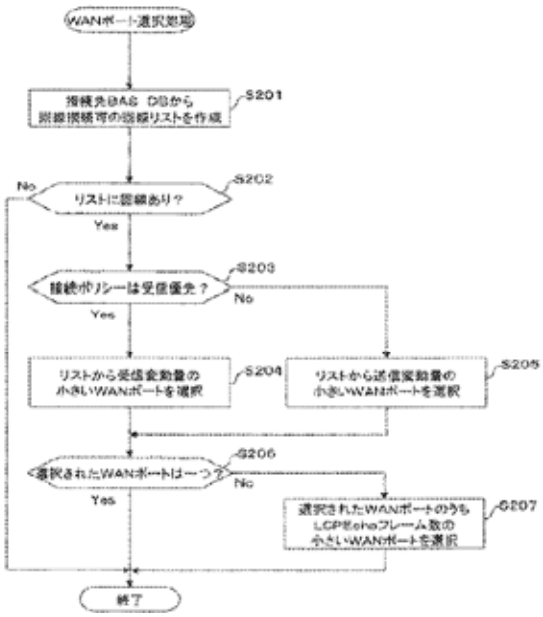
【図9】

図9



【図10】

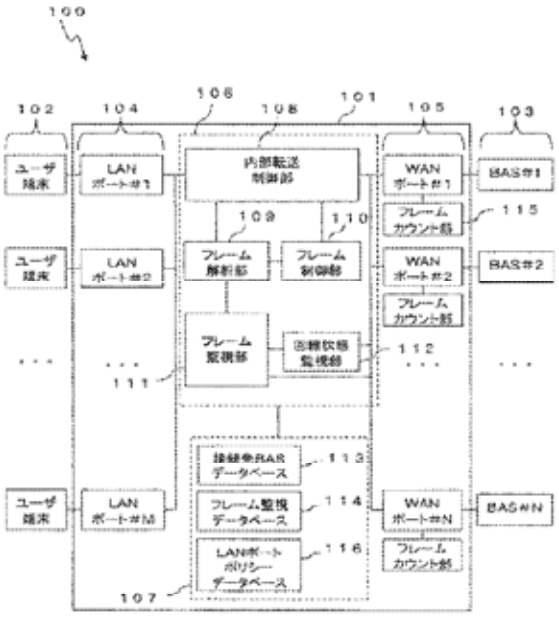
図10



Charter Communications, Inc.
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Page #1076

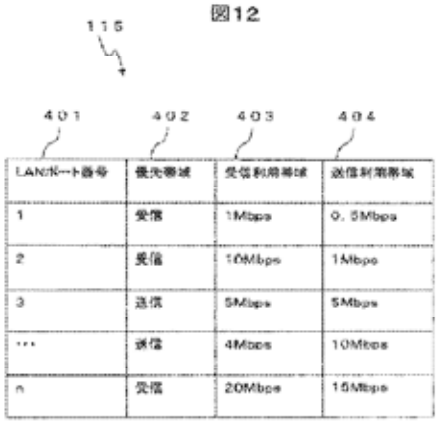
【図11】

図11



【図12】

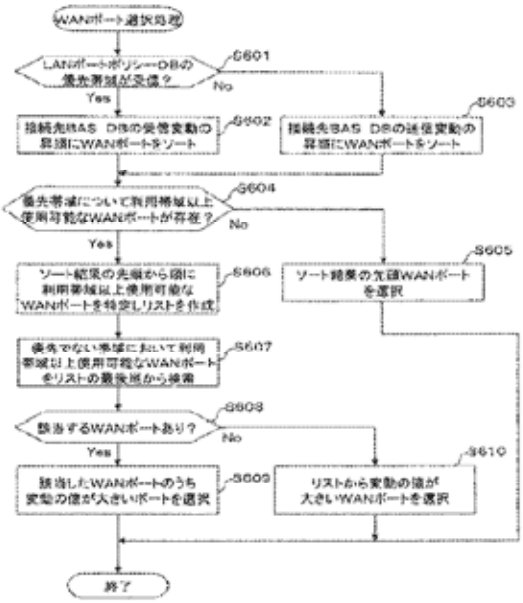
図12



LANポート番号	優先帯域	受信利用帯域	送信利用帯域
1	受信	1Mbps	0.5Mbps
2	受信	10Mbps	1Mbps
3	送信	5Mbps	5Mbps
・・・	送信	4Mbps	10Mbps
n	受信	20Mbps	15Mbps

【図13】

図13



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Page #1077

(72)発明者　依田　崇
神奈川県川崎市幸区鹿島田８９０番地　株式会社日立製作所ネットワークソリューション事業部内
Ｆターム(参考) 5K030 GA13　HA08　HC01　HD03　JA11　LB02　LB05　LC01　LC11　MA04
MB09　MC08

Charter Communications, Inc.
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Page #1078

PATENT COOPERATION TREATY

RECEIVED
AUG 16 2012
BEAVERTON

From the INTERNATIONAL SEARCHING AUTHORITY

PCT

To:
Caldwell, Gregory D....
BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP
1279 Oakmead Parkway
Sunnyvale CA 94085-4040
ETATS-UNIS D'AMERIQUE

NOTIFICATION OF TRANSMITTAL OF THE INTERNATIONAL SEARCH REPORT AND THE WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY, OR THE DECLARATION

RECEIVED
SUNNYVALE
AUG 15 2012
BLAKELY SOKOLOFF
TAYLOR ZAFMAN

(PCT Rule 44.1)

Applicant's or agent's file reference 8241P056PCT	Date of mailing *(day/month/year)* 6 August 2012 (06-08-2012) **FOR FURTHER ACTION** See paragraphs 1 and 4 below
International application No. PCT/US2011/063327	International filing date *(day/month/year)* 5 December 2011 (05-12-2011)

Applicant

ADAPTIVE SPECTRUM AND SIGNAL ALIGNMENT, INC.

1. [X] The applicant is hereby notified that the international search report and the written opinion of the International Searching Authority have been established and are transmitted herewith.

   Filing of amendments and statement under Article 19:
   The applicant is entitled, if he so wishes, to amend the claims of the International Application (see Rule 46).

   When? The time limit for filing such amendments is normally two months from the date of transmittal of the International Search Report.

   Where? Directly to the International Bureau of WIPO, 34 chemin des Colombettes 1211 Geneva 20, Switzerland, Facsimile No.: (41-22) 338.82.70

   For more detailed instructions, see *PCT Applicant's Guide*, International Phase, paragraphs 9.004 - 9.011.

2. [ ] The applicant is hereby notified that no international search report will be established and that the declaration under Article 17(2)(a) to that effect and the written opinion of the International Searching Authority are transmitted herewith.

3. [ ] **With regard to any protest** against payment of (an) additional fee(s) under Rule 40.2, the applicant is notified that:

   [ ] the protest together with the decision thereon has been transmitted to the International Bureau together with the applicant's request to forward the texts of both the protest and the decision thereon to the designated Offices.

   [ ] no decision has been made yet on the protest; the applicant will be notified as soon as a decision is made.

4. **Reminders**

   The applicant may submit comments on an informal basis on the written opinion of the International Searching Authority to the International Bureau. The International Bureau will send a copy of such comments to all designated Offices unless an international preliminary examination report has been or is to be established. Following the expiration of 30 months from the priority date, these comments will also be made available to the public.

   Shortly after the expiration of **18 months** from the priority date, the international application will be published by the International Bureau. If the applicant wishes to avoid or postpone publication, a notice of withdrawal of the international application, or of the priority claim, must reach the International Bureau before completion of the technical preparations for international publication (Rules 90*bis*.1 and 90*bis*.3).

   Within **19 months** from the priority date, but only in respect of some designated Offices, a demand for international preliminary examination must be filed if the applicant wishes to postpone the entry into the national phase **until 30 months** from the priority date (in some Offices even later); otherwise, the applicant must, **within 20 months** from the priority date, perform the prescribed acts for entry into the national phase before those designated Offices.

   In respect of other designated Offices, the time limit of **30 months** (or later) will apply even if no demand is filed within 19 months.

   For details about the applicable time limits, Office by Office, see www.wipo.int/pct/en/texts/time_limits.html and the *PCT Applicant's Guide*, National Chapters.

Name and mailing address of the International Searching Authority European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040 Fax: (+31-70) 340-3016	Authorized officer LAMPREIA, Sylvia Tel: +31 (0)70 340-1948

Form PCT/ISA/220 (July 2010)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	FOR FURTHER ACTION	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
8241P056PCT		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/US2011/063327	05/12/2011	
Applicant		
ADAPTIVE SPECTRUM AND SIGNAL ALIGNMENT, INC.		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 4 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**
   a. With regard to the **language,** the international search was carried out on the basis of:
      [X] the international application in the language in which it was filed
      [ ] a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))
   b. [ ] This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).
   c. [ ] With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I

2. [ ] **Certain claims were found unsearchable** (See Box No. II)

3. [ ] **Unity of invention is lacking** (see Box No III)

4. With regard to the **title,**
   [X] the text is approved as submitted by the applicant
   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**
   [X] the text is approved as submitted by the applicant
   [ ] the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the **drawings,**
   a. the figure of the **drawings** to be published with the abstract is Figure No. 4a
      [X] as suggested by the applicant
      [ ] as selected by this Authority, because the applicant failed to suggest a figure
      [ ] as selected by this Authority, because this figure better characterizes the invention
   b. [ ] none of the figures is to be published with the abstract

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

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2011/063327

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04L12/56 H04L12/24
ADD.

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)
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 practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2006/126613 A1 (ZWEIG JONATHAN M [US]) 15 June 2006 (2006-06-15) paragraph [0018] paragraph [0021] - paragraph [0039]; claims 7,14,20; figures 1,3 paragraph [0040] - paragraph [0047] -----	1-46
X	US 2003/031180 A1 (DATTA SANCHAITA [US] ET AL) 13 February 2003 (2003-02-13) paragraph [0021] - paragraph [0024]; figure 3 paragraph [0036] - paragraph [0069] -----	1-46
A	US 2010/290465 A1 (ANKAIAH SHASHI H [IN] ET AL) 18 November 2010 (2010-11-18) paragraph [0049] - paragraph [0062]; figures 1-4 ----- -/--	1-46

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 July 2012	06/08/2012

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, Fax: (+31-70) 340-3016	Ciurel, Cristian

2

Form PCT/ISA/210 (second sheet) (April 2005)

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2011/063327

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2011/182182 A1 (YANG KAI-YU [TW] ET AL) 28 July 2011 (2011-07-28) paragraph [0013] - paragraph [0037]; figures 1-4	1-46
A	US 2011/273979 A1 (GRABELSKY DAVID A [US] ET AL) 10 November 2011 (2011-11-10) paragraph [0062] - paragraph [0098]; figures 4-8	1-46

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Form PCT/ISA/210 (continuation of second sheet) (April 2005)

Charter Communications, Inc.
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Page #1082

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2011/063327

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2006126613 A1	15-06-2006	NONE	
US 2003031180 A1	13-02-2003	NONE	
US 2010290465 A1	18-11-2010	NONE	
US 2011182182 A1	28-07-2011	CN 102143048 A	03-08-2011
		US 2011182182 A1	28-07-2011
US 2011273979 A1	10-11-2011	US 7613170 B1	03-11-2009
		US 2010061228 A1	11-03-2010
		US 2011273979 A1	10-11-2011

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PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2011/063327	05.12.2011	

International Patent Classification (IPC) or both national classification and IPC
INV. H04L12/56 H04L12/24

Applicant
ADAPTIVE SPECTRUM AND SIGNAL ALIGNMENT, INC.

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA:	Date of completion of this opinion	Authorized Officer
European Patent Office P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Fax: +31 70 340 - 3016	see form PCT/ISA/210	Ciurel, Cristian Telephone No. +31 70 340-0

Form PCT/ISA/237 (Cover Sheet) (July 2009)

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed

   ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43bis.1(a))

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing filed or furnished:

   a. (means)

      ☐ on paper

      ☐ in electronic form

   b. (time)

      ☐ in the international application as filed

      ☐ together with the international application in electronic form

      ☐ subsequently to this Authority for the purposes of search

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	
	No:	Claims	1-46
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-46
Industrial applicability (IA)	Yes:	Claims	1-46
	No:	Claims	

2. Citations and explanations

see separate sheet

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Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

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Re Item V

The following documents are referred to in this communication; the numbering will be adhered to in the rest of the procedure:

D1 US 2006/126613 A1 (ZWEIG JONATHAN M [US]) 15 June 2006 (2006-06-15)

D2 US 2003/031180 A1 (DATTA SANCHAITA [US] ET AL) 13 February 2003 (2003-02-13)

D3 US 2010/290465 A1 (ANKAIAH SHASHI H [IN] ET AL) 18 November 2010 (2010-11-18)

D4 US 2011/182182 A1 (YANG KAI-YU [TW] ET AL) 28 July 2011 (2011-07-28)

D5 US 2011/273979 A1 (GRABELSKY DAVID A [US] ET AL) 10 November 2011 (2011-11-10)

1 The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of **claim 1 is not new** in the sense of **Article 33 (2) PCT**.

2 The **document D1** discloses (the references in parentheses applying to this document), in terms of claim 1:

A system (figures 1 and 3) comprising:

(a) a first Local Area Network ("LAN") access device is to establish a first LAN (figures 1 and 3; paragraph 21);

(b) a second LAN access device is to establish a second LAN (paragraph 21);

(c) a first Wide Area Network ("WAN") backhaul connection to provide the first LAN access device with WAN connectivity (figures 1 and 3; paragraph 22);

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(d) a second WAN backhaul connection to provide the second LAN access device with WAN connectivity, wherein each of the first WAN backhaul and the second backhaul are physically distinct (paragraph 22);

(e) a management device communicatively interfaced with each of the first LAN access device, the second LAN access device, the first WAN backhaul connection, and the second WAN backhaul connection (figure 3; paragraphs 38 and 39); and

(f) wherein the management device to route a first portion of traffic originating from the first LAN over the first WAN backhaul connection and to further route a second portion of the traffic originating from the first LAN over the second WAN backhaul connection (paragraphs 38 and 39).

Since all features of claim 1 are known in combination from document D1, the subject-matter of **claim 1 is not new in the sense of Article 33(2) PCT.**

2.1 The applicant attention is drawn to the fact that the lack of novelty of the subject-matter of claim 1 may as well be demonstrated along the disclosure of **document D2** (figure 3; paragraphs 21-24, 36-69).

2.2 The independent claims 27 and 37 define the same features as in claim 1 but in terms of a method and respectively a management device. The reasons outlined with respect to claim 1 also apply to claims 27 and 37 and therefore, the subject-matter of **claims 27 and 37 is not new** in the sense of **Article 33 (2) PCT.**

3 The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of **claim 38 is not new** in the sense of **Article 33 (2) PCT.**

4 The **document D1** discloses (the references in parentheses applying to this document), in terms of **claim 38**:

A system (figures 1 and 3) comprising:

(a) a first Local Area Network ("LAN") access device is to establish a first LAN (figures 1 and 3; paragraph 21);

(b) a second LAN access device is to establish a second LAN (paragraph 21);

(c) a first Wide Area Network ("WAN") backhaul connection to provide the first LAN access device with WAN connectivity (figures 1 and 3; paragraph 22);

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(d) a second WAN backhaul connection to provide the second LAN access device with WAN connectivity, wherein each of the first WAN backhaul and the second backhaul are physically distinct (paragraph 22);

(e) a management device communicatively interfaced with each of the first LAN access device, the second LAN access device, the first WAN backhaul connection, and the second WAN backhaul connection (figure 3; paragraphs 38 and 39); and

(f) wherein the management device, responsive to a failure event, to re-route traffic associated with the first LAN onto the second WAN backhaul connection or re-route traffic associated with the second LAN onto the first WAN backhaul connection (paragraphs 18, 40-47; claims 7, 14, 20).

Since all features of claim 38 are known in combination from document D1, the subject-matter of **claim 38 is not new in the sense of Article 33(2) PCT.**

4.1 The applicant attention is drawn to the fact that the lack of novelty of the subject-matter of claim 38 may as well be demonstrated along the disclosure of **document D2** (figure 3; paragraphs 21-24, 36-69).

4.2 The independent claims 45 and 46 define the same features as in claim 38 but in terms of a method and respectively a management device. The reasons outlined with respect to claim 38 also apply to claims 45 and 46 and therefore, the subject-matter of **claims 45 and 46 is not new in the sense of Article 33 (2) PCT.**

5 None of the dependent **claims 2-26, 28-36 and 39-44** appears to contain additional features that, in combination with the features of any claim to which they refer, meet the requirements of the PCT with respect to novelty and/or inventive step (**Article 33(2) and Article 33(3) PCT**). The subject-matter of these claims relates either to details directly derivable from the cited prior art (see passages cited for the **documents D1-D5** cited in the search report) or represents standard practice and design options that form part of the general knowledge of a skilled person.

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Re Item VIII.

6 Although claims 1 and 38 have been drafted as separate independent apparatus claims, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought and/or in respect of the terminology used for the features of that subject-matter. The aforementioned claims therefore lack conciseness and as such do not meet the requirements of **Article 6 PCT**.

7 The same considerations regarding lack in conciseness are also valid for independent method claims 27 and 45 and respectively independent management device claims 37 and 46. The aforementioned claims therefore lack conciseness and as such do not meet the requirements of **Article 6 PCT**.

8 As explained below, some of the features in the apparatus claims 1-26, 37-44 and 46 relate to a method of using the apparatus rather than clearly defining the apparatus in terms of its technical features. These features are: "to provide", "to route", "to implement", "analyze", "to initiate", etc. The intended limitations are therefore not clear from this claim, contrary to the requirements of **Article 6 PCT**.

9 All independent claims are not in the two-part form in accordance with **Rule 6.3(b) PCT**, which in the present case would be appropriate, with those features known in combination from the prior art (document D1) being placed in the preamble (Rule 6.3(b)(I) PCT) and with the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).

9.1 The features of the claims are not provided with reference signs placed in parentheses (**Rule 6.2(b) PCT**).

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PCT/US2011/063327

PATENT COOPERATION TREATY

ADVANCE E-MAIL

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION CONCERNING TRANSMITTAL OF COPY OF INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY (CHAPTER I OF THE PATENT COOPERATION TREATY)

(PCT Rule 44bis.1(c))

To:

Gec-BJ
Assm
8241P056PCT

CALDWELL, Gregory, D.
Blakely, Sokoloff, Taylor & Zafman LLP
1279 Oakmead Parkway
Sunnyvale, CA 94085-4040
ETATS-UNIS D'AMERIQUE

Date of mailing (day/month/year)	
19 June 2014 (19.06.2014)	
Applicant's or agent's file reference: 8241P056PCT	IMPORTANT NOTICE
International application No: PCT/US2011/063327	International filing date (day/month/year): 05 December 2011 (05.12.2011)
Priority date (day/month/year):	

Applicant: ADAPTIVE SPECTRUM AND SIGNAL ALIGNMENT, INC. et al

The International Bureau transmits herewith a copy of the international preliminary report on patentability (Chapter I of the Patent Cooperation Treaty)

RECEIVED
JUN 19 2014
BLAKELY SOKOLOFF TAYLOR ZAFMAN
SUNNYVALE

RECEIVED
JUN 19 2014
FIP DEPT.

RECEIVED
JUN 23 2014
BEAVERTON

Entered into FIP
By:

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Nora Lindner
Facsimile No. +41 22 338 82 70	e-mail: pt03.pct@wipo.int

Form PCT/IB/326 (January 2004)

Reported by agp 6/24/14
Entered refs 6/24/14 (agp)

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter I of the Patent Cooperation Treaty)

(PCT Rule 44*bis*)

Applicant's or agent's file reference 8241P056PCT	**FOR FURTHER ACTION** See item 4 below	
International application No. PCT/US2011/063327	International filing date *(day/month/year)* 05 December 2011 (05.12.2011)	Priority date *(day/month/year)*
International Patent Classification (8th edition unless older edition indicated) See relevant information in Form PCT/ISA/237		
Applicant ADAPTIVE SPECTRUM AND SIGNAL ALIGNMENT, INC.		

1. This international preliminary report on patentability (Chapter I) is issued by the International Bureau on behalf of the International Searching Authority under Rule 44 *bis*.1(a).

2. This REPORT consists of a total of 8 sheets, including this cover sheet.

   In the attached sheets, any reference to the written opinion of the International Searching Authority should be read as a reference to the international preliminary report on patentability (Chapter I) instead.

3. This report contains indications relating to the following items:

☒	Box No. I	Basis of the report
☐	Box No. II	Priority
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☐	Box No. VII	Certain defects in the international application
☒	Box No. VIII	Certain observations on the international application

4. The International Bureau will communicate this report to designated Offices in accordance with Rules 44*bis* 3(c) and 93*bis*.1 but not, except where the applicant makes an express request under Article 23(2), before the expiration of 30 months from the priority date (Rule 44*bis* .2).

	Date of issuance of this report 10 June 2014 (10.06.2014)
The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland	Authorized officer Nora Lindner
Facsimile No. +41 22 338 82 70	e-mail: pt05.pct@wipo.int

Form PCT/IB/373 (January 2004)

Charter Communications, Inc.
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PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2011/063327	05.12.2011	

International Patent Classification (IPC) or both national classification and IPC
INV. H04L12/56 H04L12/24

Applicant
ADAPTIVE SPECTRUM AND SIGNAL ALIGNMENT, INC.

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA:	Date of completion of this opinion	Authorized Officer
European Patent Office P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Fax: +31 70 340 - 3016	see form PCT/ISA/210	Ciurel, Cristian Telephone No. +31 70 340-0

Form PCT/ISA/237 (Cover Sheet) (July 2009)

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

International application No.
PCT/US2011/063327

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed

   ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43bis.1(a))

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing filed or furnished:

   a. (means)

      ☐ on paper

      ☐ in electronic form

   b. (time)

      ☐ in the international application as filed

      ☐ together with the international application in electronic form

      ☐ subsequently to this Authority for the purposes of search

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	
	No:	Claims	1-46
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-46
Industrial applicability (IA)	Yes:	Claims	1-46
	No:	Claims	

2. Citations and explanations

see separate sheet

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Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

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Re Item V

The following documents are referred to in this communication; the numbering will be adhered to in the rest of the procedure:

D1 US 2006/126613 A1 (ZWEIG JONATHAN M [US]) 15 June 2006 (2006-06-15)

D2 US 2003/031180 A1 (DATTA SANCHAITA [US] ET AL) 13 February 2003 (2003-02-13)

D3 US 2010/290465 A1 (ANKAIAH SHASHI H [IN] ET AL) 18 November 2010 (2010-11-18)

D4 US 2011/182182 A1 (YANG KAI-YU [TW] ET AL) 28 July 2011 (2011-07-28)

D5 US 2011/273979 A1 (GRABELSKY DAVID A [US] ET AL) 10 November 2011 (2011-11-10)

1 The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of **claim 1 is not new** in the sense of **Article 33 (2) PCT**.

2 The **document D1** discloses (the references in parentheses applying to this document), in terms of claim 1:

A system (figures 1 and 3) comprising:

(a) a first Local Area Network ("LAN") access device is to establish a first LAN (figures 1 and 3; paragraph 21);

(b) a second LAN access device is to establish a second LAN (paragraph 21);

(c) a first Wide Area Network ("WAN") backhaul connection to provide the first LAN access device with WAN connectivity (figures 1 and 3; paragraph 22);

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(d) a second WAN backhaul connection to provide the second LAN access device with WAN connectivity, wherein each of the first WAN backhaul and the second backhaul are physically distinct (paragraph 22);

(e) a management device communicatively interfaced with each of the first LAN access device, the second LAN access device, the first WAN backhaul connection, and the second WAN backhaul connection (figure 3; paragraphs 38 and 39); and

(f) wherein the management device to route a first portion of traffic originating from the first LAN over the first WAN backhaul connection and to further route a second portion of the traffic originating from the first LAN over the second WAN backhaul connection (paragraphs 38 and 39).

Since all features of claim 1 are known in combination from document D1, the subject-matter of **claim 1 is not new in the sense of Article 33(2) PCT.**

2.1 The applicant attention is drawn to the fact that the lack of novelty of the subject-matter of claim 1 may as well be demonstrated along the disclosure of **document D2** (figure 3; paragraphs 21-24, 36-69).

2.2 The independent claims 27 and 37 define the same features as in claim 1 but in terms of a method and respectively a management device. The reasons outlined with respect to claim 1 also apply to claims 27 and 37 and therefore, the subject-matter of **claims 27 and 37 is not new** in the sense of **Article 33 (2) PCT.**

3 The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of **claim 38 is not new** in the sense of **Article 33 (2) PCT.**

4 The **document D1** discloses (the references in parentheses applying to this document), in terms of **claim 38**:

A system (figures 1 and 3) comprising:

(a) a first Local Area Network ("LAN") access device is to establish a first LAN (figures 1 and 3; paragraph 21);

(b) a second LAN access device is to establish a second LAN (paragraph 21);

(c) a first Wide Area Network ("WAN") backhaul connection to provide the first LAN access device with WAN connectivity (figures 1 and 3; paragraph 22);

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(d) a second WAN backhaul connection to provide the second LAN access device with WAN connectivity, wherein each of the first WAN backhaul and the second backhaul are physically distinct (paragraph 22);

(e) a management device communicatively interfaced with each of the first LAN access device, the second LAN access device, the first WAN backhaul connection, and the second WAN backhaul connection (figure 3; paragraphs 38 and 39); and

(f) wherein the management device, responsive to a failure event, to re-route traffic associated with the first LAN onto the second WAN backhaul connection or re-route traffic associated with the second LAN onto the first WAN backhaul connection (paragraphs 18, 40-47; claims 7, 14, 20).

Since all features of claim 38 are known in combination from document D1, the subject-matter of **claim 38 is not new in the sense of Article 33(2) PCT.**

4.1 The applicant attention is drawn to the fact that the lack of novelty of the subject-matter of claim 38 may as well be demonstrated along the disclosure of **document D2** (figure 3; paragraphs 21-24, 36-69).

4.2 The independent claims 45 and 46 define the same features as in claim 38 but in terms of a method and respectively a management device. The reasons outlined with respect to claim 38 also apply to claims 45 and 46 and therefore, the subject-matter of **claims 45 and 46 is not new in the sense of Article 33 (2) PCT.**

5 None of the dependent **claims 2-26, 28-36 and 39-44** appears to contain additional features that, in combination with the features of any claim to which they refer, meet the requirements of the PCT with respect to novelty and/or inventive step (**Article 33(2) and Article 33(3) PCT**). The subject-matter of these claims relates either to details directly derivable from the cited prior art (see passages cited for the **documents D1-D5** cited in the search report) or represents standard practice and design options that form part of the general knowledge of a skilled person.

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Re Item VIII.

6 Although claims 1 and 38 have been drafted as separate independent apparatus claims, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought and/or in respect of the terminology used for the features of that subject-matter. The aforementioned claims therefore lack conciseness and as such do not meet the requirements of **Article 6 PCT**.

7 The same considerations regarding lack in conciseness are also valid for independent method claims 27 and 45 and respectively independent management device claims 37 and 46. The aforementioned claims therefore lack conciseness and as such do not meet the requirements of **Article 6 PCT**.

8 As explained below, some of the features in the apparatus claims 1-26, 37-44 and 46 relate to a method of using the apparatus rather than clearly defining the apparatus in terms of its technical features. These features are: "to provide", "to route", "to implement", "analyze", "to initiate", etc. The intended limitations are therefore not clear from this claim, contrary to the requirements of **Article 6 PCT**.

9 All independent claims are not in the two-part form in accordance with **Rule 6.3(b) PCT**, which in the present case would be appropriate, with those features known in combination from the prior art (document D1) being placed in the preamble (Rule 6.3(b)(I) PCT) and with the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).

9.1 The features of the claims are not provided with reference signs placed in parentheses (**Rule 6.2(b) PCT**).

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Electronic Patent Application Fee Transmittal

Application Number:	14356581
Filing Date:	06-May-2014
Title of Invention:	METHOD, APPARATUS, AND SYSTEM FOR OPTIMIZING PERFORMANCE OF A COMMUNICATION UNIT BY A REMOTE SERVER
First Named Inventor/Applicant Name:	Wonjong Rhee
Filer:	Michael V. North/Nita Miller
Attorney Docket Number:	20145-054US

Filed as Large Entity

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

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

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
Submission- Information Disclosure Stmt	1806	1	240	240
		Total in USD ($)		**240**

Electronic Acknowledgement Receipt

EFS ID:	32012822
Application Number:	14356581
International Application Number:	
Confirmation Number:	4319
Title of Invention:	METHOD, APPARATUS, AND SYSTEM FOR OPTIMIZING PERFORMANCE OF A COMMUNICATION UNIT BY A REMOTE SERVER
First Named Inventor/Applicant Name:	Wonjong Rhee
Customer Number:	146571
Filer:	Michael V. North/Nita Miller
Filer Authorized By:	Michael V. North
Attorney Docket Number:	20145-054US
Receipt Date:	09-MAR-2018
Filing Date:	06-MAY-2014
Time Stamp:	16:46:07
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$240
RAM confirmation Number	031218INTEFSW16465700
Deposit Account	502776
Authorized User	Nita Miller
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 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)

37 CFR 1.492 (National application filing, search, and examination fees)

37 CFR 1.492(a) (Basic national fee only)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	054US_IDS_Trans.pdf	28254 ed2f94af25c8041e2a80f2e00451bf2ff6e3f93c	no	3
Warnings:					
Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	054US_IDS_SB08.pdf	613034 5455300637fc50f77ac2a503039fe6161f244bc045	no	6
Warnings:					
Information:					
3	Foreign Reference	056USC_IDS_FR1.pdf	3253885 46d8ee05e03d06eb1cba8a0802e143ce561689a2	no	26
Warnings:					
Information:					
4	Foreign Reference	056USC_IDS_FR2.pdf	2498828 4f979dee53c3fdd11c1397692d78dd9f3691bfae2	no	23
Warnings:					
Information:					
5	Non Patent Literature	056USC_IDS_NPL1.pdf	2693183 016acc5ef3589077f78190244ecdf1285e1e63cca3	no	12
Warnings:					
Information:					
6	Non Patent Literature	056USC_IDS_NPL2.pdf	6230549 32688251d70f0021e2069d715b2e8f576943b8099	no	9
Warnings:					
Information:					

7	Non Patent Literature	056USC_IDS_NPL3.pdf	222764 26d8ac830c5fc91f29873553171250a0c045fe13	no	3
Warnings:					
Information:					
8	Non Patent Literature	056USC_IDS_NPL4.pdf	183042 1a09d0373fcb2014ca5b090be750a6649e6026db336	no	2
Warnings:					
Information:					
9	Non Patent Literature	056USC_IDS_NPL5.pdf	76721 ba89c95c72f2082af478a532ccb546498e564dc48	no	5
Warnings:					
Information:					
10	Non Patent Literature	056USC_IDS_NPL6.pdf	142359 cf07ce70bf4ccaa124f116cfc3c53de4a6bcb0618	no	4
Warnings:					
Information:					
11	Non Patent Literature	056USC_IDS_NPL7.pdf	432234 f:\cx912600533251f51dd0e11c7391efc3ff4d88d	no	36
Warnings:					
Information:					
12	Non Patent Literature	056USC_IDS_NPL8.pdf	584111 801da915c54f86ac73481320c5ce9adaf29bb72d	no	3
Warnings:					
Information:					
13	Non Patent Literature	056USC_IDS_NPL9.pdf	452902 fad6163d87209250311356ac6c7bde90b1debacac	no	28
Warnings:					
Information:					

14	Non Patent Literature	056USC_IDS_NPL10.pdf	121443 e2567a6c449dcea0ad8908ce252cd160cd22f4cb1	no	3
Warnings:					
Information:					
15	Non Patent Literature	056USC_IDS_NPL11.pdf	521360 e6158804027 3d44d8c7457896576e444c92a149251	no	7
Warnings:					
Information:					
16	Fee Worksheet (SB06)	fee-info.pdf	30968 34f89a913b6b45cac206672226a4a07663b9480ab	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	18085637		

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

New Applications Under 35 U.S.C. 111

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

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

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

New International Application Filed with the USPTO as a Receiving Office

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

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s)	:	Wonjong Rhee	Confirmation No.: 4319
Appl. No.	:	14/356,581	
Filing Date	:	2014-05-06	
Title	:	METHOD, APPARATUS, AND SYSTEM FOR OPTIMIZING PERFORMANCE OF A COMMUNICATION UNIT BY A REMOTE SERVER	
Art Unit	:	2446	
Examiner	:	Boris D. Grualvalobos	
Docket No.	:	20145-054US	

CERTIFICATE OF MAILING (37 CFR §1.8)

I hereby certify, pursuant to 37 CFR §1.8, that this correspondence is being electronically transmitted via EFS-Web addressed to Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on the date shown below:

Date: 2018-03-09 By: /Nita Miller/
Nita Miller

INFORMATION DISCLOSURE STATEMENT

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

SIR or MADAM:

Filed herewith, in accordance with the provisions of 37 CFR §§ 1.56 and 1.97–1.98, listing various references for consideration by the Examiner, is an Information Disclosure Statement ("IDS").

The filing of this IDS shall not be construed as a representation that a search has been made, or regarding the completeness of the list of references, or that no other material information exists. Furthermore, the filing of this IDS shall not be construed as a representation that inclusion of a reference in this list is an admission that it is prior art or is pertinent to this application, or as an admission that the information listed is, or may be considered to be, material to the patentability of the above referenced application. The filing of this IDS shall not be construed in any manner as an admission against interest.

This IDS is being filed:

Charter Communications, Inc.
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Page #1106

☐ within three months of the filing date of a national application, other than a continued prosecution application under § 1.53(d);

☐ within three months of the date of entry of the national stage as set forth in § 1.491 in an international application;

☐ before the mailing of a first Office Action on the merits;

☐ before the mailing of a first Office Action after the filing of a request for continued examination under § 1.114;

☒ after three months of the filing date or entry into the national stage or after the mailing of a first Office action on the merits, but before the mailing date of any final action under § 1.113, a notice of allowance under §1.311, or an action that otherwise closes prosecution in the application;

AND

☒ enclosed herein is the fee set forth in 37 CFR § 1.17(p);

OR

☐ Applicant certifies pursuant to 37 CFR § 1.97(e):

☐ That each item of information contained in the information disclosure statement was first 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 information disclosure statement;

OR

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

☐ on or before the payment of the issue fee but after the mailing of a final action under § 1.113, a notice of allowance under §1.311, or an action that otherwise closes prosecution in the application;

AND

☐ enclosed herein is the fee set forth in 37 CFR § 1.17(p);

AND

☐ Applicant certifies pursuant to 37 CFR § 1.97(e):

☐ That each item of information contained in the information disclosure statement was first 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 information disclosure statement;

OR

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

☒ Applicant submits that the enclosed Information Disclosure Statement is timely; therefore, no fee is required.

☒ Except as provided for under 37 CFR § 1.98(a)(2), Applicant has enclosed a copy of each listed reference.

☐ The above referenced application relies upon Application No. _____, filed _____ for an earlier effective filing date under 35 U.S.C. 120. Although, pursuant to 37 CFR § 1.98(d), the references submitted herein are not required to be submitted for the Examiner to consider them, Applicant submits the references herein so that the information will be printed on the patent issuing from this application.

☐ Pursuant to 37 CFR § 1.704(d), Applicant certifies that each of the references cited herein were first cited in a communication from a foreign patent office in a counterpart application and that this communication was not received by any individual designated in 37 CFR § 1.56(c) more than thirty days prior to the filing of this Information Disclosure Statement.

Consideration of the listed references and favorable action are requested. If any additional fees are due in connection with the filing of this Information Disclosure Statement, the Commissioner is hereby authorized to charge such fees to Deposit Account 50-2776.

Respectfully submitted,

Date: 2018-03-09

By: /Michael V. North/
Michael V. North
Reg. No. 46963

Customer No.
146571
UNITED STATES PATENT AND TRADEMARK OFFICE

Charter Communications, Inc.
Exhibit 1006
Page #1108

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

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

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

Application Number	14356581
Filing Date	2014-05-06
First Named Inventor	Wonjong Rhee
Art Unit	2446
Examiner Name	Boris D. Grualvalobos
Attorney Docket Number	20145-054US

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	Application Number	14356581
	Filing Date	2014-05-06
	First Named Inventor	Wonjong Rhee
	Art Unit	2446
	Examiner Name	Boris D. Grualvalobos
	Attorney Docket Number	20145-054US

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	Examiner Name	Boris D. Grualvalobos
	Attorney Docket Number	20145-054US

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

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

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Signature	/Michael North/	Date (YYYY-MM-DD)	2018-03-09
Name/Print	Michael North	Registration Number	46963

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(19) Europäisches Patentamt
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Office européen des brevets

(11) EP 2 112 781 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
28.10.2009 Bulletin 2009/44

(51) Int Cl.:
H04L 12/18 *(2006.01)* ***H04M 11/06*** *(2006.01)*

(21) Application number: **08007883.5**

(22) Date of filing: **24.04.2008**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MT NL NO PL PT RO SE SI SK TR
Designated Extension States:
AL BA MK RS

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(54) Bundling unit in a dsl network

(57) The invention relates to a bundling unit (BU) for facilitating communication between a plurality of clients (CL1, CL2, CL3, CL4) and a DSLAM (10) in a DSL network to transmit at least one signal from the DSLAM (10) to at least one client (CL1, CL2, CL3, CL4) upon request. The bundling unit (BU) is arranged to communicate with the DSLAM (10) via a first set of lines (L1, L2, L3, L4) and with the clients (CL1, CL2, CL3, CL4) via a second set of lines (L1', L2', L3', L4'). The bundling unit (BU) is arranged to

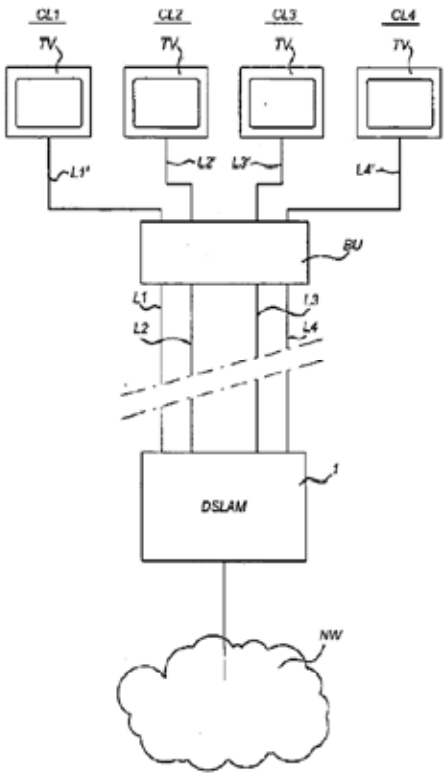
a) receive a request for a signal from a client (100);

b) verify if the requested signal is already available at the bundling unit (BU) (102) and

b1) if so, forward the requested signal to the client (103), and

b2) if not, select one of the available lines (L1, L2, L3, L4) to forward the request to the DSLAM (10) (106).

Fig 2



EP 2 112 781 A1

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Description

TECHNICAL FIELD

[0001] The invention relates to a bundling unit in a DSL network.

STATE OF THE ART

[0002] Digital Subscriber Line (DSL) technology is used to create a relatively large digital bandwidth on for instance a telephone line. Many variants of DSL technology exist, such as asymmetric DSL (ADSL, VDSL, etc.) and symmetric DSL (SDSL, HDSL, etc.).

[0003] DSL traffic is managed by a so-called DSL Access Module (DSLAM), being an intermediate between a client and the network.

[0004] It is known that the available DSL bandwidth depends on the distance between the client and the central office device, such as the DSL Access Module (DSLAM). The bandwidth decreases with increasing distance.

[0005] The layout of the DSL network is explained in more detail below with reference to Fig. 1.

[0006] DSL networks are nowadays used for all kinds of data transport, such as for distributing television signals to clients. This means that the transmission of TV signals does no longer require a separate coaxial TV cable network.

[0007] It is an object of the invention to increase the bandwidth available for clients in a DSL network, especially for data transport such as television signals.

SHORT DESCRIPTION

[0008] According to an aspect there is provided a bundling unit for facilitating communication between a plurality of clients and a DSLAM in a DSL network to transmit at least one signal from the DSLAM to at least one client upon request, wherein the bundling unit is arranged to communicate with the DSLAM via a first set of lines and with the clients via a second set of lines, and the bundling unit is arranged to

a) receive a request for a signal from a client;
b) verify if the requested signal is already available at the bundling unit and

b1) if so, forward the requested signal to the client, and
b2) if not, select one of the available lines to forward the request to the DSLAM. As a result, the bundling unit will receive the requested signal from the DSLAM via the selected line.

[0009] According to an aspect the bundling unit is further arranged to

c) in reaction to b2) receive the requested signal from the DSLAM and forward the signal to the client.

[0010] According to an embodiment the signal is a multicast signal. The multicast signal may comprise at least one of a television signal, a radio signal, a data signal.

[0011] According to an embodiment the bundling unit is further arranged to

a1) use client subscription information to verify if the client the request was received from is allowed to receive the requested television channel. This is to ensure that clients can not receive (television) signals for which they are not authorized.

[0012] According to an embodiment the bundling unit further comprises or has access to a memory comprising client subscription information. The client subscription information may comprise information to verify which television signals the client is allowed to receive or information about a fixed bandwidth assigned to a client.

[0013] According to an embodiment the bundling device further comprises a plurality of client connectors to communicate with the at least one client via the second set of lines respectively. Each client connector may be associated with a single client.

[0014] According to an embodiment the bundling device further comprises a plurality of DSLAM connectors to communicate with the DSLAM via the first set of lines respectively. Each DSLAM connector may be associated with a single line of the first set of lines.

[0015] According to an embodiment the bundling unit comprises more client connectors than DSLAM connectors. The embodiments make it possible to serve a first number of clients using a second number of DSLAM connectors, the second number being less than the first number. For instance, the number of DSLAM connectors does not need to exceed the number of available television signals available on the DSLAM. Also, it may be anticipated that not all clients request bandwidth at the same time.

[0016] According to an embodiment the bundling unit comprises less client connectors than DSLAM connectors. This allows providing a relatively high bandwidth to a number of available clients.

[0017] According to an embodiment action b2 may further comprise

b2-1) verify if bandwidth is available on one of the lines comprised by the first set of lines to meet the request, and if not
b2-2) re-distribute signals already received via the first set of lines over the first set of lines to create bandwidth for the requested signal, if possible.

[0018] According to an embodiment the bundling unit BU is further arranged to

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- generate an information message comprising a list of television signals that are being transmitted by the bundling unit BU to the clients CL1, CL2, CL3, CL4,
- transmit the information message to at least one client CL1, CL2, CL3, CL4 to be displayed on a television set TV of the at least one client CL1, CL2, CL3, CL4.

[0019] According to an embodiment the bundling unit BU is further be arranged to

1) receive at least one list of program files from providing clients CL1, CL2, CL3, CL4 comprising information about program files stored in association with certain providing clients,
II) generate a combined list of program files based on the at least one received list of program files,
III) transmit the combined list to at least one requesting client CL2,
IV) receive a selection of a program file comprised in the combined list from a requesting client CL2,
V) forward the selection to a providing client CL1, and
VI) facilitate transmittal of the selected program from the providing client CL1 to the requesting client CL2.

[0020] According to an aspect there is provided a method for operating a bundling unit for facilitating communication between a plurality of clients and a DSLAM in a DSL network to transmit at least one signal from the DSLAM to at least one client upon request, wherein the bundling unit is arranged to

a) receive a request for a signal from a client;
b) verify if the requested signal is already available at the bundling unit and

b1) if so, forward the requested signal to the client, and
b2) if not, select one of the available lines to forward the request to the DSLAM.

[0021] According to an embodiment the method further comprises

c) in reaction to b2) receive the requested signal from the DSLAM and forward the signal to the client.

[0022] According to an aspect there is provided a computer program product comprising data and instructions that can be loaded by a computer arrangement, allowing said computer arrangement to perform the methods according to the above.

[0023] According to an aspect there is provided a data carrier provided with such a computer program product.

SHORT DESCRIPTION OF THE DRAWINGS

[0024] Embodiments will now be described, by way of example only, with reference to the accompanying schematic drawings in which corresponding reference symbols indicate corresponding parts, and in which:

- Figure 1 schematically depicts a DSL network according to the prior art,
- Figure 2 schematically depicts a DSL network according to an embodiment,
- Figure 3 schematically depicts a computer arrangement,
- Figure 4 schematically depicts a bundling unit according to an embodiment,
- Figure 5 schematically depicts a flow diagram according to an embodiment, and
- Figure 6 schematically depicts a flow diagram according to a further embodiment.

DETAILED DESCRIPTION

[0025] Fig. 1 schematically depicts a DSLAM 1 according to the prior art, which is on one side connected to a number of clients CL1, CL2, CL3, CL4, and on the other hand is connected to a further network NW, such as the PSTN-network, the Internet and the like. Each client CL1, CL2, CL3, CL4 may comprise a television set TV, personal computer or the like to process the received television signals and display the television signals.

[0026] As can be seen, each client has its own line L1, L2, L3, L4 connecting the client CL1, CL2, CL3, CL4 to the DSLAM. This means that each client CL1, CL2, CL3, CL4 can only use the bandwidth provided by its associated line.

[0027] When setting up or disconnecting a connection between a client and the DSLAM 1 protocols are used that are known by the skilled person. In general, the client sends IGMP messages, such as a join message, leave message, to the DSLAM 1 in order to request or abandon multicast (television) channels.

[0028] The invention is based on the insight that this network architecture does not allow an efficient use of the total available bandwidth provided by lines L1, L2, L3, L4 for a few reasons.

[0029] Firstly, the lines L1, L2, L3, L4 are not used all of the time. So, the first client C1 using first line L1, can not use the bandwidth of line L2 associated with the second client C2 when client CL2 is not using the second line L2.

[0030] Secondly, when the first and second clients CL1, CL2 watch the same television channel, the same television signal is fed through both lines L1, L2.

[0031] Therefore, embodiments are provided in which the respective lines L1, L2, L3, L4 are no longer directly associated with one particular client CL1, CL2, CL3, CL4. A bundling unit BU is provided to manage the DSL traffic and make sure that the available capacity of lines L1, L2, L3, L4 is used in a more efficient way.

[0032] The bundling unit BU may be located in the vicinity of the clients CL1, CL2, CL3, CL4 so that lines L1,

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L2, L3, L4 that are now used in a more efficient way cover most of the distance between the clients CL1, CL2, CL3, CL4 and the DSLAM 1.

[0033] The clients CL1, CL2, CL3, CL4 may for instance be located in a hotel, a hospital, a block of flats, etc. The bundling unit BU may be located in or near the hotel, hospital, block of flats etc.

[0034] Fig. 2 schematically depicts an embodiment comprising the bundling unit BU. Corresponding reference symbols indicate corresponding parts as in Fig. 1. Fig. 2 further comprises a bundling unit BU which is connected to each client CL1, CL2, CL3, CL4 via separate lines L1', L2', L3', L4'. The bundling unit BU is connected with the DSLAM via lines L1, L2, L3, L4.

[0035] The bundling unit BU may be formed as a computer, such as explained below with reference to Fig. 3.

Computer arrangement

[0036] In Figure 3, an overview is given of a computer arrangement 10 that may function as bundling unit BU according to the embodiments. The computer arrangement 10 comprises a processor 11 for carrying out arithmetic operations.

[0037] The processor 11 is connected to a plurality of memory components, including a hard disk 12, Read Only Memory (ROM) 13, Electrically Erasable Programmable Read Only Memory (EEPROM) 14, and Random Access Memory (RAM) 15. Not all of these memory types need necessarily be provided. Moreover, these memory components need not be located physically close to the processor 11 but may be located remote from the processor 11.

[0038] The processor 11 may also be connected to devices for inputting instructions, data etc. by a user, like a keyboard 16, and a mouse 17. Other input devices, such as a touch screen, a track ball and/or a voice converter, known to persons skilled in the art may be provided too.

[0039] A reading unit 19 connected to the processor 11, may be provided. The reading unit 19 is arranged to read data from and possibly write data on a data carrier like a floppy disk 20 or a CDROM 21. Other data carriers may be tapes, DVD, CD-, DVD-R, memory sticks etc. as is known to persons skilled in the art.

[0040] The processor 11 may also be connected to a printer 23 for printing output data on paper, as well as to a display 18, for instance, a monitor or LCD (Liquid Crystal Display) screen, or any other type of display known to persons skilled in the art.

[0041] The processor 11 may be connected to a loudspeaker 29.

[0042] The processor 11 may be arranged to communicate with remote computer arrangements 10, for instance via network 27, such as the Public Switched Telephone Network (PSTN), a Local Area Network (LAN), a Wide Area Network (WAN), an IP network etc. by means of I/O device 25.

[0043] The data carrier 20, 21 may comprise a computer program product in the form of data and instructions arranged to provide the processor with the capacity to perform a method in accordance with the embodiments. However, such a computer program product may, alternatively, be downloaded via network 27.

[0044] The processor 11 may be implemented as stand alone system, or as a plurality of parallel operating processors each arranged to carry out subtasks of a larger computer program, or as one or more main processors with several sub-processors. Parts of the functionality of the invention may even be carried out by remote processors communicating with processor 11 through the network 27.

[0045] The memory components may comprise programming lines and instructions readable and executable by the processor 11, to provide the processor with functionality according to the embodiments.

[0046] It will be understood that also other network points as schematically depicted in Fig. 2, such as the client CL1, CL2, CL3, CL4 and the DSLAM 1 may be formed as computer arrangements, similar to Fig. 3.

[0047] According to an embodiment, the bundling unit BU may be arranged to function as one or more DSL modems and a router to which all clients CL1, CL2, CL3, CL4 are connected and one or more DSL modems to which the DSLAM is connected via lines L1, L2, L3, L4. However, these DSL modems facing the clients CL1, CL2, CL3, CL4 are not always necessary. For instance, in case the wiring in an apartment building, hospital, etc is e.g. CAT5 no modulation is needed towards the clients, so no DSL modems are needed. The modems may be used to talk to modems in the DSLAM 1.

[0048] Fig. 4 provides a more schematic view than Fig. 3 of an embodiment of the bundling unit BU, showing processor 11, being connected to memory components 12, 13, 14, 15 and I/O device 25.

[0049] The I/O device 25 facilitates communication with the DSLAM 10 (not shown) via lines L1, L2, L3, L4 and facilitates communication with the clients CL1, CL2, CL3, CL4 via lines L1', L2', L3', L4'.

[0050] Fig. 4 clearly shows that the bundling unit BU may comprise a plurality, such as a first, second, third and fourth client connector 31, 32, 33, 34 to communicate with the clients CL1, CL2, CL3, CL4 via lines L1', L2', L3', L4' respectively. Bundling unit BU further comprises a plurality, such as a first, second, third, fourth DSLAM connector 41, 42,43,44 to communicate with the DSLAM 10 via lines L1, L2, L3, L4 respectively.

[0051] The processor 11 may be arranged to provide the bundling unit BU with the functionality according to a method as described below with reference to Fig. 5.

[0052] In a first action 100 the bundling unit BU waits to receive a request from one of the clients CL1, CL2, CL3, CL4 via the respective client connector 31, 32, 33, 34. The request may be a request to receive a certain television signal (a particular channel).

[0053] If no request is received, the bundling unit BU

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remains waiting according to action 100. Once a request is received from for instance the first client CL1 via the first client connector 31, the bundling unit BU checks in action 102 if the requested television signal is already available on one of the lines L1, L2, L3, L4 at the bundling unit BU.

[0054] If the requested television signal is already available, for instance because the bundling unit BU was already receiving that particular television signal on behalf of another client, for instance the second client CL2, the bundling unit BU proceeds to action 103, in which the already available television signal is forwarded to the first client CL1 via first client connector 31. This way, no additional bandwidth is required on lines L1, L2, L3, L4.

[0055] If the requested television signal is not already available, the bundling unit BU proceeds to action 104, in which the bundling unit BU verifies if enough bandwidth or capacity is available on the lines L1, L2, L3, L4 connecting the bundling unit BU to the DSLAM 10. This action may be performed by evaluating for each line how much of the total bandwidth is already in use and compare the remaining bandwidth of each line with the bandwidth that is required for fulfilling the request.

[0056] According to an embodiment, action 104 may further comprise redistributing signals already received via the first set of lines L1, L2, L3, L4 over the first set of lines L1, L2, L3, L4 to create bandwidth on one line for the requested signal, if possible.

[0057] For instance, in case all available lines of the first set of lines L1, L2, L3, L4 are in use using approximately 40% of the bandwidth of each line and the request requires 75% of the bandwidth of a single line (e.g. HDTV). According to this situation none of the lines is able to provide the bandwidth for the request.

[0058] Therefore, in action 104 the bundling unit BU may re-distribute the signals already received via the first set of lines L1, L2, L3, L4 over the first set of lines L1, L2, L3, L4 to create bandwidth to meet the request. For instance, the bundling unit BU may decide to move the signal received via the first line L1 to the second line L2. The second line L2 will be able to transmit two signals as the combined bandwidth does not exceed the available bandwidth on the second line L2 (40% + 40% = 80%). The first line L1 is now able to meet the request and can be used for the transmission of for instance the HDTV signal. This embodiment enables a more efficient use of the first set of lines L1,L2,L3, L4.

[0059] Moving a signal from one line to another line may be done by sending appropriate (IGMP) messages to the DSLAM 10, such as for instance sending a leave message via the first line and a join message via the other line.

[0060] So, action 104 may comprise verifying if enough bandwidth or capacity is available and possibly creating available bandwidth or capacity by redistributing signals.

[0061] If not enough bandwidth is available on the lines L1, L2, L3, L4 (possibly also not after re-distribution), the request is denied, and a deny message is transmitted to the first client CL1 via first client connector 31 in action 105.

[0062] If however in action 104 it is determined that enough bandwidth is available, the bundling unit BU sends a request to the DSLAM 10 to request for the requested television signal via one of the available DSLAM connectors 41, 42, 43, 44. It is noted that the bundling unit BU does not necessary use the first line L1 to process a request from the first client CL1. According to the embodiments, the lines L1, L2, L3, L4 are no associated with one particular client CL1, CL2, CL3, CL4.

[0063] In action 107 the bundling unit BU waits to receive the requested television signal, and, in action 108, the bundling unit BU receives and forwards the requested television signal to the first client CL1 via one of the DSLAM 10 connectors and the client connector 31 respectively.

[0064] As an alternative, a further action 101 may be provided in between actions 100 and 102. In an action 101 (not shown in the drawings), the bundling unit BU may verify if the client CL1 the request was received from is allowed to receive the requested television channel. The bundling unit BU may comprise or have access to client subscription information, in which for each client subscription information is stored. This client subscription information can be used to verify which television signals the client is allowed to receive. If the client is not allowed to receive the requested television signal, the bundl ing unit BU may continue with action 105 in which the request is denied. If the client is allowed to receive the requested television signal, the bundling unit BU continues with action 102.

[0065] As another alternative, the client subscription information may comprise a fixed bandwidth assigned to each client in order to guarantee a minimum service for that client. Based on the assigned bandwidth, a request may be refused, if meeting the request would result in exceeding the assigned bandwidth.

[0066] The clients subscription information may be stored in memory 12, 13, 14, 15 comprised by the bundling unit BU, but may also be stored at a remote memory, for instance at the DSLAM 10, that is accessible by the bundling unit BU.

[0067] In the description the number of clients CL1, CL2, CL3, CL4 is four. However, it will be understood that this is just an example and that in fact the bundling unit BU may be used to serve any number of clients equal or exceeding two.

[0068] In the above example, the number of lines L1, L2, L3, L4 connecting the bundling unit BU to the DSLAM 10 equal the number of clients CL1, CL2, CL3, CL4. However, this is not necessarily the case. The number of clients CL1, CL2, CL3, CL4 may be higher than the number of lines L1, L2, L3, L4 connecting the bundling unit BU to the DSLAM 10, anticipating that not all clients will require bandwidth at the same time. Also, the number of lines connecting the bundling unit BU to the DSLAM 10 may be higher than the number of clients CL1, CL2, CL3,

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CL4, for instance in the case that not all clients CL1, CL2, CL3, CL4 are subscribed to the television service. Also, if the number of available television signals is limited, for instance 32, no more than 32 lines connecting the bundling unit BU to the DSLAM 10 are necessary for television signals, while the number of clients may exceed 32.

Information message

[0069] According to an embodiment, the bundling unit BU is further arranged to:

- generate an information message comprising a list of television signals that are being transmitted by the bundling unit BU to the clients CL1, CL2, CL3, CL4,
- transmit the information message to at least one client CL1, CL2, CL3, CL4 to be displayed on a television set TV of the at least one client CL1, CL2, CL3, CL4.

[0070] According to this embodiment, in use, the bundling unit BU has knowledge about which clients CL1, CL2, CL3, CL4 receive which television signals. The bundling unit BU may be arranged to send an information message to a client CL1 to be displayed on the television set TV of that client CL1 informing the client CL1 of the television signals that are being transmitted by the bundling unit BU to the clients CL1, CL2, CL3, CL4.

[0071] The information message may comprise a list of television signals that are being transmitted by the bundling unit BU to the other clients CL2, CL3, CL4 (i.e. not comprising the recipient of the information message) or all clients CL1, CL2, CL3, CL4. The list may only comprise television signals that are transmitted to at least a predetermined threshold number of clients. In the example according to the figures the predetermined threshold number may be two. The list may also only comprise the television signals that are transmitted most, such as a list of the three or five most watched television signals.

[0072] The information message may only be sent to clients that do not already watch the television signals comprised in the list of television signals in the information message.

[0073] The information message may inform a client CL1 of television programs that are being watched by the other clients CL2, CL3, CL4, so the client CL1 is informed of other popular programs. The effect of this may be that the informed client may change to one of the television signal comprised in the information message, thereby creating more available bandwidth on the lines L1, L2, L3, L4 between the bundling unit BU and the DSLAM 10.

[0074] The information message may be sent as part of action 104 if not enough bandwidth is available.

Exchanging program files

[0075] The bundling unit BU may further be arranged to facilitate exchange of program files between clients CL1, CL2, CL3, CL4 connected to the same bundling unit BU. Each client CL1, CL2, CL3, CL4 may be arranged to record television signals and store them as program files on memory ME, such as memory associated with the television set TV, external memory, or memory associated with a set-top box.

[0076] This is further explained with reference to Fig. 6, showing an exemplary flow diagram with actions as performed by a providing client CL1, a bundling unit BU and a requesting client CL2.

[0077] The providing client CL1, i.e. memory ME and/or the television set TV associated with the providing client CL1, may be arranged to generate a list of stored program files in action 201. In action 202 the providing client CL1 uploads this list to the bundling unit BU via line L1'.

[0078] The bundling unit BU is arranged to receive this list in action 203. In fact, the bundling unit BU may be arranged to receive similar lists from different providing clients CL2, CL3, CL4, although this is not shown in Fig. 6.

[0079] In action 204, the bundling unit BU generates a combined list of stored program files, being a combination of all lists received from the different providing clients in action 203. In action 205, this combined list is transmitted to at least one client, in this example client CL2, via line L2'. Of course, the bundling unit BU may also transmit the combined list to other clients.

[0080] It will be understood that actions 204 and 205 may be repeated every time a new list is received from one of the providing clients.

[0081] The combined list is received by requesting client CL2 in action 206 and subsequently displayed by the requesting client C2 in action 207. Action 207 may for instance be performed upon request of a user associated with the requesting client CL2. The requesting client CL2 may be arranged to receive a selection made by the user from the combined list displayed in action 207. The selection may for instance be received via a remote control, controlling the television set TV.

[0082] The selection is then uploaded to the bundling unit BU in action 209 via line L2'. In action 210, the bundling unit BU receives the selection and forwards the selection to the providing client, in this case providing client CL1. The appropriate providing client may be determined by the bundling unit BU by consulting stored copies of the lists received from the different providing clients in action 203.

[0083] In action 211, the providing client CL1 receives the selection and in response, uploads the selected program file to the bundling unit BU in action 212, the bundling unit BU in turn forwarding the program file to the requesting client CL2 in action 213. Finally the program file is received by the requesting client CL2 in action 214. Action 214 may further comprise displaying the received program file and/or storing the received program file on memory associated with the requesting client C L2.

[0084] Depending on the case, the transfer of the pro-

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gram file may be a streaming feed allowing immediate displaying on the receiving side (possibly using buffering techniques). In case no immediate real-time displaying is required, the transfer may use other transfer techniques and protocols.

[0085] It will be understood that a client may be both a providing client as a requesting client, i.e. a client may share certain programs with the other clients and at the same time request other programs from the other clients.

[0086] Furthermore, exchanging program files may be provided with security measures as passwords and the like to make sure that users can decide which program files may be shared by other clients (by assigning a password known to (some) other clients or not assigning a password at all) and which program files may not be shared (by assigning a secret password).

[0087] So, according to this embodiment there is provided a bundling unit BU for facilitating communication between a plurality of clients CL1, CL2, CL3, CL4, wherein the bundling unit BU is arranged to communicate with the clients CL1, CL2, CL3, CL4 via a set of lines L1', L2', L3', L4', and the bundling unit (BU) is arranged to

I) receive at least one list of program files from providing clients CL1, CL2, CL3, CL4 comprising information about program files stored in association with certain providing clients,
II) generate a combined list of program files based on the at least one received list of program files,
III) transmit the combined list to at least one requesting client CL2,
IV) receive a selection of a program file comprised in the combined list from a requesting client CL2,
V) forward the selection to a providing client CL1, and
VI) facilitate transmittal of the selected program from the providing client CL1 to the requesting client CL2.
When used like this, the bundling unit BU may also be referred to as an exchange unit.

[0088] This embodiment may be combined with other embodiments provided above. Thus, the bundling unit BU may be arranged for facilitating communication between a plurality of clients CL1, CL2, CL3, CL4 and a DSLAM 10 in a DSL network to transmit at least one signal from the DSLAM 10 to at least one client CL1, CL2, CL3, CL4 upon request, wherein the bundling unit BU is arranged to communicate with the DSLAM 10 via a first set of lines L1, L2, L3, L4 and with the clients CL1, CL2, CL3, CL4 via a second set of lines L1', L2', L3', L4', and the bundling unit BU is arranged to a) receive a request for a signal from a client (100);

b) verify if the requested signal is already available at the bundling unit (BU) (102) and

b1) if so, forward the requested signal to the client (103), and
b2) if not, select one of the available lines (L1, L2, L3, L4) to forward the request to the DSLAM (10) (106).

Further remarks

[0089] The above embodiments have several advantages, some of which are already mentioned above.

[0090] In case two or more clients watch the same television channel (multicast channel), the associated television signal only needs to be transmitted once by the DSLAM 10 to the bundling unit BU. This reduces the amount of bandwidth used on lines L1, L2, L3, L4. So, the bundling unit BU is used to bundle different channels to avoid unnecessary multicast messages being transmitted by the DSLAM 10.

[0091] Also, if a single clients wants to receive two television signals at the same time (e.g. watching two different television channels on two different television sets), the two television signals are not necessarily transmitted via a single line, i.e. the line associated with the client. The bundling unit BU is now capable of using two lines for handling the request for two television signals, if a second line is available.

[0092] As a consequence, a client that is situated relatively far away from the DSLAM 10 can now be offered more television channels. So, the embodiments at least partially compensate the disadvantage of reduced bandwidth experienced by a client being relatively far away from the DSLAM 10.

[0093] The distance to the DSLAM 1 is reduced, as the relevant distance is now the longest distance of

A) the distance between a client and the bundling unit BU or
B) the distance between the bundling unit BU and the DSLAM 1.

[0094] So, it is no longer the total distance between the client and the DSLAM 10 that is relevant. In most cases the relevant distance is the distance between the bundling unit BU and the DSLAM 1, as this is usually the longest, though this will be still be shorter than distance A or B. So, a higher throughput can be achieved over a line L1, L2 L3, L4, such as a twisted pair cable.

[0095] Furthermore, the embodiments can be integrated in existing infrastructure, such as existing ADSL2+ infrastructure, without requiring serious modifications in the architecture. Migration to newer technologies can be postponed due to the provided higher (experienced) bandwidth.

[0096] The descriptions above are intended to be illustrative, not limiting. Thus, it will be apparent to one skilled in the art that modifications may be made to the invention as described without departing from the scope of the claims set out below.

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Claims

1. Bundling unit (BU) for facilitating communication between a plurality of clients (CL1, CL2, CL3, CL4) and a DSLAM (10) in a DSL network to transmit at least one signal from the DSLAM (10) to at least one client (CL1, CL2, CL3, CL4) upon request, wherein the bundling unit (BU) is arranged to communicate with the DSLAM (10) via a first set of lines (L1, L2, L3, L4) and with the clients (CL1, CL2, CL3, CL4) via a second set of lines (L1', L2', L3', L4'), and the bundling unit (BU) is arranged to

   a) receive a request for a signal from a client (100);
   b) verify if the requested signal is already available at the bundling unit (BU) (102) and

      b1) if so, forward the requested signal to the client (103), and
      b2) if not, select one of the available lines (L1, L2, L3, L4) to forward the request to the DSLAM (10) (106).

2. Bundling unit (BU) according to claim 1, wherein the bundling unit (BU) is further arranged to

   c) in reaction to b2) receive the requested signal from the DSLAM (10) and forward the signal to the client (108).

3. Bundling unit (BU) according to claim 1, wherein the signal is a multicast signal.

4. Bundling unit (BU) according to any one of the preceding claims, wherein the bundling unit (BU) is further arranged to

   a1) use client subscription information to verify if the client the request was received from is allowed to receive the requested television channel.

5. Bundling device (BU) according to claim 4, further comprising or having access to a memory (12, 13, 14, 15) comprising client subscription information.

6. Bundling unit (BU) according to any one of the preceding claims, wherein the bundling device (BU) further comprises a plurality of client connectors (31, 32, 33, 34) to communicate with the at least one client (CL1, CL2, CL3, CL4) via the second set of lines (L1', L2', L3', L4') respectively.

7. Bundling unit (BU) according to any one of the preceding claims, wherein the bundling device (BU) further comprises a plurality of DSLAM connectors (41, 42, 43, 44) to communicate with the DSLAM (10) via the first set of lines (L1, L2, L3, L4) respectively.

8. Bundling unit (BU) according to claims 6 and 7, comprising more client connectors (31, 32, 33, 34) than DSLAM connectors (41, 42, 43, 44).

9. Bundling unit (BU) according to claims 6 and 7, comprising less client connectors (31, 32, 33, 34) than DSLAM connectors (41, 42, 43, 44).

10. Bundling unit (BU) according to any one of the preceding claims, wherein action b2 further comprises

    b2-1) verify if bandwidth is available on one of the lines comprised by the first set of lines (L1, L2, L3, L4) to meet the request (104), and if not b2-2) re-distribute signals already received via the first set of lines (L1, L2, L3, L4) over the first set of lines (L1, L2, L3, L4) to create bandwidth for the requested signal, if possible.

11. Bundling unit (BU) according to any one of the preceding claims, wherein the bundling unit (BU) is further be arranged to

    - generate an information message comprising a list of television signals that are being transmitted by the bundling unit (BU) to the clients (CL1, CL2, CL3, CL4),
    - transmit the information message to at least one client (CL1, CL2, CL3, CL4) to be displayed on a television set (TV) of the at least one client (CL1, CL2, CL3, CL4).

12. Bundling unit (BU) according to any one of the preceding claims, wherein the bundling unit (BU) is further be arranged to

    I) receive at least one list of program files from providing clients (CL1, CL2, CL3, CL4) comprising information about program files stored in association with certain providing clients,
    II) generate a combined list of program files based on the at least one received list of program files,
    III) transmit the combined list to at least one requesting client (CL2),
    IV) receive a selection of a program file comprised in the combined list from a requesting client (CL2),
    V) forward the selection to a providing client (CL1), and
    VI) facilitate transmittal of the selected program from the providing client (CL1) to the requesting client (CL2).

13. Method for operating a bundling unit (BU) for facilitating communication between a plurality of clients

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(CL1, CL2, CL3, CL4) and a DSLAM (10) in a DSL network to transmit at least one signal from the DSLAM (10) to at least one client (CL1, CL2, CL3, CL4) upon request, wherein the method comprises

a) receiving a request for a signal from a client (100);
b) verifying if the requested signal is already available at the bundling unit (BU) (102) and

b1) if so, forward the requested signal to the client (103), and
b2) if not, select one of the available lines (L1, L2, L3, L4) to forward the request to the DSLAM (10) (106).

14. Method according to claim 13, further comprising

c) in reaction to b2) receiving the requested signal from the DSLAM (10) and forward the signal to the client (108).

15. Method according to any one of the claims 13 - 14, , wherein action b2 further comprises

b2-1) verifying if bandwidth is available on one of the lines comprised by the first set of lines (L1, L2, L3, L4) to meet the request (104), and if not
b2-2) re-distributing signals already received via the first set of lines (L1, L2, L3, L4) over the first set of lines (L1, L2, L3, L4) to create bandwidth for the requested signal, if possible.

16. Method according to any one of the claims 13 - 15, wherein the method further comprises

- generating an information message comprising a list of television signals that are being transmitted by the bundling unit (BU) to the clients (CL1, CL2, CL3, CL4),
- transmit the information message to at least one client (CL1, CL2, CL3, CL4) to be displayed on a television set (TV) of the at least one client (CL1, CL2, CL3, CL4).

17. Method according to any one of the claims 13 - 16, wherein the method further comprises

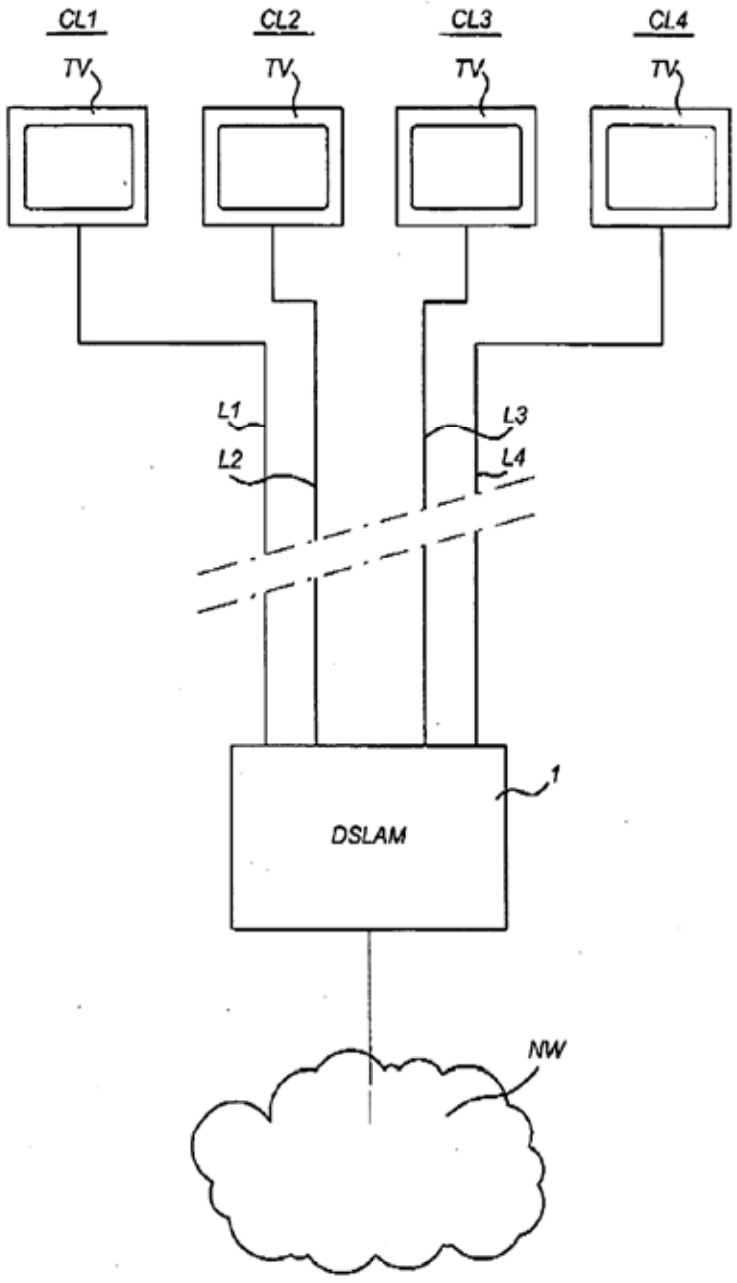
I) receiving at least one list of program files from providing clients (CL1, CL2, CL3, CL4) comprising information about program files stored in association with certain providing clients,
II) generating a combined list of program files based on the at least one received list of program files,
III) transmitting the combined list to at least one requesting client (CL2),
IV) receiving a selection of a program file comprised in the combined list from a requesting client (CL2),
V) forwarding the selection to a providing client (CL21), and
VI) facilitating transmittal of the selected program from the providing client (CL1) to the requesting client (CL2).

18. Computer program product comprising data and instructions that can be loaded by a computer arrangement, allowing said computer arrangement to perform the methods according to any one of the claims 13 - 17.

19. Data carrier provided with a computer program product as claimed in claim 18.

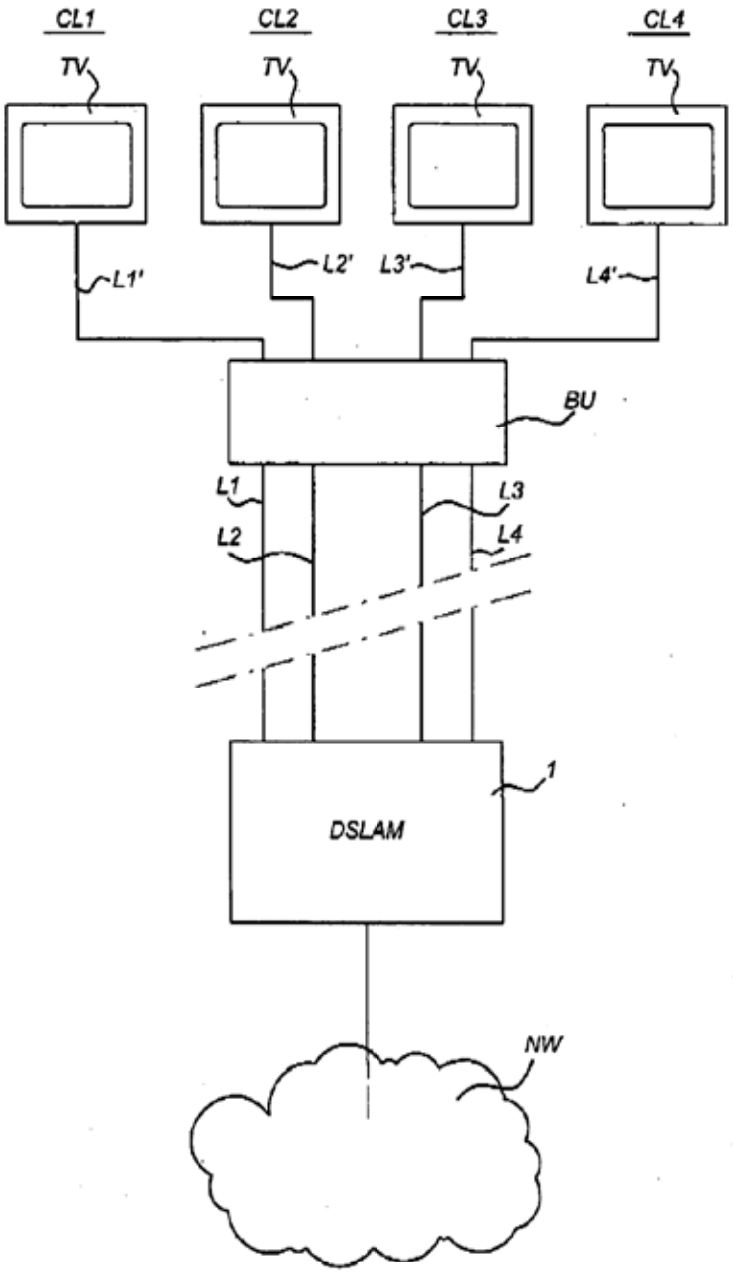
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Fig 1



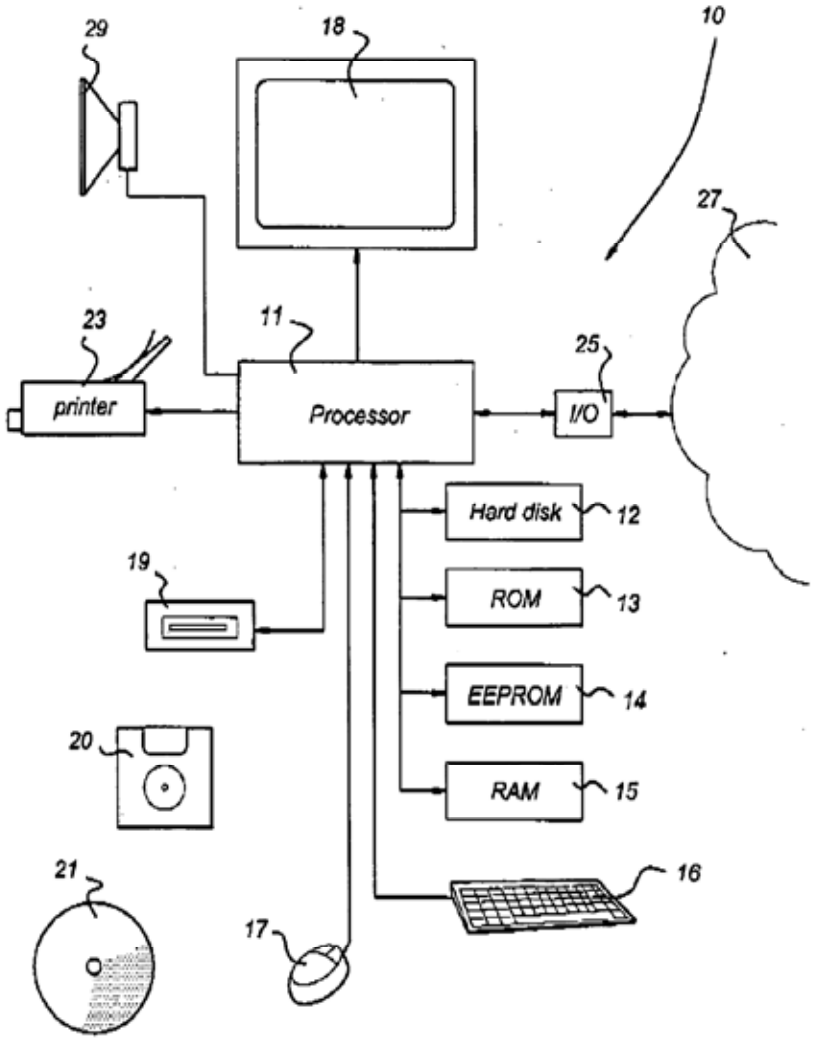
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Fig 2



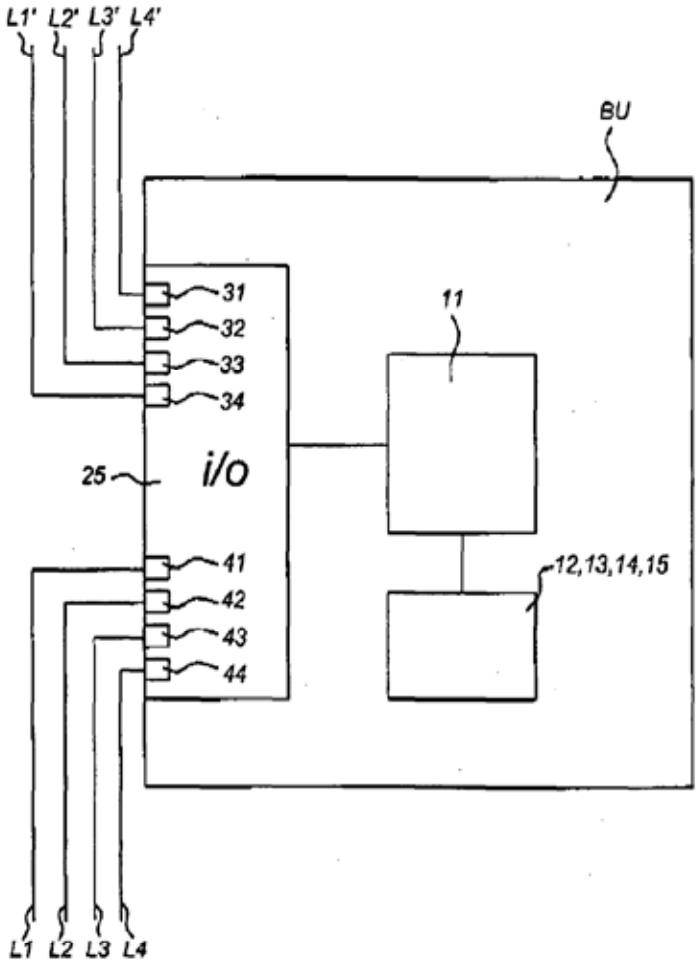
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Fig 3



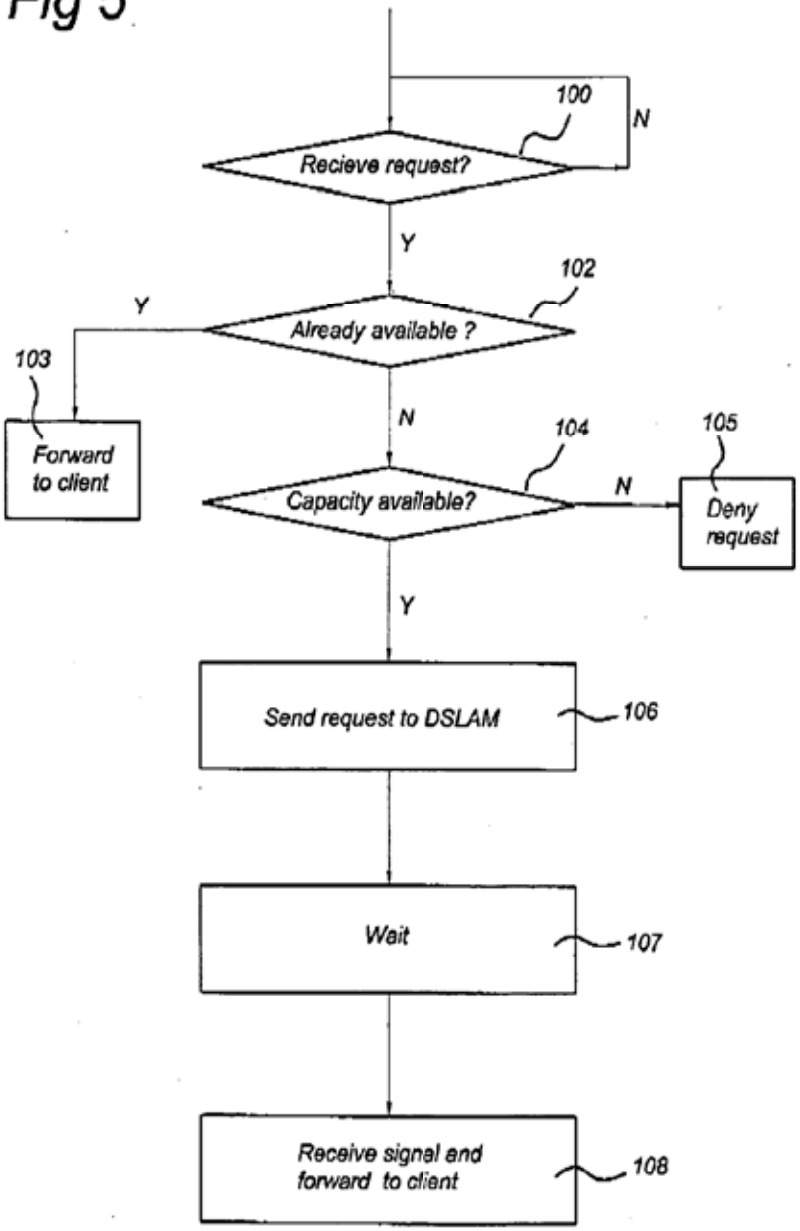
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Fig 4



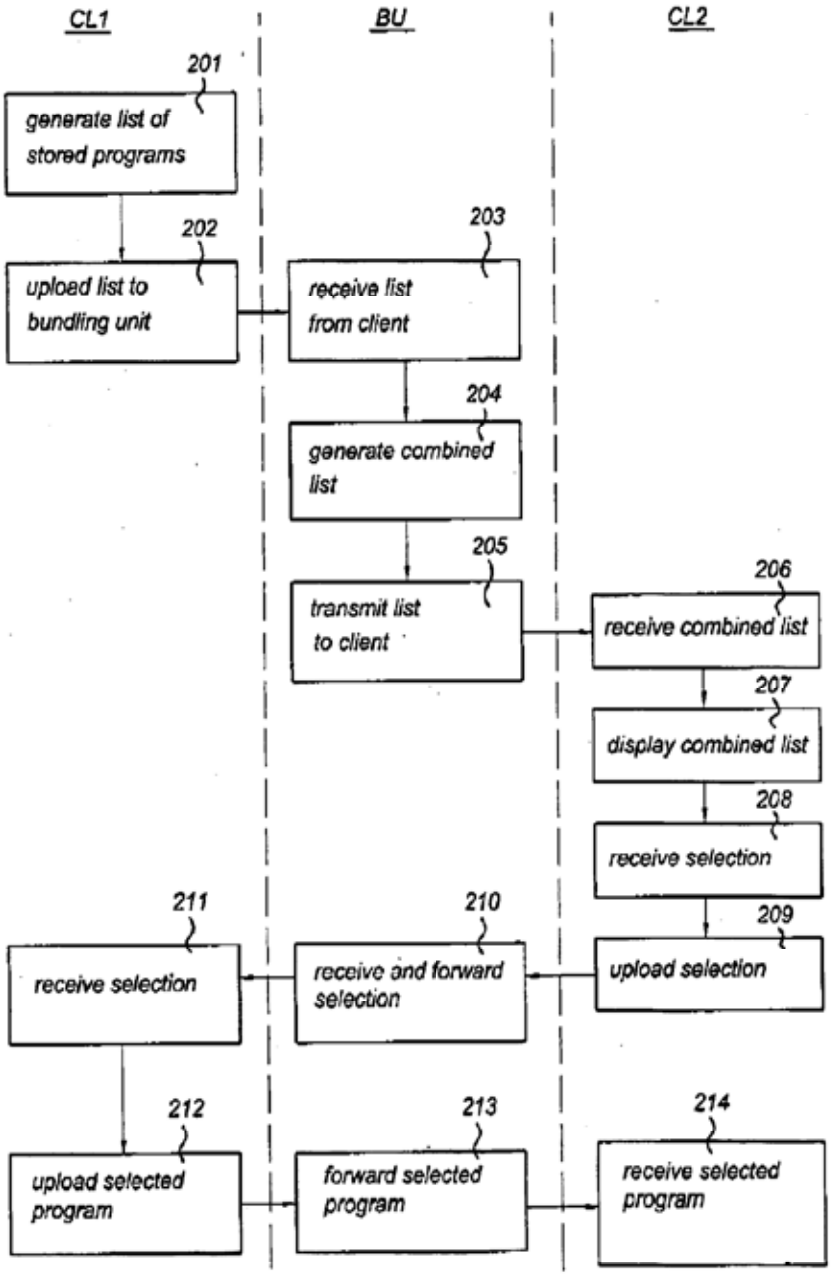
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Fig 5



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Fig 6



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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 08 00 7883

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 1 819 093 A (HUAWEI TECH CO LTD [CN]) 15 August 2007 (2007-08-15) * the whole document *	1-19	INV. H04L12/18 H04M11/06
X	WO 2007/116411 A (LINK FUSION LTD [IL]; FERMON ISRAEL [IL]) 18 October 2007 (2007-10-18) * page 13, line 23 - page 17, line 3 * * page 23, line 4 - page 24, line 13 *	1-19	
A	BEES, DUNCAN: "Flexible Bandwidth Services with DSL Bonding" TECHNOLOGY WHITE PAPER, [Online] August 2002 (2002-08), pages 1-23, XP002495657 Retrieved from the Internet: URL:http://www.pmc-sierra.com/cgi-bin/document.pl?docnum=2021395> [retrieved on 2008-09-12] * paragraph [2.13]; figure 1 *	1-19	
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A	EP 1 134 932 A (CIT ALCATEL [FR]) 19 September 2001 (2001-09-19) * paragraph [0022] - paragraph [0035]; figures 1-4 *	1-19	

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	15 September 2008	Eraso Helguera, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
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T : theory or principle underlying the invention
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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 08 00 7883

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	SCOTT SHOAF ET AL: "IGMP Capabilities in Broadband Network Architectures" INTERNET CITATION, [Online] XP002459905 Retrieved from the Internet: URL:http://www.juniper.net/solutions/literature/app_note/350060.pdf> [retrieved on 2007-11-26] * the whole document * -----	1-19	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	15 September 2008	Eraso Helguera, J

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 08 00 7883

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15-09-2008

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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(19)日本国特許庁(JP)　(12)公開特許公報(A)　(11)特許出願公開番号
特開2004-173170
(P2004-173170A)
(43)公開日　平成16年6月17日(2004.6.17)

(51)Int.Cl.[7]	F I		テーマコード（参考）
H04L 12/56	H04L 12/56	200F	5K025
G06F 17/60	H04L 12/56	C	5K030
H04L 12/46	G06F 17/60	332	5K033
H04M 11/00	G06F 17/60	502	5K101
H04M 15/00	H04L 12/46	B	

審査請求 未請求　請求項の数 17　OL　（全 26 頁）　最終頁に続く

(21)出願番号　特願2002-339334(P2002-339334)
(22)出願日　平成14年11月22日(2002.11.22)

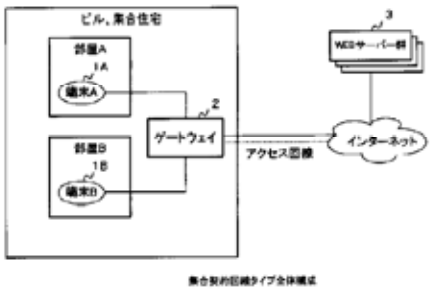
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Ｆターム(参考)　5K025 AA07　BB10　GG05

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(54)【発明の名称】インターネット接続システム

(57)【要約】
【課題】集合住宅、ビルにおいてインターネットアクセスを共有する場合に、余った通信帯域を他の部屋に割り振ると同時に、使用した通信帯域によって各部屋の通信料金を設定するインターネット接続システムを提供する。
【解決手段】予め定めた複数区域の各区域から端末によりインターネットアクセスを共有するインターネット接続システムで、通信している端末が属する区域を識別し、各区域毎の使用実績通信帯域に基づいて通信料金を算出する。また、各区域毎の使用通信帯域を識別し、通信帯域が余っている区域から不足している区域へ通信帯域を動的に割り振る。
【選択図】　図１



集合契約区域タイプ全体構成

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【特許請求の範囲】
【請求項１】
予め定めた複数区域の各区域から端末によりインターネットにアクセスして接続するインターネット接続システムにおいて、
通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出することを特徴とするインターネット接続システム。
【請求項２】
予め定めた複数区域の各区域から端末によりインターネットにアクセスして接続するインターネット接続システムにおいて、
通信している端末が属する区域と、各区域毎の使用通信帯域を識別し、通信帯域が余っている区域から不足している区域へ通信帯域を動的に割り振ることを特徴とするインターネット接続システム。
【請求項３】
予め定めた複数区域の各区域に属する少なくとも１つの端末を、少なくとも２つの区域で共有する１つのゲートウェイとアクセス回線を介してインターネットに接続し、
通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出することを特徴とするインターネット接続システム。
【請求項４】
予め定めた複数区域の各区域には、前記各区域に属する少なくとも１つの端末と前記端末と接続されているゲートウェイとを有し、前記端末を各区域のゲートウェイに接続されているアクセス回線を介してインターネットに接続し、
通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出することを特徴とするインターネット接続システム。
【請求項５】
予め定めた複数区域の各区域には、前記各区域に属する少なくとも１つの端末と前記端末と接続されているゲートウェイとを有し、前記端末を各区域のゲートウェイに接続されているアクセス回線を介してインターネットに接続し、
通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出することを特徴とするインターネット接続システム。
【請求項６】
予め定めた複数区域の各区域には、前記各区域に属する少なくとも１つの端末と前記端末と接続されているゲートウェイとを有し、各区域のゲートウェイに接続されているアクセス回線を介して前記端末をインターネットに接続し、
前記各区域毎に前記ゲートウェイを介して接続されているアクセス回線の通信量を比較し、より少ない通信量のアクセス回線が接続されているゲートウェイを介して前記端末をインターネットに接続することを特徴とするインターネット接続システム。
【請求項７】
予め定めた複数区域の各区域には、前記各区域に属する少なくとも１つの端末と前記端末と接続されているゲートウェイとを有し、各区域のゲートウェイに接続されているアクセス回線を介して前記端末をインターネットに接続し、
前記各区域毎に前記ゲートウェイを介して接続されているアクセス回線の通信量を比較し、より少ない通信量のアクセス回線が接続されているゲートウェイを介して前記端末をインターネットに接続するとともに、
通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出することを特徴とするインターネット接続システム。

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【請求項８】
予め定めた複数区域の各区域の一の区域には、前記一の区域に属する少なくとも１つの無線端末と前記無線端末と無線ＬＡＮ接続された無線ＬＡＮ基地局を有し、
前記一の区域に隣接する他の区域には、前記一の区域に属する無線ＬＡＮ基地局と無線ＬＡＮ接続された少なくとも１つの無線端末を有し、
前記無線ＬＡＮ基地局に接続されているゲートウェイと、このゲートウェイに接続されているアクセス回線を介して前記無線端末をインターネットに接続することを特徴とするインターネット接続システム。
【請求項９】
予め定めた複数区域の各区域の一の区域には、前記一の区域に属する少なくとも１つの無線端末と前記無線端末と無線ＬＡＮ接続された無線ＬＡＮ基地局を有し、
前記一の区域に隣接する他の区域には、前記一の区域に属する無線ＬＡＮ基地局と無線ＬＡＮ接続された少なくとも１つの無線端末を有し、
前記無線ＬＡＮ基地局に接続されているゲートウェイと、このゲートウェイに接続されているアクセス回線を介して前記無線端末をインターネットに接続するとともに、
通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出することを特徴とするインターネット接続システム。
【請求項１０】
予め定めた複数区域のそれぞれの区域には、少なくとも１つの無線端末と、この無線端末と無線ＬＡＮ接続された無線ＬＡＮ基地局を有し、
前記各無線端末は、自己の属する区域以外の他の区域の無線ＬＡＮ基地局とも無線ＬＡＮ接続され、
前記複数の区域に属する無線ＬＡＮ基地局が共通のゲートウェイに接続され、前記ゲートウェイに接続されているアクセス回線を介してインターネットに接続され、
通信中の無線端末とこの通信中の無線端末に無線ＬＡＮ接続された他の区域に属する無線ＬＡＮ基地局との通信速度を測定し、より高速な通信速度が測定された無線ＬＡＮ基地局とゲートウェイ及びアクセス回線を介して前記無線端末をインターネットに接続することを特徴とするインターネット接続システム。
【請求項１１】
予め定めた複数区域のそれぞれの区域には、少なくとも１つの無線端末と、この無線端末と無線ＬＡＮ接続された無線ＬＡＮ基地局を有し、
前記各無線端末は、自己の属する区域以外の他の区域の無線ＬＡＮ基地局とも無線ＬＡＮ接続され、
前記複数の区域に属する無線ＬＡＮ基地局が共通のゲートウェイに接続され、前記ゲートウェイに接続されているアクセス回線を介してインターネットに接続され、
通信中の無線端末とこの通信中の無線端末に無線ＬＡＮ接続された他の区域に属する無線ＬＡＮ基地局との通信速度を測定し、より高速な通信速度が測定された無線ＬＡＮ基地局とゲートウェイ及びアクセス回線を介して前記無線端末をインターネットに接続するとともに、
通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出することを特徴とするインターネット接続システム。
【請求項１２】
予め定めた複数区域のそれぞれの区域には、少なくとも１つの無線端末と、前記無線端末と無線ＬＡＮ接続された無線ＬＡＮ基地局を有し、
前記各無線端末は、自己の属する区域以外の他の区域の無線ＬＡＮ基地局とも無線ＬＡＮ接続され、
前記複数の区域に属する無線ＬＡＮ基地局がそれぞれゲートウェイに接続され、前記ゲートウェイに接続されているアクセス回線を介してインターネットに接続され、

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通信中の無線端末とこの通信中の無線端末に無線ＬＡＮ接続された他の区域に属する無線ＬＡＮ基地局との通信速度を測定し、より高速な通信速度が測定された無線ＬＡＮ基地局とゲートウェイ及びアクセス回線を介して前記無線端末をインターネットに接続することを特徴とするインターネット接続システム。

【請求項１３】

予め定めた複数区域のそれぞれの区域には、少なくとも１つの無線端末と、前記無線端末と無線ＬＡＮ接続された無線ＬＡＮ基地局を有し、

前記各無線端末は、自己の属する区域以外の他の区域の無線ＬＡＮ基地局とも無線ＬＡＮ接続され、

前記複数の区域に属する無線ＬＡＮ基地局がそれぞれゲートウェイに接続され、前記ゲートウェイに接続されているアクセス回線を介してインターネットに接続され、

通信中の無線端末とこの通信中の無線端末に無線ＬＡＮ接続された他の区域に属する無線ＬＡＮ基地局との通信速度を測定し、より高速な通信速度が測定された無線ＬＡＮ基地局とゲートウェイ及びアクセス回線を介して前記無線端末をインターネットに接続するとともに、

通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出することを特徴とするインターネット接続システム。

【請求項１４】

前記各区域毎に最大通信速度が予め設定され、前記端末が属する区域における通信帯域の合計が前記最大通信速度を超えたときには、通信動作を待ち状態とし、前記最大通信速度以下になったときに、通信動作を再開させることを特徴とする請求項１乃至１３のいずれかに記載のインターネット接続システム。

【請求項１５】

一の区域のユーザが他の区域のユーザの通信帯域分を使用し、前記一の区域のユーザは、その使用分の料金を前記他の区域のユーザに支払うことを特徴とする請求項１乃至１４のいずれかに記載のインターネット接続システム。

【請求項１６】

予め登録されたＭＡＣアドレスを有する端末のみ通信を可能とする信号を出力するとともに、前記ＭＡＣアドレス、前記端末の属する区域番号、前記端末の総通信量、全区域の総通信量に対する当該端末の総通信量の比、前記比率の配分で料金を算出することを特徴とする請求項１乃至１５のいずれかに記載のインターネット接続システム。

【請求項１７】

前記区域は、部屋であることを特徴とする請求項１乃至１６のいずれかに記載のインターネット接続システム。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】

本発明は、インターネット接続システムに関し、例えば、通信帯域が異なるにもかかわらず、集合住宅、ビル等におけるインターネット接続共有時の使用料金が一定であるという、ユーザの不満を解消し、インターネットアクセス回線業者もしくは、集合住宅、ビルの経営者の収益向上を図るインターネット接続システムに関する。

【０００２】

【従来の技術】

従来のこの種のインターネット接続システムでは、複数の部屋の各部屋の端末は１つのインターネットアクセス回線を１つのゲートウェイによって共用している。これまでは、このようにインターネットアクセス回線を共有する場合、各部屋の最大通信帯域を固定にして、均一なサービスを一定の料金で提供していた。

【０００３】

【発明が解決しようとする課題】

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かかるインターネット接続システムにおいては、集合住宅、ビルにおいて、インターネットアクセスを共有する場合に、各部屋の使用用途（住居、オフィス、店舗等）や人員構成によりインターネット使用頻度、最多使用時間帯がばらばらであるにも関わらず、従来の方法では各部屋に固定の通信帯域しか割り振られず、使用料金も各部屋共通で一定であった。そのため、通信帯域をあまり使っていない場合でも、通信帯域を使いきった場合でも利用料金が一定となり不公平感が多かった。また時間帯や混雑度によって一時的に通信帯域が不足している場合でも、他の時間帯や混雑していない場合には逆に通信帯域が余っている場合もあり、帯域を効率的に利用できていない不満があった。

【０００４】

そこで、本発明の目的は、集合住宅、ビルにおいてインターネットアクセスを共有する場合に、余った通信帯域を他の部屋に割り振り公平な帯域配分を可能とするインターネット接続システムを提供することにある。

【０００５】

本発明の他の目的は、使用した通信帯域によって各部屋の通信料金を公平に設定するインターネット接続システムを提供することにある。

【０００６】

【課題を解決するための手段】

前述の課題を解決するため、本発明によるインターネット接続システムは、次のような特徴的な構成を採用している。

【０００７】

（１）予め定めた複数区域の各区域から端末によりインターネットにアクセスして接続するインターネット接続システムにおいて、

通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出するインターネット接続システム。

【０００８】

（２）予め定めた複数区域の各区域から端末によりインターネットにアクセスして接続するインターネット接続システムにおいて、

通信している端末が属する区域と、各区域毎の使用通信帯域を識別し、通信帯域が余っている区域から不足している区域へ通信帯域を動的に割り振るインターネット接続システム。

【０００９】

（３）予め定めた複数区域の各区域に属する少なくとも１つの端末を、少なくとも２つの区域で共有する１つのゲートウェイとアクセス回線を介してインターネットに接続し、

通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出するインターネット接続システム。

【００１０】

（４）予め定めた複数区域の各区域には、前記各区域に属する少なくとも１つの端末と前記端末と接続されているゲートウェイとを有し、前記端末を各区域のゲートウェイに接続されているアクセス回線を介してインターネットに接続し、通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出するインターネット接続システム。

【００１１】

（５）予め定めた複数区域の各区域には、前記各区域に属する少なくとも１つの端末と前記端末と接続されているゲートウェイとを有し、前記端末を各区域のゲートウェイに接続されているアクセス回線を介してインターネットに接続し、

通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出するインターネット接続システム。

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【００１２】
（６）予め定めた複数区域の各区域には、前記各区域に属する少なくとも１つの端末と前記端末と接続されているゲートウェイとを有し、各区域のゲートウェイに接続されているアクセス回線を介して前記端末をインターネットに接続し、
前記各区域毎に前記ゲートウェイを介して接続されているアクセス回線の通信量を比較し、より少ない通信量のアクセス回線が接続されているゲートウェイを介して前記端末をインターネットに接続するインターネット接続システム。
【００１３】
（７）予め定めた複数区域の各区域には、前記各区域に属する少なくとも１つの端末と前記端末と接続されているゲートウェイとを有し、各区域のゲートウェイに接続されているアクセス回線を介して前記端末をインターネットに接続し、
前記各区域毎に前記ゲートウェイを介して接続されているアクセス回線の通信量を比較し、より少ない通信量のアクセス回線が接続されているゲートウェイを介して前記端末をインターネットに接続するとともに、
通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出するインターネット接続システム。
【００１４】
（８）予め定めた複数区域の各区域の一の区域には、前記一の区域に属する少なくとも１つの無線端末と前記無線端末と無線ＬＡＮ接続された無線ＬＡＮ基地局を有し、
前記一の区域に隣接する他の区域には、前記一の区域に属する無線ＬＡＮ基地局と無線ＬＡＮ接続された少なくとも１つの無線端末を有し、
前記無線ＬＡＮ基地局に接続されているゲートウェイと、このゲートウェイに接続されているアクセス回線を介して前記無線端末をインターネットに接続するインターネット接続システム。
【００１５】
（９）予め定めた複数区域の各区域の一の区域には、前記一の区域に属する少なくとも１つの無線端末と前記無線端末と無線ＬＡＮ接続された無線ＬＡＮ基地局を有し、
前記一の区域に隣接する他の区域には、前記一の区域に属する無線ＬＡＮ基地局と無線ＬＡＮ接続された少なくとも１つの無線端末を有し、
前記無線ＬＡＮ基地局に接続されているゲートウェイと、このゲートウェイに接続されているアクセス回線を介して前記無線端末をインターネットに接続するとともに、
通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出するインターネット接続システム。
【００１６】
（１０）予め定めた複数区域のそれぞれの区域には、少なくとも１つの無線端末と、この無線端末と無線ＬＡＮ接続された無線ＬＡＮ基地局を有し、
前記各無線端末は、自己の属する区域以外の他の区域の無線ＬＡＮ基地局とも無線ＬＡＮ接続され、
前記複数の区域に属する無線ＬＡＮ基地局が共通のゲートウェイに接続され、前記ゲートウェイに接続されているアクセス回線を介してインターネットに接続され、
通信中の無線端末とこの通信中の無線端末に無線ＬＡＮ接続された他の区域に属する無線ＬＡＮ基地局との通信速度を測定し、より高速な通信速度が測定された無線ＬＡＮ基地局とゲートウェイ及びアクセス回線を介して前記無線端末をインターネットに接続するインターネット接続システム。
【００１７】
（１１）予め定めた複数区域のそれぞれの区域には、少なくとも１つの無線端末と、この無線端末と無線ＬＡＮ接続された無線ＬＡＮ基地局を有し、
前記各無線端末は、自己の属する区域以外の他の区域の無線ＬＡＮ基地局とも無線ＬＡＮ

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接続され、
前記複数の区域に属する無線ＬＡＮ基地局が共通のゲートウェイに接続され、前記ゲートウェイに接続されているアクセス回線を介してインターネットに接続され、
通信中の無線端末とこの通信中の無線端末に無線ＬＡＮ接続された他の区域に属する無線ＬＡＮ基地局との通信速度を測定し、より高速な通信速度が測定された無線ＬＡＮ基地局とゲートウェイ及びアクセス回線を介して前記無線端末をインターネットに接続するとともに、
通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出するインターネット接続システム。

【００１８】
（１２）予め定めた複数区域のそれぞれの区域には、少なくとも１つの無線端末と、前記無線端末と無線ＬＡＮ接続された無線ＬＡＮ基地局を有し、
前記各無線端末は、自己の属する区域以外の他の区域の無線ＬＡＮ基地局とも無線ＬＡＮ接続され、
前記複数の区域に属する無線ＬＡＮ基地局がそれぞれゲートウェイに接続され、前記ゲートウェイに接続されているアクセス回線を介してインターネットに接続され、
通信中の無線端末とこの通信中の無線端末に無線ＬＡＮ接続された他の区域に属する無線ＬＡＮ基地局との通信速度を測定し、より高速な通信速度が測定された無線ＬＡＮ基地局とゲートウェイ及びアクセス回線を介して前記無線端末をインターネットに接続するインターネット接続システム。

【００１９】
（１３）予め定めた複数区域のそれぞれの区域には、少なくとも１つの無線端末と、前記無線端末と無線ＬＡＮ接続された無線ＬＡＮ基地局を有し、
前記各無線端末は、自己の属する区域以外の他の区域の無線ＬＡＮ基地局とも無線ＬＡＮ接続され、
前記複数の区域に属する無線ＬＡＮ基地局がそれぞれゲートウェイに接続され、前記ゲートウェイに接続されているアクセス回線を介してインターネットに接続され、
通信中の無線端末とこの通信中の無線端末に無線ＬＡＮ接続された他の区域に属する無線ＬＡＮ基地局との通信速度を測定し、より高速な通信速度が測定された無線ＬＡＮ基地局とゲートウェイ及びアクセス回線を介して前記無線端末をインターネットに接続するとともに、
通信している端末が属する区域を識別し、各区域毎の使用通信帯域を記録し、前記記録されている各区域毎の使用通信帯域に応じて通信料金を算出するインターネット接続システム。

【００２０】
（１４）前記各区域毎に最大通信速度が予め設定され、前記端末が属する区域における通信帯域の合計が前記最大通信速度を超えたときには、通信動作を待ち状態とし、前記最大通信速度以下になったときに、通信動作を再開させることを特徴とする上記（１）乃至（１３のいずれかのインターネット接続システム。

【００２１】
（１５）一の区域のユーザが他の区域のユーザの通信帯域分を使用し、前記一の区域のユーザは、その使用分の料金を前記他の区域のユーザに支払う上記（１）乃至（１４）のいずれかのインターネット接続システム。

【００２２】
（１６）予め登録されたＭＡＣアドレスを有する端末のみ通信を可能とする信号を出力するとともに、前記ＭＡＣアドレス、前記端末の属する区域番号、前記端末の総通信量、全区域の総通信量に対する当該端末の総通信量の比、前記比率の配分で料金を算出する上記（１）乃至（１５）のいずれかのインターネット接続システム。

【００２３】

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（１７）前記区域は、部屋である上記（１）乃至（１６）のいずれかのインターネット接続システム。

【００２４】

【発明の実施の形態】

以下、本発明によるインターネット接続システムの好適実施形態例を添付図に基づいて説明する。

【００２５】

本発明は、基本的に、例えば、集合住宅、ビル等においてインターネットアクセスを共有する場合に、余った通信帯域を他の部屋に割り振ると同時に、使用した通信帯域によって各部屋の通信料金を変動させるようにしたものである。

【００２６】

図１は本発明によるインターネット接続システムの第１の実施形態例を示すシステム構成図である。

【００２７】

図１において、部屋Ａの端末１Ａと部屋Ｂの端末１Ｂは、ＷＥＢサーバー群３に対する１つのインターネットアクセス回線を１つのゲートウェイ２によって共用している。

【００２８】

従来は、このようにインターネットアクセス回線を共有する場合、各部屋の最大通信帯域を固定にして均一サービスを一定料金で提供していたが、本発明では、通信中の端末の利用者の部屋を識別し、各部屋毎に使用通信帯域（送受データ量）を記録しておき、これらの情報に基づいて各部屋毎に使用通信帯域に応じて通信料金を算出する。

【００２９】

本発明では、各部屋の使用用途（住居、オフィス、店舗等）や人員構成により、使用頻度や最多使用時間帯がばらばらな場合でも、通信帯域が余っている部屋から不足している部屋へ通信帯域を動的に割り振り、トータルの使用通信帯域の大小により料金を割り振ることにより、公平な帯域の配分を可能とする。したがって、帯域をあまり使用しなかった部屋は通信料金が下がり、帯域が不足していた部屋は多少通信料金が上がっても不足していた帯域を補うことが可能となる。

【００３０】

図１に示す実施形態は、一例として部屋Ａと部屋Ｂからなる建築物で、１つのインターネットアクセス回線を共通のゲートウェイ２で共有して使用する場合を想定している。また、部屋Ａにはインターネットアクセスするための端末１Ａを含み、部屋Ｂにはインターネットアクセスするための端末１Ｂを含む。本実施形態では説明を簡単化するため、各部屋における端末の数を１としているが、これらは各々複数あっても構わない。

【００３１】

尚、以下の説明では、部屋は通常使われている意味での部屋だけでなく、所定の定義で区分けされた区域を含むことは当然である。

【００３２】

端末１Ａは、図２に示すように構成され、アプリケーション部１１１と、通信制御部１１２と、無線ＬＡＮ　Ｉ／Ｆ部１１３とを含む。これらの処理部はそれぞれ概略次のように動作する。

【００３３】

アプリケーション部１１１は、ユーザへの画面表示やユーザからの入力検出と、通信制御部１１２への通信開始、停止の指示を行う。通信制御部１１２は、ＬＡＮ　Ｉ／Ｆ部１１３から受信したデータのアプリケーション部１１１への送信、アプリケーション部から送信要求されたデータのＬＡＮ　Ｉ／Ｆ部１１３への送信を行う。ＬＡＮ　Ｉ／Ｆ部１１３はＬＡＮ回線上のデータの送受信を行う。

【００３４】

ゲートウェイ２は、図３に示すように構成され、ＬＡＮ　Ｉ／Ｆ部Ａ２１１と、ＬＡＮ　Ｉ／Ｆ部Ｂ２１２と、ＷＡＮ　Ｉ／Ｆ部２１３と、通信制御部２１４と、認証要求・ゲー

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ト管理部２１５とを含む。これらの処理部はそれぞれ概略次のように動作する。

【００３５】

ＬＡＮ　Ｉ／Ｆ部Ａ２１１は部屋ＡのＬＡＮ回線上のデータの送受信を、ＬＡＮ　Ｉ／Ｆ部Ｂ２１２は部屋ＢのＬＡＮ回線上のデータの送受信を、ＷＡＮ　Ｉ／Ｆ部２１３はインターネット回線を通じてインターネット上の各種サーバー（ＷＥＢサーバー群）３とのデータ送受信を行う。

【００３６】

通信制御部２１４は、ＬＡＮ　Ｉ／Ｆ部Ａ２１１とＷＡＮ　Ｉ／Ｆ部２１３の間、及びＬＡＮ　Ｉ／Ｆ部Ｂ２１２とＷＡＮ　Ｉ／Ｆ部２１３の間の通信制御を行う。　認証要求・ゲート管理部２１５は、登録されたＭＡＣアドレスを持つ端末のみインターネット通信を行えるようにするもので、通信制御部２１４を介して参照される。また、後述するように、インターネットアクセスした端末の総通信量と課金管理を行う。

【００３７】

認証要求・ゲート管理部２１５は、内部テーブルとして図４に示されるテーブル情報を格納する。テーブル７１に登録された端末のＭＡＣアドレス、テーブル７２にその端末の使用者の部屋番号、７３にその端末がその月に使用した総通信量、テーブル７４に全部屋のその月の総通信量に対するその端末の総通信量の比率、テーブル７５にインターネットアクセス回線の月額使用料金をテーブル７４の比率で配分した料金をそれぞれ格納する。

【００３８】

次に、本実施形態の動作について具体的に説明する。

先ず、部屋Ａと部屋Ｂで使用する端末１Ａ及び端末１Ｂは、予めゲートウェイ２内の認証要求・ゲート管理部２１５のテーブル７１にＭＡＣアドレスを、テーブル７２に部屋番号を登録しておく。総通信量のテーブル７３、比率のテーブル７４、料金のテーブル７５は月末の決済時にクリアされる。

【００３９】

部屋Ａの端末１Ａがインターネット上のサーバーに対して通信を開始したとする。端末１Ａのアプリケーション部１１１は、通信制御部１１２に対してゲートウェイ２経由でインターネット上のサーバーとの通信を開始するように指示する。通信制御部１１２は、ＬＡＮ　Ｉ／Ｆ部１１３を制御し、ゲートウェイ経由でインターネット上のサーバーとデータの送受信を開始する。

【００４０】

ゲートウェイ２が端末１Ａからデータを受信すると、ＬＡＮ　Ｉ／Ｆ部Ａ２１１が先ずデータを受信し、通信制御部２１４に送信する。通信制御部２１４は、受信したデータに含まれる送信元端末のＭＡＣアドレスで認証要求・ゲート管理部２１５のテーブル７１のエントリを検索する。端末１Ａは使用端末として登録されているため、一致するエントリが見つかる。見つかった該当エントリのテーブル７３にそのデータのサイズ（受信データ量）を追加し、それにより再計算した比率、料金をそれぞれテーブル７４、７５に格納した後、そのデータをＷＡＮＩ／Ｆ部２１３を通じてアクセス回線経由でインターネット上のサーバーに対して送信する。なお、一致するエントリがない場合はデータを廃棄する。

【００４１】

ゲートウェイ２がインターネット上のサーバーから端末１Ａ宛のデータを受信すると、ＷＡＮ　Ｉ／Ｆ部２１３が先ずデータを受信し、通信制御部２１４に送信する。通信制御部２１４は、受信したデータに含まれる送信先端末のＩＰアドレスから送信先端末のＭＡＣアドレスを求め、ＭＡＣアドレスで認証要求・ゲート管理部２１５のテーブル７１のエントリを検索する。端末１Ａは使用端末として登録されているため、一致するエントリが見つかる。

【００４２】

見つかった該当エントリのテーブル７３にデータのサイズを追加し、それにより再計算した比率、料金をそれぞれテーブル７４、７５に格納した後、そのデータをＬＡＮ　Ｉ／Ｆ部２１１を通じて端末１Ａに送信する。なお、一致するエントリがない場合はデータを廃

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業する。
【００４３】
端末１Ｂとの送受信もＭＡＣアドレス検索で一致するエントリが別である点を除けば端末１Ａの場合と同様である。
【００４４】
月末等の決済日には、部屋番号で、認証要求・ゲート管理部のテーブル７２を検索し、一致する全てのエントリのテーブル７５を加算することで各部屋の月額料金を決定して、各部屋に請求される。
【００４５】
上述実施形態では、通信帯域が異なるにもかかわらず、集合住宅、ビル等におけるインターネット接続共有時の使用料金が一定であるという、ユーザの不満を解消することができ、インターネットアクセス回線業者もしくは、集合住宅、ビルの経営者の収益向上を図ることができる。
【００４６】
次に、本発明の第２の実施形態について説明する。
前述の実施形態ではビル、集合住宅で一つのインターネットアクセス回線を契約し共有していたが、本実施形態では、既存の電話線を利用したＡＤＳＬ回線など、すでに各部屋に直接インターネットアクセス回線が引き込まれている場合には対応できない。そこで、各部屋のインターネットアクセス回線どうしを接続し共有するようにしてもよい。
【００４７】
本実施形態は図５に示すように構成され、部屋Ａには、インターネットアクセスするための端末１Ａと、アクセス回線Ａへのゲートウェイ２Ａを含む。部屋Ｂには、インターネットアクセスするための端末１Ｂと、アクセス回線Ｂへのゲートウェイ２Ｂを含む。ビル、集合住宅の共用部分には課金サーバー４を含む。本実施形態では説明を簡単化するため、各部屋における端末の数を１としているが、これらは各々複数あっても構わない。
【００４８】
ゲートウェイ２Ａは、図６に示すように構成され、ＬＡＮ　Ｉ／Ｆ部２２１と、ＬＡＮ　Ｉ／Ｆ部２２２と、ＷＡＮ　Ｉ／Ｆ部２２３と、通信制御部２２４と、認証要求・ゲート管理部２２５と、ゲートウェイ間帯域調整部２２６とを含む。これらの処部はそれぞれ概略次のように動作する。
【００４９】
ＬＡＮ　Ｉ／Ｆ部Ａ２２１は部屋Ａにおけるｌａｎ回線上のデータの送受信を、ＬＡＮ　Ｉ／Ｆ部Ｂ２２２は部屋Ｂのゲートウェイ２Ｂとのデータ送受信を、ＷＡＮ　Ｉ／Ｆ部２２３はインターネット（アクセス）回線を通じてインターネット上の各種サーバーとのデータ送受信を行う。
【００５０】
通信制御部２２４は、ＬＡＮ　Ｉ／Ｆ部Ａ２２１とＷＡＮ　Ｉ／Ｆ部２２３の間、及びＬＡＮ　Ｉ／Ｆ部Ｂ２２２とＷＡＮ　Ｉ／Ｆ部２２３の間の通信制御を行う。
【００５１】
認証要求・ゲート管理部２２５は、登録されたＭＡＣアドレスを持つ端末のみインターネット通信を行えるようにするもので、通信制御部２２４を介して参照されると、ＬＡＮ　Ｉ／Ｆ部Ｂ　２２２を通じて課金サーバー４を参照して返答する。
【００５２】
ゲートウェイ間帯域調整部２２６は、通信制御部２２４及びゲートウェイ２Ｂから参照され、アクセス回線Ａの現在の通信量と、ＬＡＮ　Ｉ／Ｆ部Ｂ２２２経由でアクセス回線Ｂの現在の通信量を把握し、端末１Ａからのインターネット上サーバーへのデータ送信要求を、より通信量の少ないアクセス回線に接続されているゲートウェイ２Ａまたはゲートウェイ２Ｂに振り分ける。
【００５３】
ここで、ゲートウェイ間帯域調整部２２６は一方のゲートウェイに設置しても良いし、両

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方に設置しても良い。

【００５４】

課金サーバー４は、図７に示すように構成され、ＬＡＮ　Ｉ／Ｆ部４１１はゲートウェイ２Ａ及びゲートウェイ２Ｂとのデータ送受信を行う。

【００５５】

通信制御部４１２は、ＬＡＮ　Ｉ／Ｆ部４１１と認証要求・ゲート管理部４１３の間の通信制御を行う。

【００５６】

認証要求・ゲート管理部４１３は、内部テーブルとして前述の図４に示される情報を格納する。テーブル７１に登録された端末のＭＡＣアドレス、テーブル７２にその端末の使用者の部屋番号、テーブル７３にその端末がその月に使用した総通信量、テーブル７４に全部屋のその月の総通信量に対するその端末の総通信量の比率、テーブル７５にインターネットアクセス回線ＡとＢの合計月額使用料金をテーブル７４の比率で配分した料金をそれぞれ格納する。

【００５７】

次に本実施形態の動作を具体的に説明する。

先ず、部屋Ａと部屋Ｂで使用する端末１Ａ及び端末１Ｂは、予め課金サーバーの認証要求・ゲート管理部４１３のテーブル７１にＭＡＣアドレスを、テーブル７２に部屋番号を登録しておく。総通信量のテーブル７３、比率のテーブル７４、料金のテーブル７５は前述と同様に月末の決済時にクリアされる。

【００５８】

部屋Ａの端末１Ａがインターネット上のサーバーに対して通信を開始したとする。端末１Ａのアプリケーション部１１１は、通信制御部１１２に対してゲートウェイ２Ａ経由でインターネット上のサーバーとの通信を開始するように指示する。通信制御部１１２は、ＬＡＮ　Ｉ／Ｆ部１１３を制御し、ゲートウェイ２Ａ経由でインターネット上のサーバーとデータ送受信を開始する。

【００５９】

ゲートウェイ２Ａが端末１Ａからデータを受信すると、ＬＡＮ　Ｉ／Ｆ部Ａ２２１が先ずデータを受信し、通信制御部２２４に送信する。通信制御部２２４は、データに含まれる送信元端末のＭＡＣアドレスで認証要求・ゲート管理部２２５に対して認証要求を送信する。認証要求・ゲート管理部２２５は、ＬＡＮ　Ｉ／Ｆ部Ｂ２２２を通じて課金サーバー４にそのデータのサイズとともに認証要求を転送する。

【００６０】

課金サーバー４は、ゲートウェイ２Ａから認証要求をＬＡＮ　Ｉ／Ｆ部４１１を介して受信し、通信制御部４１２経由で認証要求・ゲート管理部４１３に送信する。

【００６１】

認証要求・ゲート管理部４１３は、テーブル７１のエントリを検索する。端末１Ａは使用端末として登録されているため、一致するエントリが見つかる。見つかった該当エントリのテーブル７３にそのデータのサイズを追加し、それにより再計算した比率、料金をそれぞれテーブル７４、７５に格納した後、認証許可通知を通信制御部４１２を通じてＬＡＮ　Ｉ／Ｆ部４１１からゲートウェイ２Ａに送信する。

【００６２】

ゲートウェイ２Ａの認証要求・ゲート管理部２２５は、ＬＡＮ　Ｉ／Ｆ部２２２、通信制御部２２４経由で認証許可通知を受信する。受信後、ゲートウェイ間帯域調整部２２６に対してゲート選択要求を送出する。ゲートウェイ間帯域調整部２２６は、定期的に通信制御部２２４及びゲートウェイ２Ｂの通信制御部２２４とWAN　Ｉ／Ｆ部２２３間の現在の通信量、ゲートウェイ２Ｂの通信制御部２２４とＷＡＮ　Ｉ／Ｆ部２２３間の現在の通信量を収集する。

【００６３】

ゲート選択要求を受信したゲートウェイ間帯域調整部２２６は、その収集した通信量を基

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に、通信量が低いゲートウェイを選択し、認証要求・ゲート管理部２２５に回答する。本実施形態では、ゲートウェイ２Ａの通信量のほうが低かったとし、認証要求・ゲート管理部２２５に対してゲートウェイ２Ａを選択するように回答されたとする。

【００６４】

認証要求・ゲート管理部２２５は、この回答に従い、端末１Ａからの受信データをゲートウェイ２Ａの通信制御部２２４とＷＡＮ　Ｉ／Ｆ部２２３経由、アクセス回線Ａ経由でインターネット上のサーバーに送信する。

【００６５】

ゲートウェイ２Ａがインターネット上のサーバーから端末１Ａ宛のデータをアクセス回線Ａ経由で受信すると、ＷＡＮ　Ｉ／Ｆ部２２３が先ずデータを受信し、通信制御部２２４に送信する。通信制御部２２４は、データに含まれる送信先端末のＩＰアドレスから送信先端末のＭＡＣアドレスを求め、ＭＡＣアドレスで認証要求・ゲート管理部２２５に対して認証要求を送信する。

【００６６】

認証要求・ゲート管理部２２５は、ＬＡＮ　Ｉ／Ｆ部２２２を通じて課金サーバー４に認証要求を転送する。課金サーバー４は、ゲートウェイ２Ａから認証要求をＬＡＮ　Ｉ／Ｆ部４１１で受信し通信制御部４１２経由で認証要求・ゲート管理部４１３に送信する。

【００６７】

認証要求・ゲート管理部４１３は、テーブル７１のエントリを検索する。端末１Ａは使用端末として登録されているため、一致するエントリが見つかる。見つかった該当エントリのテーブル７３にそのデータのサイズを追加し、それにより再計算した比率、料金をそれぞれテーブル７４、７５に格納した後、認証許可通知を通信制御部４１２を通じてＬＡＮ　Ｉ／Ｆ部４１１からゲートウェイ２Ａに送信する。

【００６８】

認証要求・ゲート管理部２２５は、ＬＡＮ　Ｉ／Ｆ部２２２、通信制御部２２４経由で認証許可通知を受信すると、端末１Ａ宛の受信データを通信制御部２２４、ＬＡＮ　Ｉ／Ｆ部２２１経由で端末１Ａに送信する。

【００６９】

端末１Ｂとの送受信も最初に端末１Ｂからインターネット上サーバーへの送信データを受信するゲートウェイがゲートウェイ２Ｂである点と、認証要求時にＭＡＣアドレス検索で一致するエントリが別である点を除けば端末１Ａの場合と同様である。

【００７０】

月末等の決済日には、部屋番号で、課金サーバーの認証要求・ゲート管理部のテーブル７２を検索し、一致する全てのエントリのテーブル７５を加算することで各部屋の月額料金を決定して、各部屋に請求される。

【００７１】

次に、本発明の第３の実施形態について説明する。

前述の図４の実施形態では、隣接する各部屋において、その隣接する部屋の総合使用帯域が、アクセス回線１つ分の帯域でまかなえる場合でも、各部屋個別にアクセス回線を契約するしかなく非効率であった。そこで、本実施形態では、アクセス回線を引き込んでいる１つの部屋の無線ＬＡＮ基地局を隣接する部屋の無線端末が利用して契約回線数を減らす。ここで、通信をしている端末の利用者の部屋を識別し、各部屋毎の使用通信帯域を記録し、各部屋毎に使用通信帯域に応じて通信料金を算出する。

【００７２】

図８を参照すると、部屋Ａには、インターネットアクセスするための無線端末１１Ａと、無線端末１１Ａと通信をする無線ＬＡＮ基地局１２Ａとを含む。部屋Ｂには、インターネットアクセスするための無線端末１１Ｂを含む。本実施形態では説明を簡単化するため、各部屋における端末の数を１としているが、これらは各々複数あっても構わない。

【００７３】

無線端末１１Ａ、１１Ｂは、図９に示すように構成され、アプリケーション部１３１と、

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基地局検出部１３２と、通信制御部１３３と、無線ＬＡＮ　Ｉ／Ｆ部１３４と、通信速度検出部１３５とを含む。これらの処理部はそれぞれ概略次のように動作する。

【００７４】

アプリケーション部１３１は、ユーザへの画面表示やユーザからの入力検出と、基地局検出部１３２で検出された複数の基地局の平均速度比較と最適な接続先基地局の判断、通信制御部１３３への通信開始、停止の指示を行う。

【００７５】

基地局検出部１３２は、無線ＬＡＮ　Ｉ／Ｆ部１３４から受信した信号から無線ＬＡＮ基地局のビーコン信号を識別することで通信可能な無線ＬＡＮ基地局を検出しアプリケーション部１３１に通知する。

【００７６】

通信制御部１３３は、無線ＬＡＮ　Ｉ／Ｆ部１３４から受信したデータのアプリケーション部１３１への送信、アプリケーション部から送信要求されたデータの無線ＬＡＮ　Ｉ／Ｆ部１３４への送信を行う。

【００７７】

無線ＬＡＮ　Ｉ／Ｆ部１３４は、基地局とデータの送受信を行う。無線ＬＡＮ基地局Ａは、図１０に示すように構成され、有線ＬＡＮ　Ｉ／Ｆ部１２１と、通信制御部１２２と、無線ＬＡＮ　Ｉ／Ｆ部１２３を含み、これらの処理部はそれぞれ概略次のように動作する。

【００７８】

有線ＬＡＮ　Ｉ／Ｆ部１２１は、有線ＬＡＮとのデータ送受信を行う。通信制御部１２２は、無線ＬＡＮ　Ｉ／Ｆ１２３から受信したデータの有線ＬＡＮ　Ｉ／Ｆ１２１への送信、有線ＬＡＮ　Ｉ／Ｆ部１２１から受信したデータの無線ＬＡＮ　Ｉ／Ｆ部１２３への送信を制御する。無線　ＬＡＮ　Ｉ／Ｆ部１２３は、無線端末とのデータ送受信を行う。

【００７９】

ゲートウェイ２１は、前述の図３に示すように構成され、ＬＡＮ　Ｉ／Ｆ部２１１と、ＬＡＮ　Ｉ／Ｆ部２１２と、ＷＡＮ　Ｉ／Ｆ部２１３と、通信制御部２１４と、認証要求・ゲート管理部２１５とを含む。ＬＡＮ　Ｉ／Ｆ部２１２は、本実施形態では使用しない。これらの処部はそれぞれ概略次のように動作する。

【００８０】

ＬＡＮ　Ｉ／Ｆ部２１１は部屋ＡのＬＡＮ回線上のデータ送受信を、ＷＡＮ　Ｉ／Ｆ部２１３はインターネット回線を通じてインターネット上の各種サーバーとのデータ送受信を行う。

【００８１】

通信制御部２１４は、ＬＡＮ　Ｉ／Ｆ部２１１とＷＡＮ　Ｉ／Ｆ部２１３の間の通信制御を行う。

【００８２】

認証要求・ゲート管理部２１５は、登録されたＭＡＣアドレスを持つ端末のみインターネット通信を行えるように通信制御部２１４から参照される。また、インターネットアクセスした端末の総通信量と課金管理を行う。認証要求・ゲート管理部２１５は、内部テーブルとして図４に示される情報を格納する。

テーブル７１に登録された端末のＭＡＣアドレス、テーブル７２にその端末の使用者の部屋番号、テーブル７３にその端末がその月に使用した総通信量、テーブル７４に全部屋のその月の総通信量に対するその端末の総通信量の比率、テーブル７５にインターネットアクセス回線の月額使用料金をテーブル７４の比率で配分した料金を格納する。

【００８３】

次に、本実施形態の動作について具体的に説明する。

先ず、部屋Ａと部屋Ｂで使用する無線端末１１Ａ及び無線端末１１Ｂは、予めゲートウェイの認証要求・ゲート管理部のテーブル７１にＭＡＣアドレスを、テーブル７２に部屋番号を登録しておく。総通信量のテーブル７３、比率のテーブル７４、料金のテーブル７５

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は月末の決済時にクリアされる。

【００８４】

部屋Ｂの無線端末１１Ｂがインターネット上のサーバーに対して通信を開始したとする。先ず、無線端末１１Ｂの無線ＬＡＮ　Ｉ／Ｆ部１３５が周囲の無線ＬＡＮ基地局のビーコン（通信信号）を受信しようとする。無線端末１１Ｂは、図８に示すように、無線ＬＡＮ基地局１２Ａのビーコン到達範囲に含まれる。無線ＬＡＮ基地局の発したビーコンを無線ＬＡＮ端末の無線ＬＡＮ　Ｉ／Ｆ部１３５が受信すると、基地局検出部１３２はそれを検知しアプリケーション部１３１に通知する。アプリケーション部１３１は、通信制御部１３４、無線ＬＡＮ　Ｉ／Ｆ部１３５を通じて無線ＬＡＮ基地局１２Ａにデータを送信する。

【００８５】

無線ＬＡＮ基地局１２Ａは、その通信データを無線ＬＡＮ　Ｉ／Ｆ部１２３、通信新制御部１２２、有線ＬＡＮ　Ｉ／Ｆ部１２１を通じてゲートウェイ２１に対して転送する。

【００８６】

ゲートウェイ２１が端末１１Ｂからデータを受信すると、前述の図３に示すＬＡＮ　Ｉ／Ｆ部２１１が先ずデータを受信し、通信制御部２１４に送信する。通信制御部２１４は、データに含まれる送信元端末のＭＡＣアドレスで認証要求・ゲート管理部のテーブル７１のエントリを検索する。無線端末１１Ｂは使用端末として登録されているため、一致するエントリが見つかる。見つかった該当エントリのテーブル７３にそのデータのサイズを追加し、それにより再計算した比率、料金をそれぞれテーブル７４、７５に格納した後、そのデータをＷＡＮ　Ｉ／Ｆ部２１３を通じてアクセス回線経由でインターネット上のサーバーに対して送信する。なお、一致するエントリがない場合はデータを廃棄する。

【００８７】

ゲートウェイ２１がインターネット上のサーバーから無線端末１１Ｂ宛のデータを受信すると、ＷＡＮ　Ｉ／Ｆ部２１３が先ずデータを受信し、通信制御部２１４に送信する。通信制御部２１４はデータに含まれる送信先端末のＩＰアドレスから送信先端末のＭＡＣアドレスを求め、ＭＡＣアドレスで認証要求・ゲート管理部２１５のテーブル７１のエントリを検索する。無線端末１１Ｂは使用端末として登録されているため、一致するエントリが見つかる。

【００８８】

見つかった該当エントリのテーブル７３にデータのサイズを追加し、それにより再計算した比率、料金をそれぞれテーブル７４、７５に格納した後、そのデータをＬＡＮ　Ｉ／Ｆ部２１１を通じて無線ＬＡＮ基地局経由で無線端末１１Ｂに送信する。なお、一致するエントリがない場合はデータを廃棄する。

【００８９】

無線端末１１Ａとの送受信もＭＡＣアドレス検索で一致するエントリが別である点を除けば無線端末１１Ｂの場合と同様である。

【００９０】

月末等の決済日には、部屋番号で、認証要求・ゲート管理部のテーブル７２を検索し、一致する全てのエントリのテーブル７５を加算することで各部屋の月額料金を決定して、各部屋に請求される。

【００９１】

次に、本発明の第４の実施形態について説明する。

前述の図１の実施形態では、部屋によってはアクセス回線の速度に比してゲートウェイ⇔端末間の最大伝送速度が、障害物の存在等により遅い場合や、ゲートウェイ⇔無線ＬＡＮ基地局⇔無線端末という接続形態を採用した場合に、無線ＬＡＮ基地局⇔無線端末間の最大伝送速度がアクセス回線や、ゲートウェイ⇔無線ＬＡＮ基地局間の最大伝送速度に比して遅い場合、そこがボトルネックとなりアクセス回線の通信帯域を最大まで使用できない場合があった。

【００９２】

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そこで本実施形態では、各部屋に無線ＬＡＮ基地局と無線端末を設置し、無線端末が室内の基地局の混雑度合（通信速度）と隣接した部屋の基地局の混雑度合（通信速度）を比較する手段と、無線端末が隣接した部屋の基地局経由でゲートウェイにアクセスする。ここで、アクセス回線へのゲートウェイ部分において、通信をしている端末の利用者の部屋を識別し、各部屋毎に使用通信帯域を記録し、各部屋毎に使用通信帯域に応じて通信料金を算出する。

【００９３】

図１１を参照すると、部屋Ａには、インターネットアクセスするための無線端末１１Ａと、無線端末１１Ａと通信する無線ＬＡＮ基地局１２Ａを含む。部屋Ｂには、インターネットアクセスするための無線端末１１Ｂと、無線端末１１Ｂと通信する無線ＬＡＮ基地局１２Ｂを含む。本実施形態では説明を簡単化するため、各部屋における端末の数を１としているが、これらは各々複数あっても構わない。

【００９４】

無線端末１１Ａ、１１Ｂは、図１２に示すように構成され、アプリケーション部１３１と、基地局検出部１３２と、通信速度検出部１３５と、通信制御部１３３と、無線ＬＡＮ　Ｉ／Ｆ部１３４と、通信速度検出部１３５とを含む。これらの処理部はそれぞれ概略次のように動作する。通信速度検出部１３５は、必ずしも無線端末内に設けなくとも良い。

【００９５】

アプリケーション部１３１は、ユーザへの画面表示やユーザからの入力検出と、基地局検出部１３２で検出された複数の基地局の平均速度比較と最適な接続先基地局の判断、通信制御部１３３への通信開始、停止の指示を行う。

【００９６】

基地局検出部１３２は、無線ＬＡＮ　Ｉ／Ｆ部１３４から受信した信号から無線ＬＡＮ基地局のビーコン信号を識別することで通信可能な無線ＬＡＮ基地局を検出しアプリケーション部１３１に通知する。

【００９７】

通信速度検出部１３５は、通信制御部１３３を監視し現通信速度の算出、通信速度の算出を行う。通信制御部１３３は、無線ＬＡＮ　Ｉ／Ｆ部１３４から受信したデータのアプリケーション部１３１への送信、アプリケーション部から送信要求されたデータの無線ＬＡＮ　Ｉ／Ｆ部１３４への送信を行う。

【００９８】

無線ＬＡＮ　Ｉ／Ｆ部１３４は、基地局とデータの送受信を行う。無線ＬＡＮ基地局１２Ａ、１２Ｂは、前述の図１０に示すように構成され、有線ＬＡＮ　Ｉ／Ｆ部１２１と、通信制御部１２２と、無線ＬＡＮ　Ｉ／Ｆ部１２３を含む。これらの処理部はそれぞれ概略次のように動作する。

【００９９】

有線ＬＡＮ　Ｉ／Ｆ部１２１は、有線ＬＡＮとのデータ送受信を行う。通信制御部１２２は無線ＬＡＮ　Ｉ／Ｆ１２３から受信したデータの有線ＬＡＮ　Ｉ／Ｆ１２１への送信、有線ＬＡＮ　Ｉ／Ｆ部１２１から受信したデータの無線ＬＡＮ　Ｉ／Ｆ部１２３への送信を制御する。無線　ＬＡＮ　Ｉ／Ｆ部１２３は、無線端末とのデータ送受信を行う。

【０１００】

ゲートウェイ２１は、前述の図３に示すように構成され、ＬＡＮ　Ｉ／Ｆ部２１１と、ＬＡＮ　Ｉ／Ｆ部２１２と、ＷＡＮ　Ｉ／Ｆ部２１３と、通信制御部２１４と、認証要求・ゲート管理部２１５とを含む。これらの処部はそれぞれ概略次のように動作する。

【０１０１】

ＬＡＮ　Ｉ／Ｆ部２１１は部屋ＡのＬＡＮ回線上のデータ送受信を、ＬＡＮ　Ｉ／Ｆ部２１２は、部屋ＢのＬＡＮ回線上のデータ送受信を、ＷＡＮ　Ｉ／Ｆ部２１３はインターネット回線を通じてインターネット上の各種サーバーとのデータ送受信を行う。

【０１０２】

通信制御部２１４は、ＬＡＮ　Ｉ／Ｆ部２１１とＷＡＮ　Ｉ／Ｆ部２１３の間と、ＬＡＮ

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Ｉ／Ｆ部２１１とＬＡＮ　Ｉ／Ｆ部２１２の間と、ＬＡＮ　Ｉ／Ｆ部２１２とＷＡＮ　Ｉ／Ｆ部２１３の間の通信制御を行う。

【０１０３】

認証要求・ゲート管理部２１５は、登録されたＭＡＣアドレスを持つ端末のみインターネット通信を行えるように通信制御部２１４から参照される。また、インターネットアクセスした端末の総通信量と課金管理を行う。認証要求・ゲート管理部２１５は内部テーブルとして図７に示される情報を格納する。

【０１０４】

テーブル７１に登録された端末のＭＡＣアドレス、テーブル７２にその端末の使用者の部屋番号、テーブル７３にその端末がその月に使用した総通信量、テーブル７４に全部屋のその月の総通信量に対するその端末の総通信量の比率、テーブル７５にインターネットアクセス回線の月額使用料金を７４の比率で配分した料金を格納する。

【０１０５】

次に、本実施形態の動作について具体的に説明する。

先ず、部屋Ａと部屋Ｂで使用する無線端末１１Ａ及び無線端末１１Ｂは、予めゲートウェイ２１の認証要求・ゲート管理部２１５のテーブル７１にＭＡＣアドレスを、テーブル７２に部屋番号を登録しておく。総通信量のテーブル７３、比率のテーブル７４、料金のテーブル７５は月末の決済時にクリアされる。

【０１０６】

先ず、無線端末１１Ｂが起動すると、無線端末１１Ｂの無線ＬＡＮ　Ｉ／Ｆ部１３４が周囲の無線ＬＡＮ基地局のビーコン（通信信号）を受信しようとする。無線端末１１Ｂは、図１１に示すように、無線ＬＡＮ基地局１２Ａと無線ＬＡＮ基地局１２Ｂのビーコン到達範囲に含まれる。ここでは、無線ＬＡＮ基地局１２Ａの発したビーコンを先に無線ＬＡＮ　Ｉ／Ｆ部１３４が受信したとする。

【０１０７】

基地局検出部１３２は、それを検知しアプリケーション部１３１に通知する。アプリケーション部１３１は、通信制御部１３３、無線ＬＡＮ　Ｉ／Ｆ部１３４を通じて通信速度測定用のダミーデータを基地局１２Ａと送受信し、通信速度検出部１３５がその平均速度を計算してアプリケーション部１３１に通知する。

【０１０８】

次に、無線ＬＡＮ　Ｉ／Ｆ部１３４が他の無線ＬＡＮ基地局のビーコン（通信信号）を受信しようとし、無線ＬＡＮ基地局１２Ｂのビーコンを受信し、基地局検出部１３２はそれを検知しアプリケーション部１３１に通知する。アプリケーション部１３１は、通信制御部１３３、無線ＬＡＮ　Ｉ／Ｆ部１３４を通じて通信速度測定用のダミーデータを基地局１２Ｂと送受信し、通信速度検出部１３５がその平均速度を計算してアプリケーション部１３１に通知する。基地局１２Ａと１２Ｂ以外からはビーコンが到達しないため、基地局１２Ａと１２Ｂの計測した平均通信速度を比較する。

【０１０９】

比較した結果、無線ＬＡＮ基地局１２Ａとの平均通信速度が無線ＬＡＮ基地局１２Ｂとの平均通信速度よりも速かったとし、アプリケーション部は通信制御部１３３、無線ＬＡＮ　Ｉ／Ｆ部１３４を通じて無線ＬＡＮ基地局１２Ａに対して通信を開始する。

【０１１０】

無線ＬＡＮ基地局１２Ａは、その通信データを無線ＬＡＮ　Ｉ／Ｆ部１２３、通信制御部１２２、有線ＬＡＮ　Ｉ／Ｆ部１２１を通じてゲートウェイに対して転送する。

【０１１１】

ゲートウェイ２１が無線端末１１Ｂからデータを受信すると、ＬＡＮ　Ｉ／Ｆ部２１１が先ずデータを受信し、通信制御部２１４に送信する。通信制御部２１４は、データに含まれる送信元端末のＭＡＣアドレスで認証要求・ゲート管理部のテーブル７１のエントリを検索する。無線端末１１Ｂは使用端末として登録されているため、一致するエントリが見つかる。見つかった該当エントリのテーブル７３にそのデータのサイズを追加し、それに

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より再計算した比率、料金をそれぞれテーブル７４、７５に格納した後、そのデータをＷＡＮ　Ｉ／Ｆ部２１３を通ってアクセス回線経由でインターネット上のサーバーに対して送信する。なお、一致するエントリがない場合はデータを廃棄する。

【０１１２】

ゲートウェイ２１がインターネット上のサーバーから無線端末１１Ｂ宛のデータを受信すると、ＷＡＮ　Ｉ／Ｆ部２１３が先ずデータを受信し、通信制御部２１４に送信する。通信制御部２１４は、データに含まれる送信先端末のＩＰアドレスから送信先端末のＭＡＣアドレスを求め、ＭＡＣアドレスで認証要求・ゲート管理部のテーブル７１のエントリを検索する。

【０１１３】

無線端末１１Ｂは使用端末として登録されているため、一致するエントリが見つかる。見つかった該当エントリのテーブル７３にデータのサイズを追加し、それにより再計算した比率、料金をそれぞれテーブル７４、７５に格納した後、そのデータをＬＡＮ　Ｉ／Ｆ部２１１を通じて無線ＬＡＮ基地局１２Ａ経由で無線端末１１Ｂに送信する。なお、一致するエントリがない場合はデータを廃棄する。

【０１１４】

無線端末１１Ａとの送受信もＭＡＣアドレス検索で一致するエントリが別である点を除けば端末１１Ｂの場合と同様である。

【０１１５】

月末等の決済日には、部屋番号で、認証要求・ゲート管理部のテーブル７２を検索し、一致する全てのエントリのテーブル７５を加算することで各部屋の月額料金を決定して、各部屋に請求される。

【０１１６】

次に、本発明の第５の実施形態について説明する。

前述の図４の実施形態では、２つのアプリケーションを同時に使用したりして部屋によってはアクセス回線Ａ＋Ｂの速度に比してゲートウェイＡまたはＢ⇔端末間の最大伝送速度が遅い場合や、ゲートウェイ⇔無線ＬＡＮ基地局⇔無線端末という接続形態を採用した場合に、無線ＬＡＮ基地局⇔無線端末間の最大伝送速度がアクセス回線Ａ＋Ｂや、ゲートウェイ⇔無線ＬＡＮ基地局間の最大伝送速度に比して遅い場合、そこがボトルネックとなりアクセス回線の通信帯域を最大まで使用できない場合があった。

【０１１７】

そこで、本実施形態では、各部屋に無線ＬＡＮ基地局と無線端末を設置し、無線端末が室内の基地局の混雑度合と隣接した部屋の基地局の混雑度合を比較する。無線端末が隣接した部屋の基地局経由でゲートウェイにアクセスする。アクセス回線へのゲートウェイ部分において、通信をしている端末の利用者の部屋を識別し、各部屋毎に使用通信帯域を記録し、各部屋毎に使用通信帯域に応じて通信料金を算出する。

【０１１８】

図１３を参照すると、部屋Ａには、インターネットアクセスするための無線端末１１Ａと、無線端末と通信する無線ＬＡＮ基地局１２Ａと、アクセス回線Ａへのゲートウェイ２１Ａを含む。部屋Ｂには、インターネットアクセスするための端末１１Ｂと、無線端末と通信する無線ＬＡＮ基地局１２Ｂと、アクセス回線Ｂへのゲートウェイ２１Ｂを含む。ビル、集合住宅の共用部分には課金サーバー４１を含む。本実施形態では説明を簡単化するため、各部屋における端末の数を１としているが、これらは各々複数あっても構わない。

【０１１９】

無線端末１１Ａ、１１Ｂは、前述の図１２に示すように構成され、アプリケーション部１３１と、基地局検出部１３２と、通信制御部１３３と、無線ＬＡＮ　Ｉ／Ｆ部１３４と、通信速度検出部１３５とを含む。これらの処理部はそれぞれ概略次のように動作する。

【０１２０】

アプリケーション部１３１は、ユーザへの画面表示やユーザからの入力検出と、基地局検出部１３２で検出された複数の基地局の平均速度比較と最適な接続先基地局の判断、通信

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制御部１３３への通信開始、停止の指示を行う。

【０１２１】

基地局検出部１３２は、無線ＬＡＮ　Ｉ／Ｆ部１３４から受信した信号から無線ＬＡＮ基地局のビーコン信号を識別することで通信可能な無線ＬＡＮ基地局を検出しアプリケーション部１３１に通知する。

【０１２２】

通信速度検出部１３５は、通信制御部１３３を監視し現通信速度の算出、通信速度の算出を行う。通信制御部１３３は、無線ＬＡＮ　Ｉ／Ｆ部１３４から受信したデータのアプリケーション部１３１への送信、アプリケーション部から送信要求されたデータの無線ＬＡＮ　Ｉ／Ｆ部１３４への送信を行う。

【０１２３】

無線ＬＡＮ　Ｉ／Ｆ部１３４は基地局とデータの送受信を行う。無線ＬＡＮ基地局１２Ａ、１２Ｂは、前述の図１０に示すように構成され、有線ＬＡＮ　Ｉ／Ｆ部１２１と、通信制御部１２２と、無線ＬＡＮ　Ｉ／Ｆ部１２３を含む。これらの処理部はそれぞれ概略次のように動作する。

【０１２４】

有線ＬＡＮ　Ｉ／Ｆ部１２１は有線ＬＡＮとのデータ送受信を行う。通信制御部１２２は、無線ＬＡＮ　Ｉ／Ｆ１２３から受信したデータの有線ＬＡＮ　Ｉ／Ｆ１２１への送信、有線ＬＡＮ　Ｉ／Ｆ部１２１から受信したデータの無線ＬＡＮ　Ｉ／Ｆ部１２３への送信を制御する。無線　ＬＡＮ　Ｉ／Ｆ部１２３は、無線端末とのデータ送受信を行う。

【０１２５】

ゲートウェイ２１Ａは、図６に示すように構成され、ＬＡＮ　Ｉ／Ｆ部２２１と、ＬＡＮ　Ｉ／Ｆ部２２２と、ＷＡＮ　Ｉ／Ｆ部２２３と、通信制御部２２４と、認証要求・ゲート管理部２２５と、ゲートウェイ間帯域調整部２２６とを含む。これらの処部はそれぞれ概略次のように動作する。

【０１２６】

ＬＡＮ　Ｉ／Ｆ部２２１は部屋ＡのＬＡＮ回線上のデータの送受信を、ＬＡＮ　Ｉ／Ｆ部２２２は部屋Ｂのゲートウェイ２１Ｂとのデータ送受信を、ＷＡＮ　Ｉ／Ｆ部２２３はインターネット回線を通じてインターネット上の各種サーバーとのデータ送受信を行う。

【０１２７】

通信制御部２２４は、ＬＡＮ　Ｉ／Ｆ部２２１とＷＡＮ　Ｉ／Ｆ部２２３の間、及びＬＡＮ　Ｉ／Ｆ部２２２とＷＡＮ　Ｉ／Ｆ部２２３の間の通信制御を行う。

【０１２８】

認証要求・ゲート管理部２２５は、登録されたＭＡＣアドレスを持つ端末のみインターネット通信を行えるように通信制御部２２４から参照されると、ＬＡＮＩ／Ｆ部２２２を通じて課金サーバーを参照し返答する。

【０１２９】

ゲートウェイ間帯域調整部２２６は、通信制御部２２４及びゲートウェイ２１Ｂから参照され、アクセス回線Ａの現在の通信量とＬＡＮ　Ｉ／Ｆ部２２２経由でアクセス回線Ｂの現在の通信量を把握し端末１Ａからのインターネット上サーバーへのデータ送信要求をゲートウェイ２１Ａとゲートウェイ２１Ｂに振り分ける。

【０１３０】

課金サーバーは、前述の図７に示すように構成され、ＬＡＮ　Ｉ／Ｆ部４１１はゲートウェイ２１Ａ及びゲートウェイ２１Ｂとのデータ送受信を行う。

【０１３１】

通信制御部４１２は、ＬＡＮ　Ｉ／Ｆ部４１１と認証要求・ゲート管理部４１３の間の通信制御を行う。

【０１３２】

認証要求・ゲート管理部４１３は、内部テーブルとして前述の図４に示される情報を格納する。テーブル７１に登録された端末のＭＡＣアドレス、テーブル７２にその端末の使用

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者の部屋番号、テーブル７３にその端末がその月に使用した総通信量、テーブル７４に全部屋のその月の総通信量に対するその端末の総通信量の比率、テーブル７５にインターネットアクセス回線ＡとＢの合計月額使用料金をテーブル７４の比率で配分した料金を格納する。

【０１３３】

次に動作を具体的に説明する。

先ず、部屋Ａと部屋Ｂで使用する無線端末１１Ａ及び無線端末１１Ｂは、予め課金サーバーの認証要求・ゲート管理部のテーブル７１にＭＡＣアドレスを、テーブル７２に部屋番号を登録しておく。総通信量のテーブル７３、比率のテーブル７４、料金のテーブル７５は月末の決済時にクリアされる。

【０１３４】

無線端末１１Ｂが起動すると、無線端末１１Ｂの無線ＬＡＮ　Ｉ／Ｆ部１３５が周囲の無線ＬＡＮ基地局のビーコン（通信信号）を受信しようとする。無線端末１１Ｂは、図１３に示すように、無線ＬＡＮ基地局１２Ａと無線ＬＡＮ基地局１２Ｂのビーコン到達範囲に含まれる。ここでは、無線ＬＡＮ基地局１２Ａの発したビーコンを先に無線ＬＡＮ　Ｉ／Ｆ部１３５が受信したとする。

【０１３５】

基地局検出部１３２は、それを検知しアプリケーション部１３１に通知する。アプリケーション部１３１は、通信制御部１３３、無線ＬＡＮ　Ｉ／Ｆ部１３４を通じて通信速度測定用のダミーデータを基地局１２Ａと送受信し、通信速度検出部１３５がその平均速度を計算してアプリケーション部１３１に通知する。

【０１３６】

次に、無線ＬＡＮ　Ｉ／Ｆ部１３４が他の無線ＬＡＮ基地局のビーコン（通信信号）を受信しようとし、無線ＬＡＮ基地局１２Ｂのビーコンを受信し、基地局検出部１３２はそれを検知しアプリケーション部１３１に通知する。アプリケーション部１３１は、通信制御部１３３、無線ＬＡＮ　Ｉ／Ｆ部１３４を通じて通信速度測定用のダミーデータを基地局Ｂと送受信し、通信速度検出部１３５がその平均速度を計算してアプリケーション部１３１に通知する。

【０１３７】

基地局１２Ａと１２Ｂ以外からはビーコンが到達しないため、基地局１２Ａと１２Ｂの計測した平均通信速度を比較する。比較した結果、無線ＬＡＮ基地局１２Ａとの平均通信速度が無線ＬＡＮ基地局１２Ｂとの平均通信速度よりも速かったとし、アプリケーション部は通信制御部１３３、無線ＬＡＮ　Ｉ／Ｆ部１３４を通じて無線ＬＡＮ基地局１２Ａに対して通信を開始する。

【０１３８】

無線ＬＡＮ基地局１２Ａは、その通信データを無線ＬＡＮ　Ｉ／Ｆ部１２３、通信新制御部１２２、有線ＬＡＮ　Ｉ／Ｆ部１２１を通じてゲートウェイ２１Ａに対して転送する。

【０１３９】

ゲートウェイ２１Ａが無線端末１１Ｂからデータを受信すると、ＬＡＮ　Ｉ／Ｆ部２２１が先ずデータを受信し、通信制御部２２４に送信する。通信制御部２２４はデータに含まれる送信元端末のＭＡＣアドレスで認証要求・ゲート管理部２２５に対して認証要求を送信する。認証要求・ゲート管理部２２５は、ＬＡＮＩ／Ｆ部２２２を通じてそのデータサイズとともに課金サーバーに認証要求を転送する。

【０１４０】

課金サーバーは、ゲートウェイ２１Ａから認証要求をＬＡＮ　Ｉ／Ｆ部４１１で受信し通信制御部４１２経由で認証要求・ゲート管理部４１３に送信する。認証要求・ゲート管理部４１３は、テーブル７１のエントリを検索する。無線端末１１Ｂは使用端末として登録されているため、一致するエントリが見つかる。見つかった該当エントリのテーブル７３にそのデータのサイズを追加し、それにより再計算した比率、料金をそれぞれテーブル７４、７５に格納した後、認証許可通知を通信制御部４１２を通じてＬＡＮ　Ｉ／Ｆ部４１

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１からゲートウェイ２１Ａに送信する。
【０１４１】
ゲートウェイ２１Ａの認証要求・ゲート管理部２２５は、ＬＡＮ　Ｉ／Ｆ部２２２、通信制御部２２４経由で認証許可通知を受信する。受信後、ゲートウェイ間帯域調整部２２６に対してゲート選択要求を送出する。ゲートウェイ間帯域調整部２２６は、定期的に通信制御部２２４及び、ゲートウェイ２１Ｂの通信制御部２２４と通信しゲートウェイ２１Ａの通信制御部２２４とＷＡＮ　Ｉ／Ｆ部２２３間の現在の通信量、ゲートウェイ２１Ｂ通信制御部２２４とＷＡＮ　Ｉ／Ｆ部２２３間の現在の通信量（現在通信している通信速度）を収集している。
【０１４２】
ゲート選択要求を受信したゲートウェイ間帯域調整部２２６は、その収集した通信量をもとに、通信量が低いゲートウェイを選択し、認証要求・ゲート管理部２２５に回答する。本実施形態ではゲートウェイ２１Ａの通信量のほうが低かったとし、認証要求・ゲート管理部２２５に対してゲートウェイ２１Ａを選択するように回答されたとする。
【０１４３】
認証要求・ゲート管理部２２５は、回答に従い、無線端末１１Ｂからの受信データをゲートウェイ２１Ａの通信制御部２２４とＷＡＮ　Ｉ／Ｆ部２２３経由、アクセス回線Ａ経由でインターネット上のサーバーに送信する。
【０１４４】
ゲートウェイ２１Ａがインターネット上のサーバーから無線端末１１Ｂ宛のデータをアクセス回線Ａ経由で受信すると、ＷＡＮ　Ｉ／Ｆ部２２３が先ずデータを受信し、通信制御部２２４に送信する。通信制御部２２４は、データに含まれる送信先端末のＩＰアドレスから送信先端末のＭＡＣアドレスを求め、ＭＡＣアドレスで認証要求・ゲート管理部２２５に対して認証要求を送信する。認証要求・ゲート管理部２２５は、ＬＡＮ　Ｉ／Ｆ部Ｂ　２２２を通じて課金サーバーにそのデータサイズとともに認証要求を転送する。
【０１４５】
課金サーバーは、ゲートウェイ２１Ａから認証要求をＬＡＮ　Ｉ／Ｆ部４１１で受信し通信制御部４１２経由で認証要求・ゲート管理部４１３に送信する。認証要求・ゲート管理部４１３は、テーブル７１のエントリを検索する。無線端末１１Ｂは、使用端末として登録されているため、一致するエントリが見つかる。見つかった該当エントリのテーブル７３にそのデータのサイズを追加し、それにより再計算した比率、料金をそれぞれテーブル７４、７５に格納した後、認証許可通知を通信制御部４１２を通じてＬＡＮ　Ｉ／Ｆ部４１１からゲートウェイ２１Ａに送信する。
【０１４６】
認証要求・ゲート管理部２２５は、ＬＡＮ　Ｉ／Ｆ部２２２、通信制御部２２４経由で認証許可通知を受信すると、端末１１Ａ宛の受信データを通信制御部２２４、ＬＡＮ　Ｉ／Ｆ部２２１経由で無線端末１１Ｂに送信する。
【０１４７】
月末等の決済日には、部屋番号で、課金サーバーの認証要求・ゲート管理部のテーブル７２を検索し、一致する全てのエントリのテーブル７５を加算することで各部屋の月額料金を決定して、各部屋に請求される。
【０１４８】
次に、本発明の第６の実施形態について説明する。
前述の図１、図５、図８、図１１及び図１３の実施形態では、共用している他方の混在度合により通信帯域が変動するため、一定した通信帯域を確保したい場合に対応できない。
【０１４９】
そこで本実施形態では、ある部屋の通信帯域を一定速度以上に保つ手段と、その一定速度を時間帯によって変更する手段を設ける。
【０１５０】
具体的に説明すると、図１、図８及び図１１の実施形態において、ゲートウェイの認証要

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求・ゲート管理部２１５の内部テーブルを図１４に示される情報を格納するようにする。テーブル８１に部屋に登録された端末のＭＡＣアドレス、テーブル８２にその端末の部屋番号、テーブル８３に時間帯、テーブル８４にその時間帯毎の最大通信帯域、テーブル８５に全時間を合計した１日の最大通信量が、アクセス回線の１日の最大通信量に占める割合、８６にアクセス回線の月額使用料金をテーブル８５の比率で配分した料金を格納する。

【０１５１】

また、通信制御部２１４の動作を以下のように変更する。

通信制御部２１４は、インターネットへの送信データを受信すると、データに含まれる送信元端末のＭＡＣアドレスで認証要求・ゲート管理部のテーブル８２のエントリを検索する。見つかった該当エントリのテーブル８３から現在時刻と合致するエントリを検索し、その時間の最大通信帯域をテーブル８４から読み取り、その端末の所属する部屋の全端末の現在の通信帯域合計がその最大通信帯域以上だったら、その送信データを待ち行列に格納し、最大通信帯域以下になるまで送信しない。その状態で次の送信データが送られてきたら、現在の待ち行列の最後尾にそのデータも格納する。最大通信帯域以下になったら順次待ち行列からアクセス回線に対して送信する。

【０１５２】

また、月末等の決済日には、部屋番号で、認証要求・ゲート管理部のテーブル８２を検索し、一致するエントリのテーブル８６の額を各部屋の月額料金として、各部屋に請求される。

【０１５３】

図４と図１２の実施形態においては、課金サーバーの認証要求・ゲート管理部４１３の内部テーブルを図１４に示される情報を格納するようにする。テーブル８２に部屋番号、テーブル８１にその部屋に登録された端末のＭＡＣアドレス、テーブル８３に時間帯、テーブル８４にその時間帯毎の最大通信帯域、テーブル８５に全時間を合計した１日の最大通信量が、アクセス回線の１日の最大通信量に占める割合、テーブル８６に全アクセス回線の月額使用料金をテーブル８５の比率で配分した料金を格納する。

【０１５４】

また、課金サーバーの認証要求・ゲート管理部４１３の動作を以下のように変更する。

【０１５５】

認証要求・ゲート管理部４１３は、認証要求を受信すると、テーブル８２のエントリを検索する。認証要求データに含まれる送信元端末のＭＡＣアドレスで認証要求・ゲート管理部４１３のテーブル８１のエントリを検索する。見つかった該当エントリのテーブル８３から現在時刻と合致するエントリを検索し、その時間の最大通信帯域をテーブル８４から読み取り、認証許可通知とともに通信制御部４１２を通じてＬＡＮ　Ｉ／Ｆ部４１１からゲートウェイ２Ａ、２１Ａもしくは２Ｂ、２１Ｂに送信する。

【０１５６】

ゲートウェイ２Ａ、２１Ａもしくは２Ｂ、２１Ｂの認証要求・ゲート管理部２２５は、ＬＡＮ　Ｉ／Ｆ部２２２、通信制御部２２４経由で認証許可通知を受信する。受信後、ゲートウェイ間帯域調整部２２６に対してゲート選択要求を送出する。ゲートウェイ間帯域調整部２２６は、定期的に通信制御部２２４及び、他のゲートウェイの通信制御部２２４と通信し自ゲートウェイの通信制御部２２４とＷＡＮ　Ｉ／Ｆ部２２３間の現在の通信量、他ゲートウェイの通信制御部２２４とＷＡＮ　Ｉ／Ｆ部２２３間の現在の通信量を収集している。ゲート選択要求を受信したゲートウェイ間帯域調整部２２６はその収集した通信量をもとに、通信量が低いゲートウェイを選択する。

【０１５７】

ただし、その端末の所属する部屋の全端末の現在の通信帯域合計が、認証許可通知とともに送られてきたその時間の端末が所属する部屋の最大通信帯域以上だったら、その送信データを待ち行列に格納し、最大通信帯域以下になるまで認証要求・ゲート管理部２２５に回答しない。その状態で次の送信データが送られてきたら、現在の待ち行列の最後尾にそ

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のデータも格納する。
【０１５８】
最大通信帯域以下になったら、再度通信量の低いゲートウェイを選択しなおしたのち、順次待ち行列から認証要求・ゲート管理部２２５にゲート選択結果とともに送信する。
【０１５９】
また、月末等の決済日には、部屋番号で、認証要求・ゲート管理部４１３のテーブル８１を検索し、一致するエントリのテーブル８６の額を各部屋の月額料金として、各部屋に請求される。
【０１６０】
次に、本発明の第７の実施形態について説明する。
前述の図１、図５、図８、図１１及び図１３に示す実施形態では、一部の部屋の使用用途が店舗である場合、その店舗の売り上げをのばすビジネスモデルがない。
【０１６１】
そこで本実施形態では、店舗の通信料金の一部を希望する住居世帯主に負担してもらい、その料金に一定割合の額を上乗せした額相当のクーポンをその住居世帯主に支払う仕組みを設ける。ここで、当該額相当の料金を支払っても良い。
【０１６２】
具体的に説明すると、図１、図８及び図１１に示す実施形態において、月末等の決済日に、店舗の部屋番号で、認証要求・ゲート管理部のテーブル８２を検索し、一致するエントリのテーブル８６の額の一部を、クーポンを希望する部屋のテーブル８６に均等に割り振り、店舗には割り振った額を一定割合増加した額に相当するクーポンの発行依頼を送信する。その後通常の決済処理を行う。ここで、勿論、当該額相当の料金を支払っても良い。
【０１６３】
図５及び図１３に示す実施形態においては、月末等の決済日に、店舗の部屋番号で、認証要求・ゲート管理部４１３のテーブル８２を検索し、一致するエントリのテーブル８６の額の一部を、クーポンを希望する部屋のテーブル８６に均等に割り振り、店舗には割り振った額を一定割合増加した額に相当するクーポンの発行依頼を送信する。その後通常の決済処理を行う。
【０１６４】
以上、本発明によるインターネット接続システムの好適実施形態の構成及び動作を詳述した。しかし、斯かる実施形態は、本発明の単なる例示に過ぎず、何ら本発明を限定するものではない。本発明の要旨を逸脱することなく、特定用途に応じて種々の変形変更が可能であること、当業者には容易に理解できよう。
【０１６５】
【発明の効果】
以上説明したように、本発明においては、各部屋の使用用途（住居、オフィス、店舗等）や人員構成により、使用頻度や最多使用時間帯がばらばらな場合でも、通信帯域が余っている部屋から不足している部屋へ通信帯域を動的に割り振り、トータルの使用通信帯域の大小により料金を割り振っているので公平な帯域の配分が可能となる。したがって、帯域をあまり使用しなかった部屋は通信料金が下がり、帯域が不足していた部屋は多少通信料金があがっても不足していた帯域を補うことが可能となる。
【図面の簡単な説明】
【図１】本発明によるインターネット接続システムの第１の実施形態例を示すシステム構成図である。
【図２】本発明の第１の実施形態における端末の構成図である。
【図３】本発明の第１の実施形態におけるゲートウェイの構成図である。
【図４】本発明の第１の実施形態における認証要求・ゲート管理部の内部テーブルを示す図である。
【図５】本発明によるインターネット接続システムの第２の実施形態例を示すシステム構成図である。

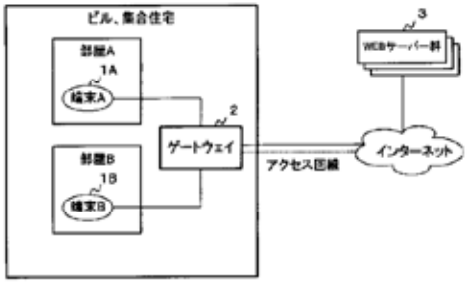
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【図６】本発明の第２の実施形態におけるゲートウェイの構成図である。
【図７】本発明の第２の実施形態における課金サーバーの構成図である。
【図８】本発明によるインターネット接続システムの第３の実施形態例を示すシステム構成図である。
【図９】本発明の第３の実施形態における無線端末の構成図である。
【図１０】本発明の第３の実施形態における基地局の構成図である。
【図１１】本発明によるインターネット接続システムの第４の実施形態例を示すシステム構成図である。
【図１２】本発明の第４の実施形態における無線端末の構成図である。
【図１３】本発明によるインターネット接続システムの第５の実施形態例を示すシステム構成図である。
【図１４】本発明の第５の実施形態における認証要求・ゲート管理部の内部テーブルを示す図である。
【符号の説明】

１Ａ、１Ｂ	端末
１１Ａ、１１Ｂ	無線端末
２、２Ａ、２Ｂ、２１、２１Ａ、２１Ｂ	ゲートウェイ
３	ＷＥＢサーバー群
４	課金サーバー
１２Ａ、１２Ｂ	無線ＬＡＮ基地局
１１１、１３１	アプリケーション部
１１２、１２２、１３４、２１４、２２４、４１２	通信制御部
１１３、２１１、２１２、２２１、２２２、４１１	ＬＡＮ　Ｉ／Ｆ部
１２１	有線ＬＡＮ　Ｉ／Ｆ部
１２３	無線ＬＡＮ　Ｉ／Ｆ部
１３２	基地局検出部
１３３	通信速度検出部
２１３、２２３	ＷＡＮ　Ｉ／Ｆ部
２１５、２２５、４１３	認証要求・ゲート管理部
２２６	ゲートウェイ間帯域調整部

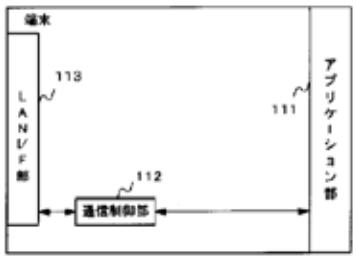
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【図１】



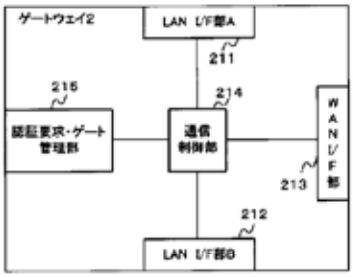
集合契約回線タイプ全体構成

【図２】



端末の内部構成

【図３】



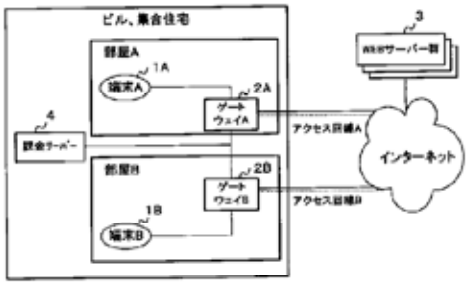
ゲートウェイの内部構成

【図４】

71 MACアドレス	72 部屋番号	73 現在の転送容量	74 全転送量の転送容量に対する比率	75 料金
※ 11.22.33.44.55.66	例: 101	例: 161 KByte	例: 1%	例: ¥1500
※ 22.33.44.55.66.77	例: 102	例: 680 KByte	例: 1%	例: ¥1500
…	…	…	…	…

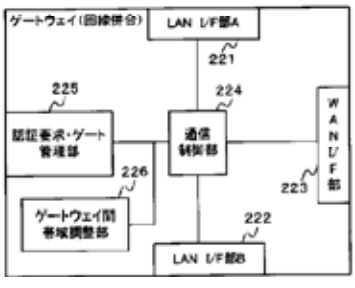
認証要求・ゲート管理部のテーブル(ベストエフォート)

【図５】



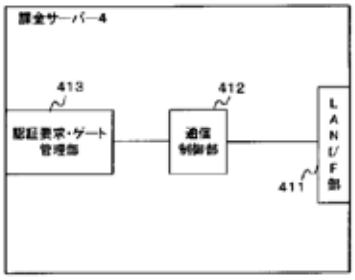
個別契約回線タイプ(回線併合)全体構成

【図６】



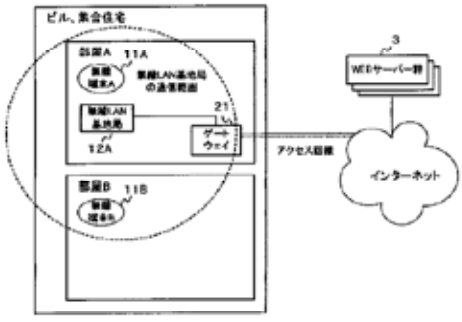
ゲートウェイ(回線併合)の内部構成

【図７】



課金サーバーの内部構成

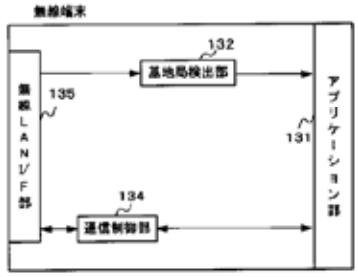
【図８】



個別契約回線タイプ(共有)全体構成例

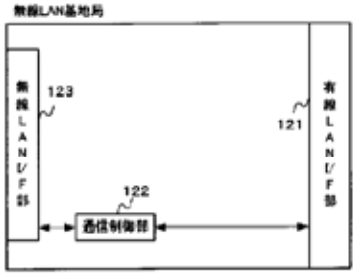
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【図９】



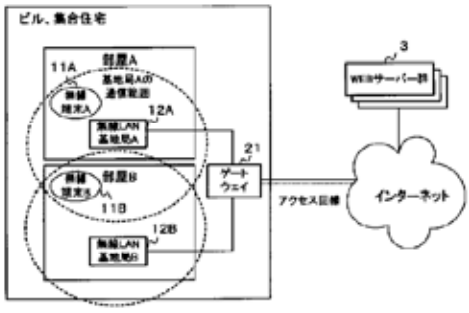
無線端末の内部構成

【図１０】



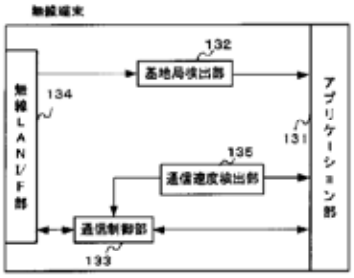
無線LAN基地局の内部構成

【図１１】



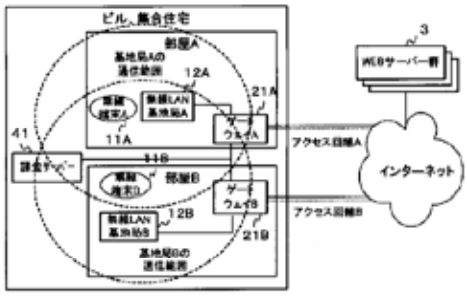
集合契約回線タイプ（無線端末）全体構成

【図１２】



無線端末の内部構成

【図１３】



個別契約回線タイプ（回線住合_無線端末）全体構成

【図１４】

81 MACアドレス	82 部屋番号	83 時間帯	84 時間帯毎の帯域	85 全部屋の総通信量に対する比率	86 料金
例 11.21.32.44.45.66	例：101	例	例：161 KByte	例：1%	例：¥1500
例 22.33.44.55.66.77	例：102	例	例：680 KByte	例：1%	例：¥1500
・・・	・・・	・・・	・・・	・・・	・・・

認証基地・ゲート管理部のテーブル（時間帯別帯域保障）

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フロントページの続き

(51)Int.Cl.[7]	F I	テーマコード（参考）
	H04M 11/00 302	
	H04M 15/00 Z	

Fターム(参考) 5K030 GA03 GA20 HA08 HB08 HC13 HD03 KX30 LC01 MB02 MB09
MC08
5K033 AA01 DA06 DA17 DB18 EC03
5K101 KK20 NN48

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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
18 October 2007 (18.10.2007)

PCT

(10) International Publication Number
WO 2007/116411 A1

(51) International Patent Classification:
H04L 12/28 (2006.01) *H04M 11/06* (2006.01)
H04L 12/56 (2006.01) *H04L 12/18* (2006.01)
H04L 29/06 (2006.01)

(21) International Application Number:
PCT/IL2007/000470

(22) International Filing Date: 11 April 2007 (11.04.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
174930 11 April 2006 (11.04.2006) IL

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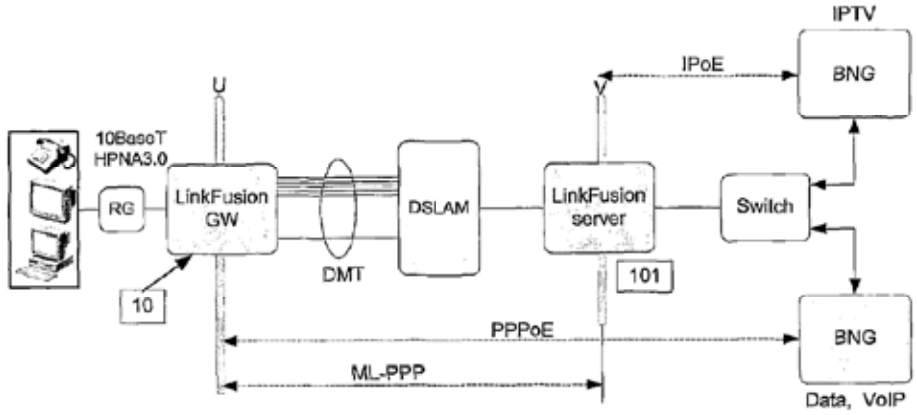
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD AND APPARATUS FOR PROVISIONING ENSURED QoS TRIPLE PLAY SERVICES OVER EXISTING COPPER INFRASTRUCTURE



(57) Abstract: Method and system for providing Triple Play services with assured QoS by Telecommunication companies to subscribers in MDU/MTU over existing unshielded copper infrastructure in the local loop. All the bandwidth available on the xDSL lines is aggregated to form a manageable broadband link from all or a part of the telephone lines that are routed to the building and enabled to be used as xDSL lines. The wideband services are provisioned to subscribers using the manageable broadband link, by performing statistical multiplexing and Dynamic Resource Allocation. The delivery of the multicast content such as video broadcasting is extended to reach the building and then the broadband services are distributed to each subscriber using standard based in-building distribution.

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METHOD AND APPARATUS FOR PROVISIONING ENSURED QoS TRIPLE PLAY SERVICES OVER EXISTING COPPER INFRASTRUCTURE

Field of the invention

The present invention relates to the field of providing digital data and content over a data communication network. More particularly, the present invention proposes a method and apparatus for provisioning of triple play services with ensured QoS to subscribers, over existing copper infrastructure.

Background of the invention

While the delivery of combined voice and data has become widespread in the recent years, effective addition of video has been a barrier to completion of the true triple play for several reasons. First, outdated, inefficient video compression algorithms greatly exceed available bandwidth; second, bandwidth in the access networks has been insufficient for even compressed video; and third, the vast majority of today's Customer Premises Equipment (CPE) is unable to handle the service segmentation and quality of service (QoS) requirements that are crucial for voice and video services. Significant advances in video compression technology make IPTV-based video services, such as Video-On-Demand (VOD), not only practical, but highly desirable. These IPTV-based video services include improved content selection and navigation, no-delay channel changes, VOD and promotions tailored to a subscriber's viewing habits and preferences, and connection to other IP devices and content, such as photographs, music, games, or video contents located anywhere on the subscriber's network.

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Depending on compression technology used, each channel received from a service provider video server or distribution point needs as much as 3-4 Mb/s of bandwidth for standard definition TV (SDTV) and 9-12 Mb/s for High definition TV (HDTV). Broadcast video channels are multicast in nature. If handled properly by the network infrastructure, the amount of total bandwidth multicast video consumes between the headend (the control center of a television system, where broadcast signals are received and distributed) and RT (Remote Terminal) can be minimized. In addition, video services such as Video on Demand (VOD) are unicast in nature, i.e., requiring individual bandwidth streams from the headend to the subscriber.

A Triple Play service bundles high-speed Internet access, television (TV broadcast or Video on Demand) and telephone service over a single broadband connection. As competition between Multiple System Operators (a.k.a., Cable Operators) and Incumbent Local Exchange Carriers (ILECs) over subscribers increases, the ability to offer a Triple Play package that bundles voice, video, and data services is a dominant factor that determines the consumer's final choice. Triple Play service also allows ILECs' and CLECs to expand beyond their traditional voice services. True Triple Play services used concurrently by family members in one household require networks that can support higher quality at super-broadband speeds. They may include Point to Point like VOD (specifically requested by one person), (Point to Multipoint) like broadcasting to multiple users Television over IP, or gaming (Multipoint to Multipoint). Other services sometimes require a constant bit rate connection (like an audio stream), a bit rate that can vary within limits (like streaming video content), or a bursting data rate (like a query on a web page or file download).

Solutions such as Fiber-To-The-Home (FTTH) provide the required bandwidth but require high costs (high upfront investment with long return on investment). VDSL can provide high bandwidth but is highly limited by the loop length. ADSL2 and ADSL2+ significantly boost the bandwidth, but practically cannot serve more than one TV channel and do not support the large bandwidth required for High-Definition Television (HDTV).

Fixed Wireless Access technologies like WiMax might also be able to realize the same speeds. However, the number of end-users sharing the wireless channel capacity is limited.

ADSL doesn't offer sufficient downstream bandwidth over long enough distances to be able to reach all customers. Specifically, ADSL cannot deliver 8 Mbps beyond 6,000 to 8,000 feet. Many Telco customers are 12,000 to 18,000 feet from the nearest RT. ADSL2/2+ increase ADSL bandwidth but only for shorter distances. Therefore, their effective bandwidth is limited.

VDSL provides a lot of bandwidth, but over very short distances—3,000 to 4,000 feet and requires Fiber To The Curb (FTTC). Therefore, Telco companies are required to relocate the serving areas to approximately 4,000 feet between subscribers and RTs (the DSLAM – DSL Access Multiplexer) in order to use VDSL. This of course is costly.

All the methods described above have not yet provided satisfactory solutions to the problem of allowing Telco companies - ILECs and CLECs to

provide cost effective triple play services to their subscribers, while ensuring voice and video quality.

It is therefore an object of the present invention to allow Telco companies – ILECs and CLECs providing triple play services to their subscribers, using their existing access network infrastructure, while ensuring voice and video quality.

It is another object of the present invention to allow Telco companies – ILECs and CLECs providing triple play services to their subscribers, using their existing access network infrastructure, while ensuring individual service quality and priority, especially quality-sensitive voice and video services.

It is a further object of the present invention to allow Telco companies – ILECs and CLECs providing triple play services to their subscribers, using their existing access network infrastructure, while provisioning the unique requirements of each service

It is still an object of the present invention to allow Telco companies – ILECs and CLECs providing triple play services to their subscribers, using their existing access network infrastructure, while allowing management and support of the individual services once they are provisioned.

It is yet an object of the present invention to allow Telco companies – ILECs and CLECs providing triple play services to their subscribers, using their existing access network infrastructure, in a scalable manner that does not require upfront investments.

It is yet another object of the present invention to allow Telco companies – ILECs and CLECs providing triple play services to their subscribers, over existing copper lines, at High quality with no need to upgrade the existing infrastructure.

Other objects and advantages of the invention will become apparent as the description proceeds.

Summary of the invention

The present invention is directed to a method for providing broadband services (such as Triple Play services) with assured QoS by Telecommunication companies (e.g., ILECs, CLECs, Service Providers or ISPs) to subscribers in a site (e.g., - apartment buildings, office buildings, Multi Dwelling Units (MDUs), Multi Tenant Units (MTUs) or a campus deployment) over existing unshielded copper infrastructure in the local loop, according to which all the bandwidth available on the xDSL lines is aggregated to form a manageable broadband link from all or a part of the telephone lines that are routed to the site and enabled to be used as xDSL lines. The wideband services are provisioned to subscribers using the manageable broadband link, by performing statistical multiplexing and Dynamic Resource Allocation. The delivery of the multicast content (particularly video broadcasting), intended for simultaneous use by different subscribers, is extended to reach the site and then the broadband services are distributed to each subscriber using standard based in-building distribution.

Preferably, the available bandwidth on the xDSL lines is aggregated using ML-PPP protocol. In this case, whenever the ML-PPP is implemented via the U interface at the system side, the BRAS that supports ML-PPP is used

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as the ML-PPP termination (i.e., ML-PPP implementation at the network side) for the subscriber's data traffic. If the BRAS does not support ML-PPP or if a BRAS independent ML-PPP implementation is desired, a dedicated server is used for supporting the ML-PPP termination at the network side of the subscriber's data traffic.

Whenever the network architecture for providing broadband services complies with TR-101, a dedicated server that resides in the aggregation network over the V interface is used for forming a broadband ML-PPP between the V and U interfaces, based on multiple links of PPPoE. The formed broadband ML-PPP may be used for transferring data and voice. The IPTV video streaming, received by the server as an IPoE streaming, is then transferred in an appropriate protocol through the broadband ML-PPP.

The broadband services may be provisioned based on statistical multiplexing, according to different subscribers' and services' profiles at any given instance and on a corresponding dynamic resources allocation. Preferably, the multicast streaming is extended until reaching the site and then splitting the streaming via the in-building distribution.

The wideband services may be distributed among the subscribers in the site via Ethernet/LAN cables, Coax cables, Home PNA-3.0, PowerLine, using wireless communication or any combination thereof. Additional Functions like QoS Management, Resource Scheduling, Multicasting, Remote Configuration and Management, Authentication, Security, Policy Management, SLA Management, Redundancy, Admission Control, Traffic Accounting and Monitoring, Traffic Filtering, Billing Mediation, Broadcast

Buffering, File Cashing or any combination thereof may also be provided along with the broadband services.

The available bandwidth on the xDSL lines may be aggregated using one of the G.998 series of ITU-T Recommendations.

The provisioning of broadband services may comply with recommendations of the DSL Forum standards and different network architectures included therein, particularly as defined in TR-25, TR-58, TR-59, TR-94 and TR-101.

The present invention is also directed to a system for providing broadband services with assured QoS by Telecommunication companies to subscribers in a site over existing unshielded copper infrastructure in the local loop, that comprises:

a) circuitry and software for aggregating all the bandwidth available on all or a part of the telephone lines that are routed to the site and enabled to be used as xDSL lines, to form at least one manageable broadband link;

b) software for performing statistical multiplexing;

c) circuitry and software for performing Dynamic Resource Allocation;

d) circuitry and software for extending the delivery of the multicast content intended for simultaneous use by different subscribers, particularly video broadcasting, to reach the site; and

e) circuitry and software for in-building distribution of the broadband services to each subscriber.

If the available bandwidth on the xDSL lines is aggregated using ML-PPP protocol, the system includes a BRAS that supports ML-PPP as the ML-PPP termination for the subscriber's data traffic at the network side.

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Alternatively, the system may further include a dedicated server for supporting the ML-PPP termination at the network side of the subscriber's data traffic, whenever the BRAS does not support ML-PPP or whenever a BRAS independent ML-PPP implementation is desired. Also, a dedicated server that resides in the aggregation network over the V interface may be included, for forming a broadband ML-PPP between the V and U interfaces, whenever the network architecture for providing broadband services complies with TR-101.

Preferably, the system comprises circuitry and software for extending multicast streaming until reaching the site and circuitry for splitting the streaming via the in-building distribution, as well as circuitry and associated software for providing the above additional functions.

Brief Description of the Drawings

The above and other characteristics and advantages of the invention will be better understood through the following illustrative and non-limitative detailed description of preferred embodiments thereof, with reference to the appended drawings, in which:

- Fig. 1 schematically illustrates the general architecture of the proposed solution, according to a preferred embodiment of the invention;
- Fig. 2 schematically illustrates an exemplary concept of the proposed solution, according to a preferred embodiment of the invention;
- Fig. 3 schematically illustrates the platform implemented for in-building service distribution options, according to a preferred embodiment of the invention;
- Fig. 4A schematically illustrates the architecture for provisioning triple play services to subscribers with in-building distribution over existing copper infrastructure, according to a preferred embodiment of the invention;

- Fig. 4B schematically illustrates the architecture for provisioning triple play services to subscribers with in-building distribution over Ethernet cables, according to a preferred embodiment of the invention;
- Fig. 4C schematically illustrates the architecture for provisioning triple play services to subscribers with wireless in-building distribution, according to a preferred embodiment of the invention;
- Fig. 5 is a block diagram of the system for provisioning triple play services with ensured QoS to subscribers over existing copper infrastructure, according to a preferred embodiment of the invention;
- Fig. 6 (prior art) schematically illustrates the process of DSL Bonding with ML-PPP;
- Fig. 7A (prior art) schematically illustrates a Multi Service Reference Model taken from TR-58;
- Fig. 7B (prior art) schematically illustrates a High Level Architectural Reference Model taken from TR-59;
- Fig. 7C schematically illustrates the a network architecture that includes a specific server that is installed in the network to perform the BRAS functionalities related to the ML-PPP termination, according to a preferred embodiment of the invention;
- Fig. 7D (prior art) depicts the network architecture considered in TR-101;
- Fig. 8A (prior art) illustrates the protocol stacks at the U interface;
- Fig. Fig. 8B (prior art) illustrates the protocol stacks at the V interface;
- Fig. 9 (prior art) illustrates a common network topology when using TR-101; and
- Fig. 10 illustrates Multi Edge network architecture, according to a preferred embodiment of the invention.

Detailed description of the invention

The present invention proposes a method and system for providing residential and commercial Triple Play broadband services by Telecommunication companies (ILECs, CLECs) or service providers to apartment buildings - Multi Dwelling Units (MDU), office buildings – Multi Tenant Units (MTU), condominiums, and other campus deployments over the existing copper infrastructure.

The system proposed by the present invention combines implementation of all the functions needed to deliver these services, so as to fulfill the requirements which are essential to provide high quality Triple Play services. These requirements include: Bandwidth, QoS management, Availability and Security, in addition to other highly desirable requirements to provide efficient and profitable services. It can meet all of these requirements in a single appliance located adjacent to the Network Interface Unit (NIU/NID) – the MDF - of each building (before the Demarcation Point).

The proposed system serves as a platform that performs the following functions: Bandwidth Aggregation, Statistical Multiplexing, Resource Scheduling, Multicasting, QoS Management, In Building Distribution, Admission Control, Remote Management, Authentication, Redundancy (High Availability), Policy Management, Security, SLA Management and optionally: Traffic Accounting and Monitoring, , Traffic Filtering, Billing Mediation.

The system utilizes part or all of the existing copper twisted pair telephone lines, routed to an MDU, as bonded DSL links, while aggregating all their available bandwidth to form one "Fat Pipe". The formed broad bandwidth

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"Fat pipe" is than used for the provisioning of the Triple Play services based on Statistical Multiplexing, Dynamic Resource Allocation, and Multicasting. In building distribution is performed, based on Standards, such as: Home PNA3.0 or PowerLine, or LAN Cable, or Coax, or Wireless. The combination of all this functions with the way in which all the Twisted Copper Pairs routed to the building are used to achieve the required bandwidth, the dynamic allocation and the statistical multiplexing of the available resources, the Multicasting, the QoS, Policy and SLA management and the remote configuration combined with all the other functions enable Telco companies to deliver high quality Triple Play services using their existing network, maintaining and preserving their installed base of unshielded twisted pair in the local loop.

The system proposed by the present invention allows ILECs to deliver True Triple Play to Multi Dwelling Units (MDUs) over existing copper lines at High quality, without a need to replace or even upgrade the infrastructure and at a far lower cost than any other known alternative (such as FTTH, FTTC/VDSL FTTB/VDSL etc.). ILECs can provide multi-channel TV, HDTV, VOD, ultra-high-speed data and VoIP over their existing installed base of unshielded twisted pairs in the local loop.

In order to deliver commercial Triple Play services acceptable Quality of Service requirements must be met. By deploying such highly integrated systems, service providers can expand their offerings easily and cost effectively, better manage and control traffic, and accelerate the delivery of triple play services. The end result is a quicker time to market and an assured user experience of Triple Play services over the existing copper infrastructure.

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The proposed platform performs the following functions: Bandwidth Aggregation, Statistical Multiplexing, Resource Scheduling, Multicasting, QoS Management, In Building Distribution, Admission Control, Remote Management, Authentication, Redundancy (High Availability), Policy Management, Security, SLA Management and optionally: Traffic Accounting and Monitoring, , Traffic Filtering, Billing Mediation.

Fig. 1 schematically illustrates the general architecture of the proposed solution, according to a preferred embodiment of the invention. The system 10 that is installed in the building aggregates the bandwidth of all incoming DSL lines into a wideband link and it's bandwidth is then dynamically allocated.

Fig. 2 schematically illustrates the concept of the proposed solution, according to a preferred embodiment of the invention. The incoming lines may be ADSL lines, ADSL2 lines, and ADSL2+ lines or a combination of these lines.

System 10 performs bandwidth aggregation from all incoming lines. For a building consisting of n apartments there are at least n telephone lines (copper twisted pairs) already installed by the Telco company (ILEC) in order to provide Plain Old Telephone Service (POTS). These n lines terminate in a Network Interface Unit or Device (NIU/NID) the MDF in the building. From the MDF cabinet, each copper pair is routed to an apartment and terminated by a telephone set.

Each telephone line can be enabled to be a DSL line to carry digital data, in addition to the circuit switch telephone voice. DSL is a family of technologies that provide digital data transmission over the wires used in

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the "last mile" of a local telephone network. The most common DSL technology is ADSL. ADSL standard can (theoretically) deliver 8 Mbit/s over about 2 km (1¼ miles) of unshielded twisted pair copper wire. All the available bandwidth is aggregated from all or part of the lines rolled out to the building as DSL enabled links, into one broad manageable link of a bandwidth equal to n times each DSL line bandwidth. Several known techniques may be used to implement the bandwidth aggregation (these techniques are sometimes called "Loop Bonding") and will be described below.

After the DSL loops have been bonded, the resultant aggregated link is used for the provisioning of the wideband services, including true Triple Play, to the various customers in the building based on Statistical Multiplexing and Dynamic Resource Allocation. In this manner, the required bandwidth for such service can be achieved based on the following logical assumptions:

- first, not all households are necessarily customers of the service.
- second, not all users use the service simultaneously
- third, not all connected users consume the same service concomitantly (Web browsing, file downloading, watching TV broadcast, VoIP conversation, etc.) .
- fourth, part of the data is delivered in bursts;
- fifth: the managed resources are allocated to subscribers dynamically.

The system proposed by the present invention can save bandwidth also when video content is delivered by multicasting. Multicast is the delivery of video streams (video broadcast channels) to a group of destinations simultaneously using the most efficient strategy to deliver the video streams over each link of the network only once, creating copies only when

the links to the destinations split. Significant part of the traffic is expected to be IPTV broadcast. During multicasting, only one stream is required for multiple audience of the same broadcast. Usually Multicast is brought all the way from the video server, located at the service provider to the DSL aggregation point (the DSLAM- DSL Access Multiplexer) and then is split to each individual subscriber. System 10 extends the multicasting to the MDU, while splitting the streams through the "In Building Distribution" as described below. This saves precious bandwidth in the last mile, which is the most critical part and bottle neck of the network - the access network.

The proposed system is located adjacent to the building MDF, as shown in Fig. 4A. In building service distribution to each apartment, as shown in Fig. 3 is implemented based on one of the following methods: LAN cable – CAT5; Coax; HPNA 3.0 standard; PowerLine; Wireless.

Service Example

The following service example describes an MDU of a building with 50 apartments. There are at least 50 telephone lines which can be used as DSL enabled links, Either ADSL ADSL2 ADSL2+ or any combination of them. It is assumed that the service provider has a relatively high penetration level of 40%, i.e., the service provider has 20 subscribers (customers) in this building. It is also assumed that only 36 copper lines (out of the 50 available) are used as ADSL links. Each link provides 5Mb/s data rate (for short enough loop length the standard can reach 8Mb/s). After bonding all these links and aggregating all the available bandwidth, system 10 forms one broad pipe of (36x5) 180Mb/s, as shown in Table I. If more bandwidth is needed more links can be added to the "pipe" (the 50-36=14 unused lines) and if and when ADSL2/2+ will be available, broader bandwidth pipes can be formed by simply reconfiguring system 10.

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Table I

	No of tenants	DSL lines	ADSL	ADSL2	ADSL2+	% penetration	No of Sub
	50	36	36	0	0	40	20
BW (aver. Per line)			5	0	0		
BW			180	0	0		
Total BW							100

The following example describes a service scenario for such MDU in a typical demand. In this example 43 users (at the 20 households which are subscribers of the wideband service) are served as follows:

17 users are watching 6 High Definition TV broadcast channels.

5 users are watching 2 Standard Definition TV broadcast channels.

2 users are watching High Definition Video on Demand.

5 users are making VoIP calls

10 users are surfing the Web.

To provide this service demand a total bandwidth of 109Mb/s is required out of the 180Mb/s available, as shown in Table II.

Table II

Service	TV Broadcast	BC1	BC 2	BC3	BC4	BC5	BC6	SD1	SD2	VoD (HDTV)	VoIP	Internet	Users	Sub. (hh)
Sub. Per service	22									2	5	20	43	20
HDTV Broadcast		6	4	3	2	1	1							
SDTV Broadcast								3	2					
Total Allocated BW		12	12	12	12	12	12	4	4	24	1	4		109
Total Available BW														180

The following additional example describes a service scenario for such MDU in an extreme demand. In this example, 67 users (at the 20 households which are subscribers of the wideband service) are served as follows:

24 users are watching 6 High Definition TV broadcast channels.

5 users are watching 2 standard Definition TV broadcast channels.

4 users are watching High Definition Video on Demand.

15 users are making VoIP calls

20 users are surfing the Web.

To provide this service demand a total bandwidth of 140Mb/s is required out of the 180Mb/s available, as shown in Table III.

Table III

Service	TV Broadcast	BC1	BC 2	BC3	BC4	BC5	BC6	SD1	SD2	VoD (HDTV)	VoIP	Internet	Users	Sub. (hh)
Sub. Per service	28									4	15	20	67	20
HDTV Broadcast		8	5	4	3	2	1							
SDTV Broadcast								3	2					
Total Allocated BW		12	12	12	12	12	12	4	4	48	4	8		140
Total Available BW														180

It is assumed that 12Mb/s is required for HDTV channel though 9-10Mb/s is sufficient for MPEG4. There is still additional 40Mb/b margin left to fulfill even higher demand. For even more extreme cases there are still (50-36) 14 more unused lines that can be added by the service provider as required to provide for additional (5x14) 70Mb/s to this particular MDU. For even more extreme cases, (which are very rare with extremely low probability to happen), exceeding the available resources, the "Admission Control" (see below) comes into action according to its algorithms and the service provider policy.

Other requirements essential for the successful delivery of the service are also fulfilled by system 10, which functions as a platform, on which all these requirements are met while providing prominent advantages.

The platform implemented by system 10 is located adjacent to the building MDF, as shown in Fig. 3. In building service distribution to each apartment is implemented based on one of the following methods: LAN cable – CAT5; Coax; HPNA 3.0 standard; PowerLine; Wireless. The terminal devices that

may consume the broadband service may include a PC 301, a home server 302, a TV STB 303, a PDA 304, a gaming console 305, a VOIP phone 306, a security camera 307 or a Home Network sharing device 308.

Fig. 4A schematically illustrates the architecture for provisioning triple play services to subscribers with in-building distribution over existing copper infrastructure, according to a preferred embodiment of the invention.

Fig. 4B schematically illustrates the architecture for provisioning triple play services to subscribers with in-building distribution over Ethernet cables, according to a preferred embodiment of the invention.

Fig. 4C schematically illustrates the architecture for provisioning triple play services to subscribers with wireless in-building distribution, according to a preferred embodiment of the invention.

Fig. 5 is a block Diagram of the system for provisioning triple play services with ensured QoS to subscribers over existing copper infrastructure, according to a preferred embodiment of the invention.

System 10 provides the required bandwidth by combining the traditional copper telephone lines, used for DSL, to form one broad, manageable data pipe. This is accomplished by one of the following ways:

Several DSL Forum protocol models for accessing data networks utilize the Point-to-Point Protocol (PPP) to carry packets over the "U" interface (described with respect to Figs. 7A to 7C below). Because of the widespread use of PPP, Multi Link PPP (ML-PPP) can be used for DSL Bonding. ML-PPP as defined in RFC 1990 can be used to combine multiple PPP links into a single virtual bundle. At the transmitting side, ML-PPP takes a PPP

packet, optionally fragments it and generates a new ML-PPP header. Each resulting fragment (or a whole packet) is transmitted across a separate physical link. At the receiving side, the per-fragment headers are used to reconstruct the complete packets. This process is represented schematically in Fig. 6.

The Multi Link PPP (MLPPP) protocol has the following advantages regarding DSL link bandwidth aggregation method (DSL bonding):

- Standard well known widely used protocol
- Capable of asymmetric operation over ADSL, ADSL2, ADSL2+ and VDSL
- Allows routing of delay sensitive traffic over a single link via PPP, bypassing the ML-PPP bundle and an associated delay in ML-PPP processing
- When implemented with multi-class extensions, provides additional support for traffic of different priorities or classes.
- Provides the flexibility to the distribution of fragments to links and therefore, freedom to accommodate links of different bandwidth, thereby supporting dynamic link rate changes.

The proposed solution fully complies with recommendations of the DSL Forum standards, in particular as defined in the following Technical Reports (TRs):

- **TR-25** - Core Network Architecture Recommendations for Access to Legacy Data Networks over ADSL
- **TR-58** - Multi-Service Architecture & Framework Requirements
- **TR-59** - DSL Evolution – Architecture Requirements for the Support of QoS-Enabled IP Services

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- **TR-94** - Multi-Service Delivery Framework for Home Networks
- **TR-101** - Migration to Ethernet-Based DSL Aggregation

Fig. 7A (prior art) schematically illustrates a Multi Service Reference Model taken from TR-58.

Fig. 7B (prior art) schematically illustrates a High Level Architectural Reference Model taken from TR-59.

The ML-PPP is implemented via the U interface at the system side (The U interface protocol stacks are specified below).

At the network side, The ML-PPP is implemented at the Broadband Remote Access Server (BRAS). The BRAS is the aggregation point for the subscriber's data traffic. It provides aggregation capabilities (e.g., IP, PPP, ATM) between the Regional/Access Network and the NSP or ASP. In addition to aggregation, it is also the "injection point" for policy management and IP QoS in the Regional/Access Networks.

Commercial BRAS implementations can support the MLPPP protocol. All is needed in this case at the network side for the above network architecture is to configure the BRAS for MLPPP. Thus, system 10 in this case is single sided single box solution that does not require any changes in the network topology (except BRAS configuration for ML-PPP).

There might be cases in which ML-PPP configuration in the BRAS is not possible or is not desirable or cases in which an independent solution or system testing is desirable. For such cases, a specific server 701 can be

installed in the network to perform the BRAS functionalities related to the ML-PPP implementation, as depicted in Fig. 7C. This solution is carried out by software and there is no need for the BRAS to support ML-PPP.

DSL Forum TR-101 outlines how an ATM aggregation network can be migrated to an Ethernet based aggregation network in the context of TR-25 and TR-59 based architectures. The TR-101 provides an architectural/topological model of such an Ethernet based aggregation network that supports the business requirements in TR-058. It describes requirements for protocol translation and interworking, QoS, multicast, security, and OAM for a DSL aggregation network.

TR-101 defines a new access network topology where the connectivity between the Access Node and the Broadband Network Gateway is Ethernet based rather than ATM. Access nodes can be directly connected or can go through an aggregation layer(s) before reaching the Broadband Network Gateway.

TR-059 based architectures assume a single Broadband Network Gateway (e.g., BRAS) where user services are performed. TR-101, however, recognizes the potential for service segregation. Some applications, such as video, may have specific enough requirements from the network that they are best optimized separately from other types of traffic. The architecture described in TR-101 supports the possibility for a dual Broadband Network Gateway (BNG) scenario when required for video optimization. When used, the BNG dedicated to video is denoted as the 'video BNG'. Such an approach may have additional complexities not present with a single BRAS/BNG arrangement described in TR-059. This is most notable with respect to traffic/bandwidth management and the resulting network efficiency, as well

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as the additional operations overhead. Furthermore, in dual node architectures, it is not mandated that both BNGs support all of the requirements detailed in TR-101. Specifically, the video BNG may not implement subscriber management functions (e.g., PPP termination, per user QoS), provided that these functions are likely to be performed by the other BNG. Fig. 7D (prior art) depicts the network architecture considered in TR-101. The fundamental changes from current deployment architectures are:

- V interface that supports Ethernet as the transport protocol with no ATM present.
- An Ethernet aggregation network
- The possibility of dual Broadband Network Gateways
- Higher bit rate services (e.g. by supporting Access Nodes nearer the end-user)
- Higher network availability (in support of application and business customer needs)
- U interface that could support direct Ethernet framing over DSL.

Similar to the TR-059 architecture, the architecture depicted in Fig. 7D uses a Broadband Network Gateway for providing IP QoS down to the user level. TR-059 also supported legacy ATM services that may not have traversed the BNG. Similarly, the architecture described within this document (TR-101) also enables services to be injected into the network without going through a single Broadband Network Gateway.

Fig. 8A (prior art) illustrates the protocol stacks at the U interface.

Option 'a' is denoted IPoEoATM and option 'b' is denoted PPPoEoATM. Option 'c' is denoted IPoA and option 'd' is denoted PPPoA.

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Options 'e' and 'f represent those scenarios when the access loop supports direct Ethernet encapsulation and are referred to as IPoE and PPPoE.

Similarly, Option 'g' represents a pure Ethernet service where there is no visibility above layer 2. Both options 'a' and 'e' are commonly referred to as **IPoE** and options 'b' and 'f' are referred to as **PPPoE**.

Those options where Ethernet is included in the protocol stack may also include 802.1Q headers to carry Virtual LAN (VLAN) tags and priority markings.

The PPP is the protocol that allows the carriers to connect the customers to different ISP's/CSP's and allow them to authenticate the customers via Remote Authentication Dial-In User Service (RADIUS) protocol and provide them with the services they are paying for through Lightweight Directory Access Protocol (LDAP) database in the back office.

Fig. 8B (prior art) illustrates the protocol stacks at the V interface.

DSL Forum's TR-101 defines the network topologies for supporting multiple services using Ethernet networks. Unlike its predecessor, TR-101 does not mandate a single topology but rather allows several variations. One new alternative is support for IP over Ethernet (IPoE) encapsulation. IPoE extends several LAN-based protocols, including Dynamic Host Configuration Protocol (DHCP, which is a communications protocol that lets network administrators centrally manage and automate the assignment of Internet Protocol (IP) addresses in an organization's network) to allow using a broadband network.

Fig. 9 (prior art) illustrates a common network topology when using TR-101. TR-101 does not advocate using IPoE over PPPoE, but rather allows

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the broadband provider to select when to use each alternative. Since DHCP was designed for use on a shared LAN, its capabilities complies with the requirements for sending common data traffic to many users. Traditional broadcast television is an example of this case. As a result, IPoE/DHCP is typically used for delivering IPTV data traffic. In contrast, PPPoE more closely meets the needs of point-to-point broadband connections such as data and VoIP, since it was designed to support this environment. Broadband networks have been using PPP for many years, while DHCP is a recent entrant into this market. Today, existing unicast services are offered using PPP and there is little impetus to move away from using it. In fact, many broadband service providers prefer to stick with PPPoE, since it is more functional and mature than IPoE/DHCP, eliminates the need to retrain operations personnel, and lowers the risk of adding new subscribers and services. The most common broadband implementation, therefore, is to use IPoE/DHCP to support TV and other services across the broadband network to the Set-Top-Box (STB, which is a device that converts signals to be viewable images on TV), while using PPPoE to support services to other devices such as PCs and VoIP phones. Businesses receive all broadband services typically via PPP while residential subscribers receive services via both technologies.

The solution proposed by the present invention can also be adjusted to be used by multiple edge routers. Many organizations would like to use the same simple edge switch and DSLAM access networks, but manage the services separately in the metro network using different edge routers. This is most common if another organization (either another group within the same broadband service provider or a contracted third party) provides the IP video services. This scenario is depicted in Fig. 9.

Fig. 10 illustrates a Multi Edge Network architecture, according to a preferred embodiment of the invention. At the side of system 10, the architecture is similar to all other cases. At the network side, one or more servers 101 are installed in the Aggregation Network. The higher in the aggregation hierarchy the less servers are needed per DSLAMs served by each server 101 (thereby reducing the system per subscriber cost, at the expense of less redundancy).

The server 101 is configured to create ML-PPP data pipe between system 10 (at the U interface) and server 101 (at the V interface). Such a data pipe is created per each system 10 in the network. In addition, server 101 receives the IPTV streaming video reaching it as IPoE, and transfers it to the respective destination in an appropriate protocol through ML-PPP data pipe, in addition to the VoIP and the data traffic.

When building an IPTV-capable broadband network, one important issue is VLAN design. VLANs limit the broadcast domain, potentially ensuring that subscribers cannot see each other's information and reducing network traffic. VLANs allow the network to logically segment the network into multiple communities by "tagging" each packet with a field which identifies packet ownership. VLAN usage is standardized as IEEE 802.1Q, and are sometimes called "VLAN tags" or "Q-tags". There are two fundamental VLAN design options:

1. Customer VLAN: In this model, there is a dedicated VLAN for each subscriber. This is also called the 1:1 model since there is one VLAN per subscriber.

2. Service VLAN: In this model, there is a dedicated VLAN for each service. This is also called the N:1 model since multiple subscribers share each VLAN.

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System 10 can be adopted for each of the two fundamental VLAN design options.

In addition, system 10 can be configured to support other possible Loop bonding techniques that are used to implement DSL bonding according to the G.998 series of ITU-T Recommendations, which simply increases the data rate in proportion to the number of bonded lines. Two bonded lines will double the data rate for both upstream and downstream. Likewise three bonded lines will triple the data upstream and downstream rate, and so on. This is independent of the DSL technology (ADSL, VDSL etc.). The following three different types of bonding offer multiplexing of various service data streams (Ethernet, ATM, TDM) over multiple DSL links:

Recommendation G.998.1 'ATM-based multi-pair bonding' describes a method for bonding of multiple digital subscriber lines (DSL) to transport an ATM payload beyond the rate/reach capability of a single DSL loop.

The bonding protocol allows the bonding of 2-32 loops (copper wire pairs) and supports dynamic removal and restoration of pairs without human intervention. The maximum one-way bonding delay will not exceed 2 ms.

Recommendation G.998.2 'Ethernet-based multi-pair bonding' describes a method for bonding of multiple digital subscriber lines (DSL) for Ethernet transport. This Recommendation builds on the IEEE 802.3ah-2004 methods and extends Ethernet transport over other xDSL technologies, including ADSL.

Recommendation G.998.3 'multi-pair bonding using time-division inverse multiplexing' describes a method for bonding of multiple Digital Subscriber Lines (DSLs) using Time-Division Inverse Multiplexing (TDIM). This Recommendation uses IEEE 802.3ah handshake for pair discovery,

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parameter negotiation and setup. It allows the hitless addition and removal of pairs and the fast removal of a pair upon pair failure.

In addition to bandwidth aggregation and dynamic resource allocation, system 10 is configured to provide Quality of Service (QoS) management. The QoS implementation allows delivery of high-priority video and premium data traffic. The use of hierarchical scheduling for QoS allows bandwidth management between requests for a single end user and controlled bandwidth distribution between different user types.

When sharing network resources with other services, most services also needs some form of 'Quality of Service', in order to ensure the quality of the service can be what the end-user expects. Requirements on the network to support Quality of Service differ from service to service. For example a telephony service will have more stringent quality of service requirements then a more 'general' Internet access service (browsing websites). Usually the following "Quality of Service parameters" are used to express how the network can support a certain quality to a service (telephony, video, or internet):

Delay/Delay Variations (Jitter): Services that have to be delivered almost 'real-time' (like the VoIP telephony service) often have more stringent requirements regarding the delay and variation in delay than non Real-Time services (like file downloads). A VOD service is less susceptible to delay, since often the video stream is 'buffered' for several seconds in the player in order to be able to adjust hick-ups in the network.

Packet Loss: A low packet loss is usually more important for services that cannot retransmit their information when it was in error. This is the case with most of the 'real-time' services which do not have the time to do this (if they retransmit an erroneous packet the retransmission will come most likely to late to use, since that video or audio segment has already passed).

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In order to make sure that delay (variation) and packet loss requirements can be fulfilled for specific traffic flows under network congestion conditions, system 10 implements "Quality of Service mechanisms". These mechanisms consist of implementing the tagging (marking) of certain types of traffic (e.g. voice- or internet-traffic) and using this to serve e.g., voice traffic with a higher priority than the internet traffic (which has to wait a bit longer than the voice-traffic to be transmitted).

The traditional packet scheduling mechanism on the Internet has been first-in, first-out (FIFO) scheduling, by which packets are transmitted in the same order in which they arrive in the output queue. FIFO is simple and easy to implement but cannot differentiate between multiple data flows; hence, FIFO cannot allocate specific performance bounds for a flow, or prioritize one flow over the others.

Weighted Fair Queuing (WFQ) is a scheduling discipline, according to which flow differentiation occurs in scheduling. In WFQ, each flow or traffic class is assigned a weight, and the rate at which a flow or a traffic class is serviced is proportional to its assigned weight. WFQ provides prioritization among unequally weighted traffic flows and fairness and protection among equally weighted traffic flows as per the max-min fair-share allocation scheme.

Packet dynamics in a network can make the network prone to occasional or constant congestion. At times when a network doesn't see traffic congestion, any scheduling scheme works, because no queues build. When some network congestion exists, however, queues build upon, and the scheduling mechanism determines the order in which the packets in the queue are serviced.

For the scheduling algorithm to deliver QoS, at a minimum it needs to be able to differentiate among the different packets in the queue and know

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each packet's service level. Such a scheduling algorithm should allow guarantees on performance bounds by allocating resources on a flow basis and/or by prioritizing one flow over the other. In addition, a scheduling algorithm is needed that provides fairness and protection among the flows with the same priority, such as all best-effort traffic flows.

Security in general is important for services that carry some privacy sensitive information (like the content of a telephone conversation or home banking), or content that has a certain commercial value (like on demand movies). These services need some level of protection so that only the intended recipient can receive and use this information. This type of security is usually implemented on a 'higher level' than by the network itself, often this is done by the (service related) client and server (like a software player or set top box for the on demand video). Network level security consists of more general security functions like some sort of "traffic separation" between different users by means of port based traffic switching or Virtual LANs and/or the possibility to 'bulk encrypt" all the traffic between user and central office. The segregation of traffic function is often used to make sure that traffic of customers served by one Service Provider do not interfere with the traffic generated by customers of a different Service Provider and is especially important for "open broadband networks" which give access to multiple Service Providers.

Most current internet-based services have low availability requirements as they are often free of charge and do not perform 'critical' services. However, this situation is changing as the existing services such as telephony and broadcast TV will also be offered over the Internet (Voice over IP, Digital TV over IP) via the different types of broadband networks. For these services often the user will have to pay a fee and has an expectation that

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the availability is similar as the service that was offered in the 'traditional' way. The uninterrupted availability and reliability is provided by system 10 using its built-in redundancy.

Policy management allows operators to establish subscriber and service parameters that dynamically provide access to a choice of service levels, as well as a mechanism to better manage and bill for these services. System 10 supports dynamic, network control, according to policy, thereby helping service providers to deliver highly customized business and consumer broadband services while reducing total cost of network ownership. Policies can be created to account for a wide range of user and service attributes, such as user identity, user location, user service level, time of day, available network resources, or network-use restrictions.

In order to provide any predictability or guarantee for transport QoS, there must be some end-to-end control of how much traffic is allowed into each IP QoS service class. Even a strict priority queue does not provide guaranteed service if too much traffic is entered into it. This is why resource based admission control is required. The ability to deny a session by means of admission control is a powerful tool for the service provider. Some of the benefits provided are:

If there are n sessions in a service and session n+1 is denied, based on resource based admission control, the quality of the n established sessions is consistently protected. If an additional session n+1 is admitted, the service provider would risk facing n+1 unsatisfied subscribers who pay a premium fee for a guaranteed QoS service which in essence, is being degraded by faulty admissions.

Resource based admission control relates to bandwidth management (as bandwidth is the resource being controlled). An admission control function should combine policy based and resource based admission control. There

can be a range of non-resource based policies in place to support sophisticated business models of the service provider. Admission control decisions are combined policy based and resource based decisions.

System 10 can significantly reduce service providers' operational expenses by enabling automatic connection, configuration, and provisioning of initial broadband services, as well as allowing subscriber self-provisioning for adding new services or changing existing services once they have become a broadband customer. It allows provider staff at a central location to manage quality-sensitive triple play services such as VoIP and video. It automates a variety of tasks, thereby saving significant amounts of human hours, including management of: centralized Virtual Private Network (VPN, which is a network that uses a public telecommunication infrastructure, such as the Internet, to provide remote offices or individual users with secure access to their organization's network), firewall, firmware, and configuration administration, real time single-device management and automated tasks for mass CPE, new service provision and integration with provider billing systems.

System 10 simplifies provisioning and management of all IP-based services and devices at the customer premises for reduced errors and lower operational costs.

System 10 can also deliver differentiated service levels to different classes of subscribers and price them accordingly based on SLA, e.g., premium service or service packages.

System 10 can (optionally) monitor filter and prevent or block users' access to unsuitable content. When the filter is activated, users cannot open or link to sites that the filtering rules recognize as unsuitable. (e.g., pornographic sites). Filtering of incoming and outgoing email can also be provided. Since

different groups of users may require different filtering, System 10 enables the tailoring of individual subscriber's requirements. System 10 can also manage attempted access to blocked resources or emails containing inappropriate language or material. For example, if a keyword matching/blocking algorithm identifies a match, it might either not display the offending page or email at all or display it but with the offending content obscured or stripped out.

IP traffic accounting and network monitoring makes it easy to count custom IP packets and troubleshoot problems saving network administration efforts. It captures all, but count only useful data. It creates counting rules for a single host, for a subnet, for a specific group of hosts, it supports a traffic accounting per any IP protocol with splitting traffic per port numbers. It allows real-time visualization of traffic activity on graphic charts. The traffic counters or the custom packet headers can be stored in a database, thereby providing the ability to build various traffic reports or traffic traces per month or/and per day.

System 10 can also provide authentication services that are required for authorizing a service provider administrator to access all the remote configuration functions as described above. In addition authentication is required to let authorized subscribers to access data which is relevant to them.

Since software can generate traffic volume statistics based on the number and origin of the records passing through it, those statistics could then be used for capacity planning or as part of a network monitoring procedure, as well as Billing Mediation, used to convert one type of data to another, for billing purposes. It is used to process IP Detail Record (IPDR) which provides information about IP-based service usage

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Video streaming applications typically employ large buffers (between 30 seconds and several minutes) at the receiving end. This helps avoiding any delay, jitter or packet loss. As long as the required bandwidth is guaranteed, the receiving application should be able to effectively deal with any other QoS requirements. System 10 can provide file cashing, so as to obtain more efficient access to frequently-visited Internet pages by holding them in local memory.

The above examples and description have of course been provided only for the purpose of illustration, and are not intended to limit the invention in any way. As will be appreciated by the skilled person, the invention can be carried out in a great variety of ways, employing more than one technique from those described above, all without exceeding the scope of the invention.

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Claims:

1. Method for providing broadband services with assured QoS by Telecommunication companies to subscribers in a site over existing unshielded copper infrastructure in the local loop, comprising:

a) forming at least one manageable broadband link from all or a part of the telephone lines that are routed to said site and enabled to be used as xDSL lines, by aggregating all the bandwidth available on said xDSL lines;

b) provisioning said wideband services using said manageable broadband link to subscribers, by performing:

b.1) statistical multiplexing;

b.2) Dynamic Resource Allocation;

c) extending the delivery of the multicast content intended for simultaneous use by different subscribers, particularly video broadcasting, to reach said site; and

d) performing in-building distribution of said broadband services to each subscriber.

2. Method according to claim 1, wherein the broadband services include Triple Play.

3. Method according to claim 1, wherein the site is selected from the following group:

- apartment buildings;
- office buildings;
- Multi Dwelling Units (MDUs);
- Multi Tenant Units (MTUs);
- a campus deployment.

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4. Method according to claim 1, wherein telecommunication companies include:

- ILECs;

- CLECs;

- Service Providers;

- ISPs

5. Method according to claim 1, wherein the available bandwidth on the xDSL lines is aggregated using ML-PPP protocol.

6. Method according to claim 5, wherein whenever the ML-PPP is implemented via the U interface at the system side, the BRAS that supports ML-PPP is used as the ML-PPP termination for the subscriber's data traffic at the network side.

7. Method according to claim 6, wherein whenever the BRAS does not support ML-PPP or whenever a BRAS independent ML-PPP implementation is desired, a dedicated server is used for supporting the ML-PPP termination at the network side of the subscriber's data traffic.

8. Method according to claim 5, wherein whenever the network architecture for providing broadband services complies with TR-101, a dedicated server residing in the aggregation network over the V interface is used for forming a broadband ML-PPP between the V and U interfaces, based on multiple links of PPPoE.

9. Method according to claim 8, wherein the formed broadband ML-PPP is used for transferring data and voice.

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10. Method according to claim 8, wherein the formed broadband ML-PPP is used for receiving the IPTV video streaming based on IPoE and for transferring the video streaming in an appropriate protocol over said broadband ML-PPP.

11. Method according to claim 1, wherein the broadband services are provisioned based on statistical multiplexing, according to different subscribers' and services' profiles at any given instance and on a corresponding dynamic resources allocation.

12. Method according to claim 1, wherein multicast streaming is extended until reaching the site and then splitting said streaming via the in-building distribution.

13. Method according to claim 1, wherein the wideband services are distributed among the subscribers in the site via one of the following means:

- Ethernet/LAN cables;
- Coax cable;
- Home PNA-3.0
- PowerLine;
- wireless communication; or
- any combination thereof.

14. Method according to claim 1, further comprising providing one or more of the following functions along with the broadband services:

- QoS Management;

- Resource Scheduling;
- Multicasting;
- Remote Configuration and Management;
- Authentication;
- Security;
- Policy Management;
- SLA Management;
- Redundancy;
- Admission Control;
- Traffic Accounting and Monitoring;
- Traffic Filtering;
- Billing Mediation;
- Broadcast Buffering;
- File Cashing; and
- any combination thereof.

15. Method according to claim 1, wherein the available bandwidth on the xDSL lines is aggregated using one of the G.998 series of ITU-T Recommendations.

16. Method according to claim 1, wherein the provisioning of broadband services complies with recommendations of the DSL Forum standards and different network architectures included therein, particularly as defined in the following Technical Reports (TRs):

- TR-25;
- TR-58;
- TR-59;

- TR-94;
- TR-101

17. System for providing broadband services with assured QoS by Telecommunication companies to subscribers in a site over existing unshielded copper infrastructure in the local loop, comprising:

a) circuitry and software for aggregating all the bandwidth available on all or a part of the telephone lines that are routed to said site and enabled to be used as xDSL lines, to form at least one manageable broadband link;

b) software for performing statistical multiplexing;

c) circuitry and software for performing Dynamic Resource Allocation;

d) circuitry and software for extending the delivery of the multicast content intended for simultaneous use by different subscribers, particularly video broadcasting, to reach said site; and

e) circuitry and software for in-building distribution of said broadband services to each subscriber.

18. System according to claim 17, in which the broadband services include Triple Play.

19. System according to claim 17, in which the site is selected from the following group:

- apartment buildings;
- office buildings;
- Multi Dwelling Units (MDUs);
- Multi Tenant Units (MTUs);
- a campus deployment.

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20. System according to claim 17, in which the telecommunication companies include:

- ILECs;

- CLECs;

- Service Providers;

- ISPs

21. System according to claim 17, in which the available bandwidth on the xDSL lines is aggregated using ML-PPP protocol.

22. System according to claim 21, including a BRAS that supports ML-PPP as the ML-PPP termination for the subscriber's data traffic at the network side.

23. System according to claim 22, further including a dedicated server for supporting the ML-PPP termination at the network side of the subscriber's data traffic, whenever the BRAS does not support ML-PPP or whenever a BRAS independent ML-PPP implementation is desired.

24. System according to claim 21, further including a dedicated server that resides in the aggregation network over the V interface, for forming a broadband ML-PPP between the V and U interfaces, whenever the network architecture for providing broadband services complies with TR-101.

25. System according to claim 17, comprising circuitry and software for extending multicast streaming until reaching the site and circuitry for splitting said streaming via the in-building distribution.

26. System according to claim 17, in which the wideband services are distributed among the subscribers in the site via one of the following means:

- Ethernet/LAN cables;
- Coax cable;
- Home PNA-3.0
- PowerLine;
- wireless communication; or
- any combination thereof.

27. System according to claim 17, further comprising circuitry and associated software for providing one or more of the following functions along with the broadband services:

- QoS Management;
- Resource Scheduling;
- Multicasting;
- Remote Configuration and Management;
- Authentication;
- Security;
- Policy Management;
- SLA Management;
- Redundancy;
- Admission Control;
- Traffic Accounting and Monitoring;
- Traffic Filtering;
- Billing Mediation;
- Broadcast Buffering;

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- File Cashing; and

- any combination thereof.

28. System according to claim 17, in which the available bandwidth on the xDSL lines is aggregated using one of the G.998 series of ITU-T Recommendations.

29. System according to claim 17, in which the provisioning of broadband services complies with recommendations of the DSL Forum standards and different network architectures included therein, particularly as defined in the following Technical Reports (TRs):

- TR-25;

- TR-58;

- TR-59;

- TR-94;

- TR-101

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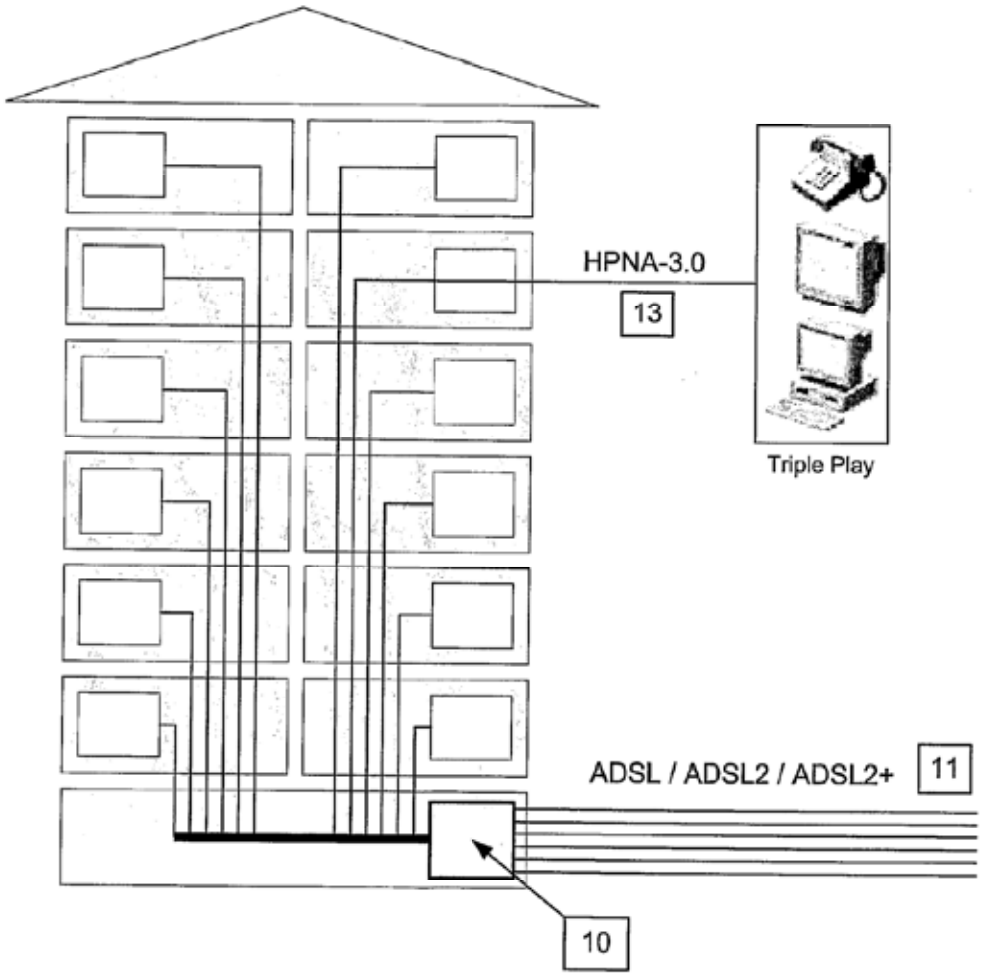


Fig. 1

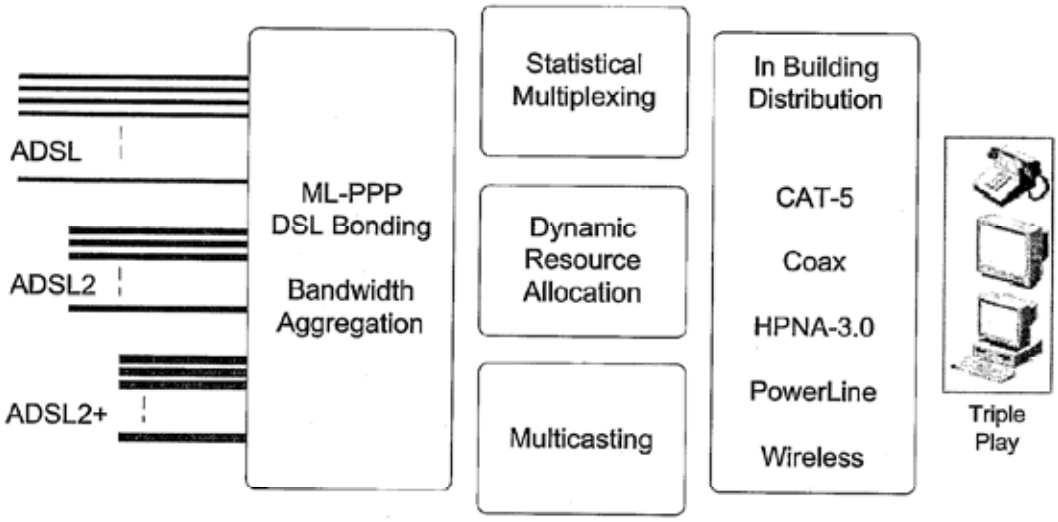

ADSL
ADSL2
ADSL2+
ML-PPP
DSL Bonding
Bandwidth
Aggregation
Statistical
Multiplexing
Dynamic
Resource
Allocation
Multicasting
In Building
Distribution
CAT-5
Coax
HPNA-3.0
PowerLine
Wireless
Triple
Play

Fig. 2

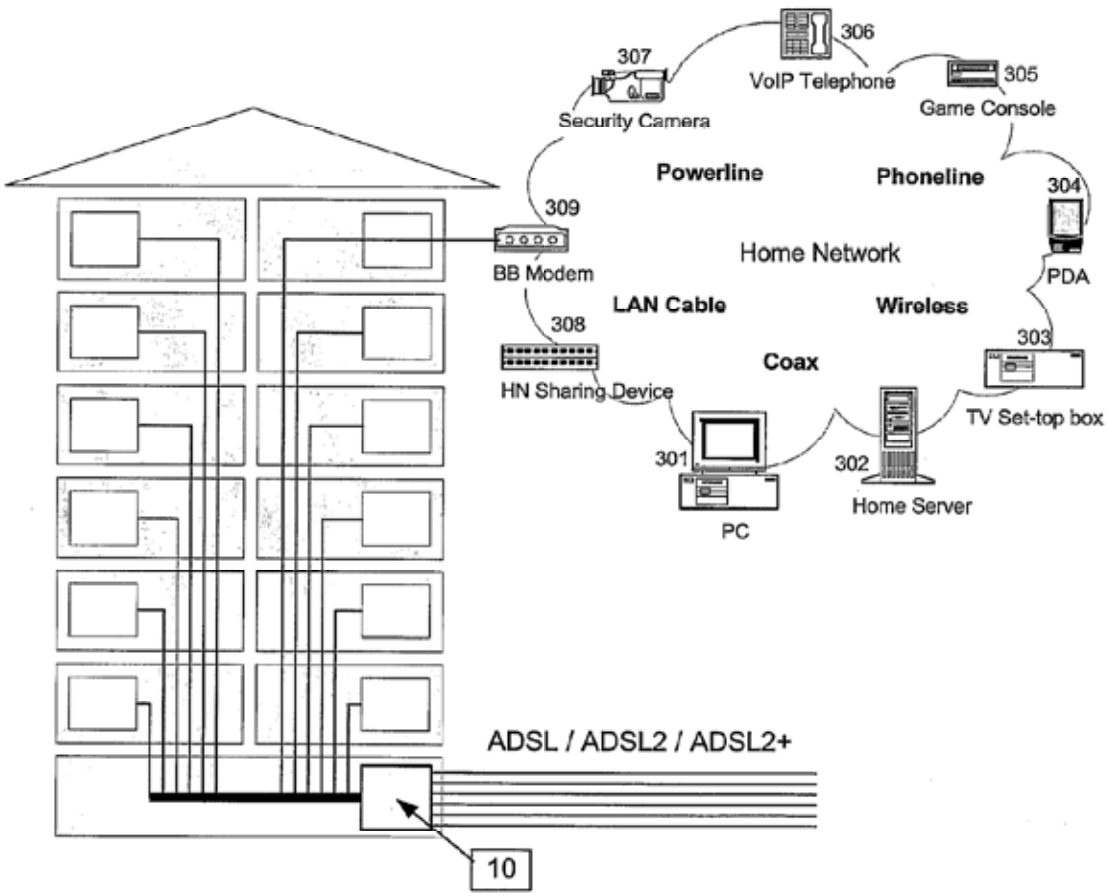

306
VoIP Telephone
307
Security Camera
305
Game Console
Powerline
Phoneline
304
309
Home Network
PDA
BB Modem
LAN Cable
Wireless
308
303
Coax
HN Sharing Device
TV Set-top box
301
302
Home Server
PC
ADSL / ADSL2 / ADSL2+
10

Fig. 3

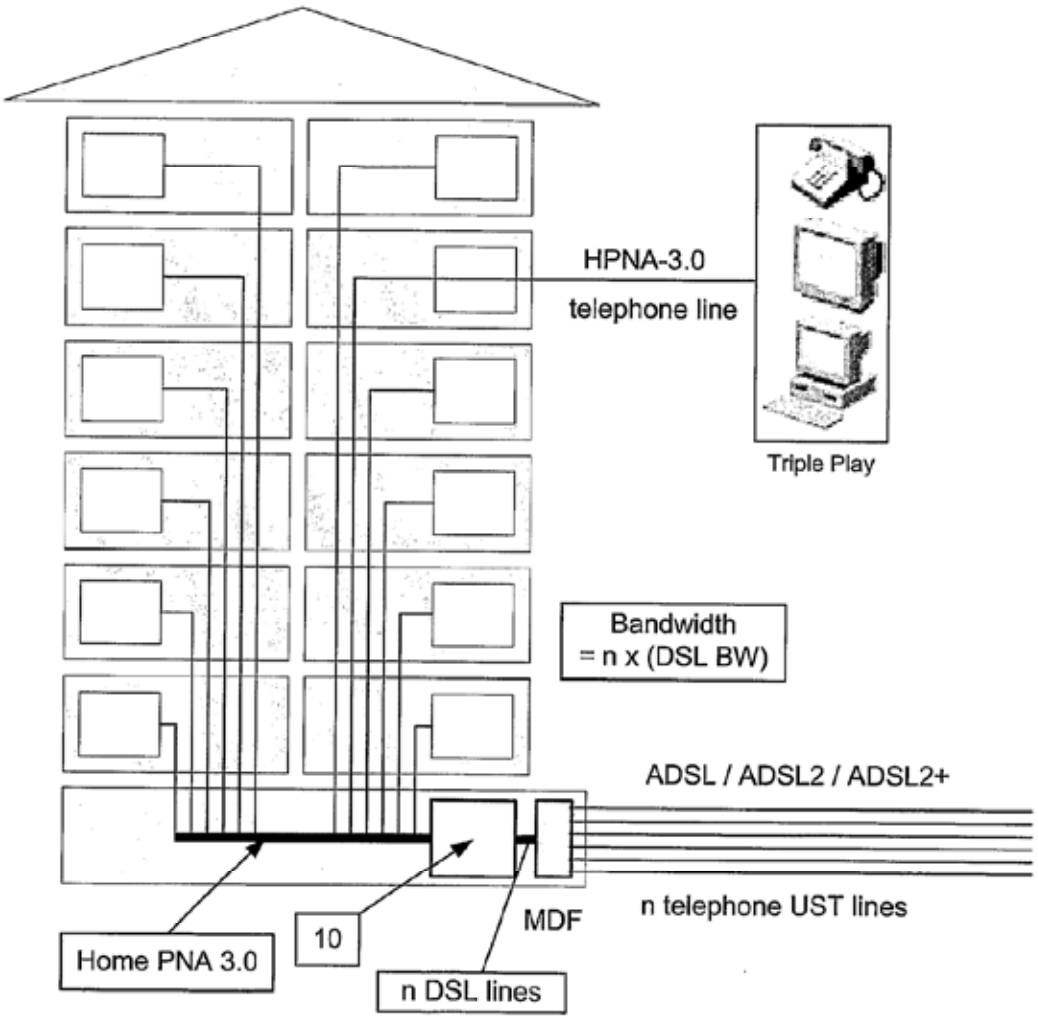

HPNA-3.0
telephone line
Triple Play
Bandwidth
= n x (DSL BW)
ADSL / ADSL2 / ADSL2+
n telephone UST lines
MDF
Home PNA 3.0
10
n DSL lines

Fig. 4A

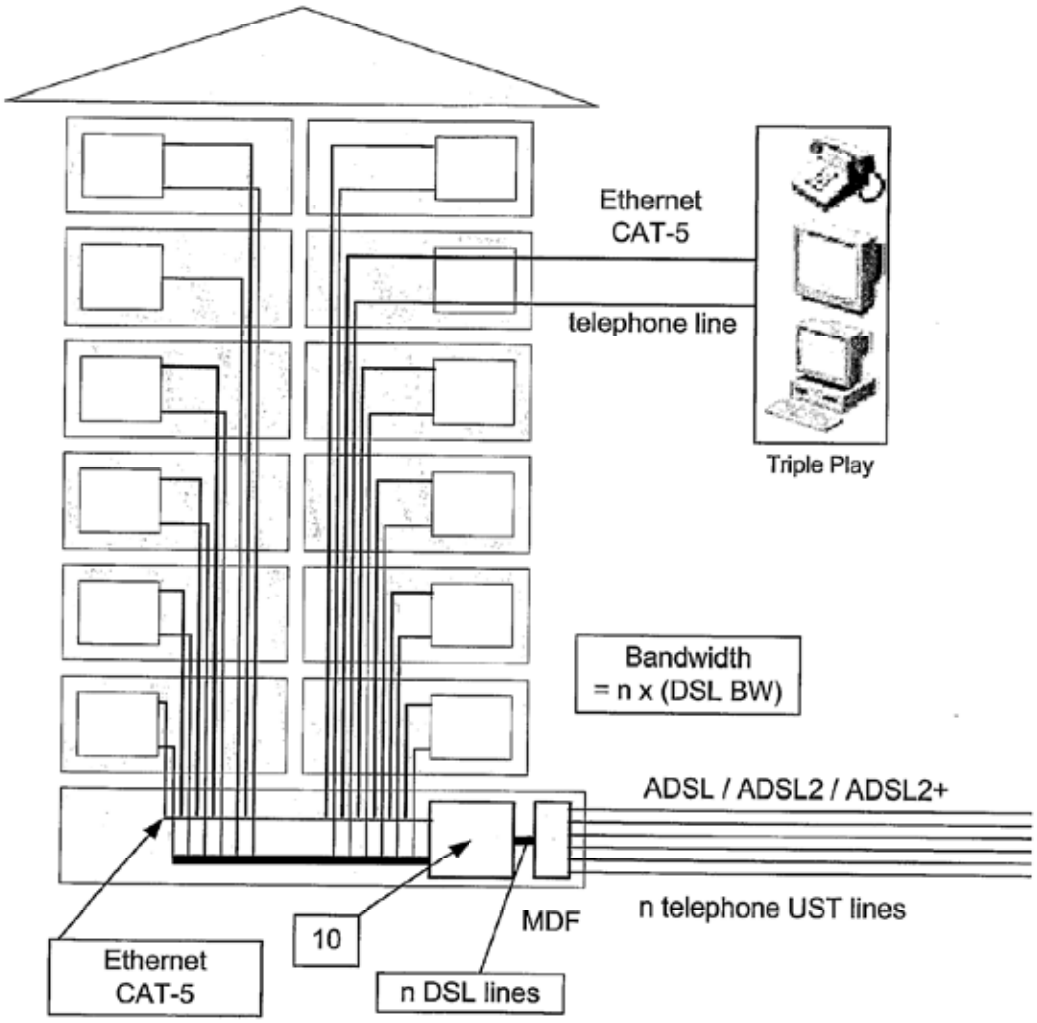

Ethernet
CAT-5
telephone line
Triple Play
Bandwidth
= n x (DSL BW)
ADSL / ADSL2 / ADSL2+
n telephone UST lines
MDF
10
Ethernet
CAT-5
n DSL lines

Fig. 4B

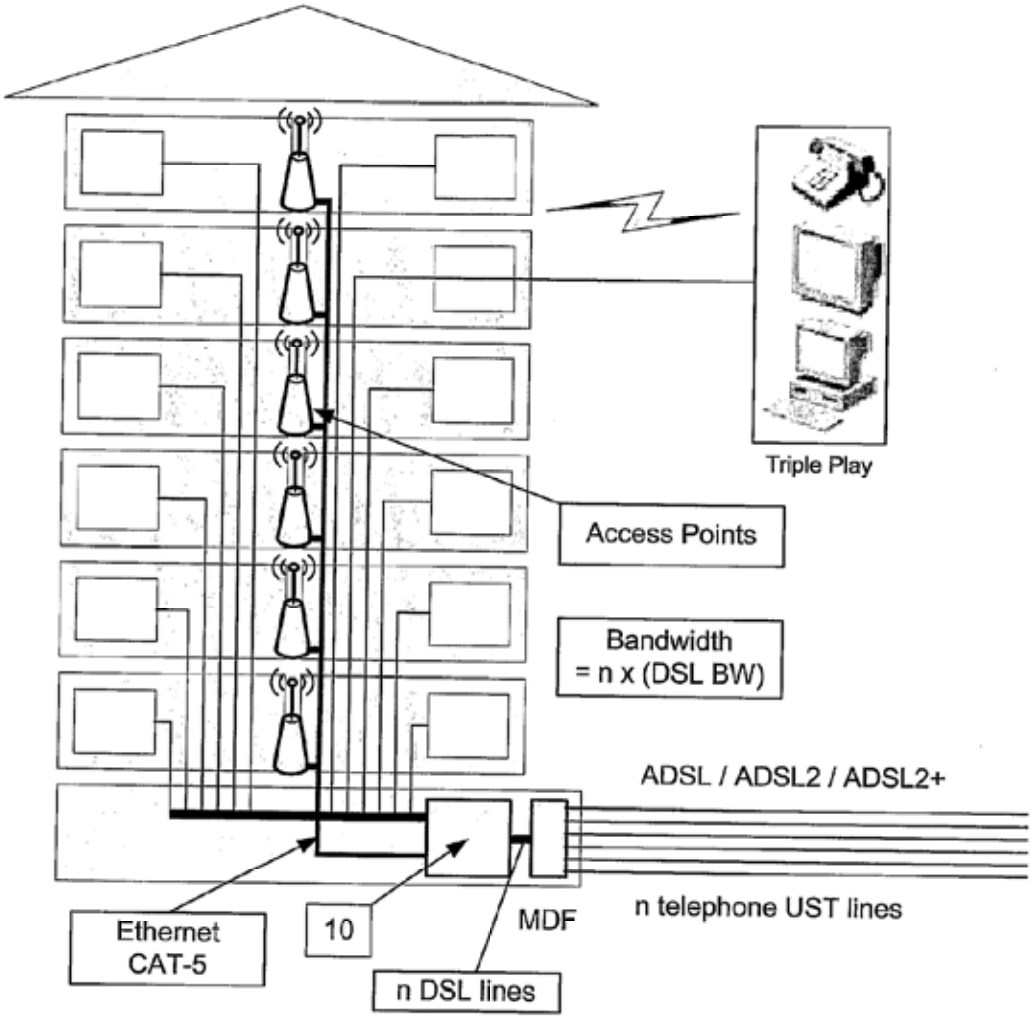

Triple Play
Access Points
Bandwidth
= n x (DSL BW)
ADSL / ADSL2 / ADSL2+
n telephone UST lines
MDF
Ethernet
CAT-5
10
n DSL lines

Fig. 4C

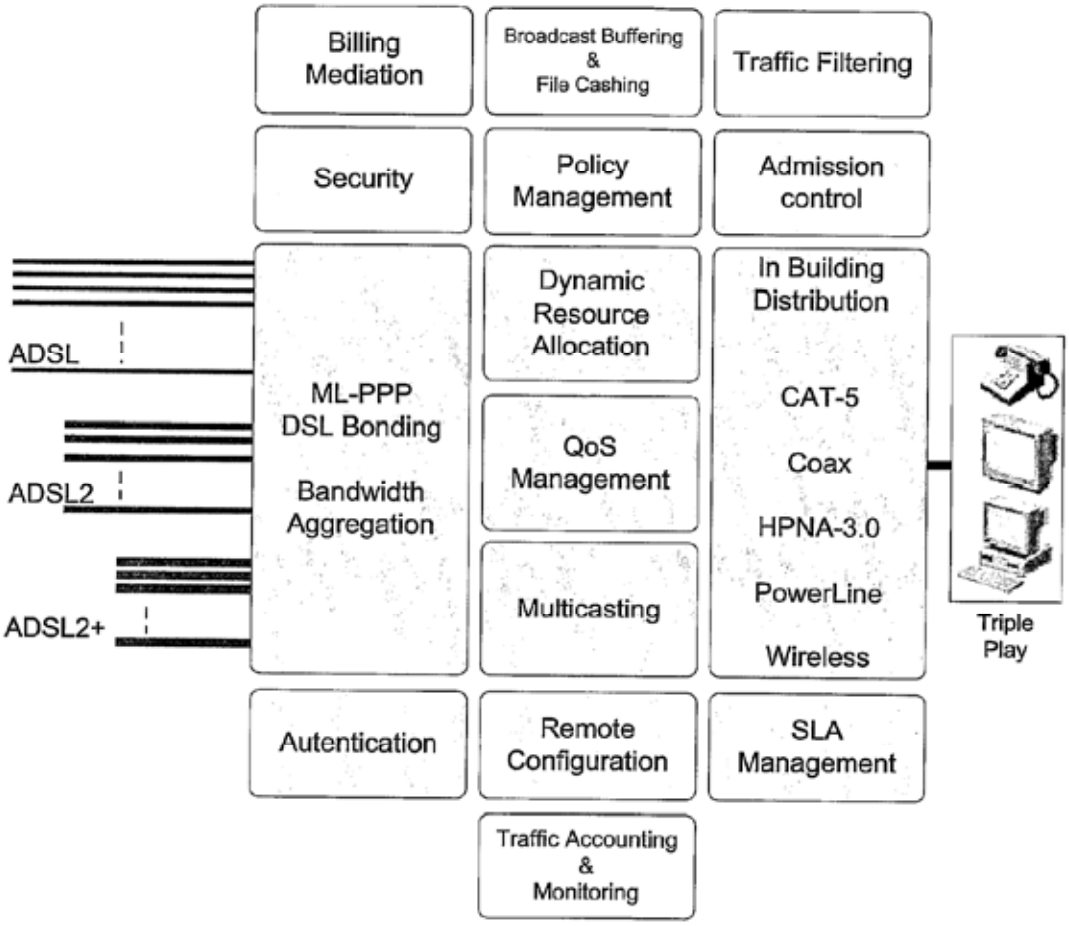

Billing Mediation
Broadcast Buffering & File Cashing
Traffic Filtering
Security
Policy Management
Admission control
ADSL
ADSL2
ADSL2+
ML-PPP DSL Bonding
Bandwidth Aggregation
Dynamic Resource Allocation
QoS Management
Multicasting
In Building Distribution
CAT-5
Coax
HPNA-3.0
PowerLine
Wireless
Triple Play
Autentication
Remote Configuration
SLA Management
Traffic Accounting & Monitoring

Fig. 5

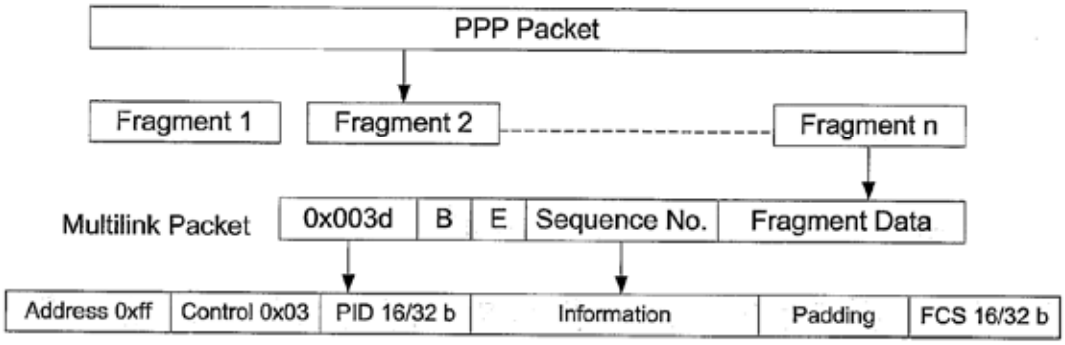

PPP Packet
Fragment 1
Fragment 2
Fragment n
Multilink Packet
0x003d
B
E
Sequence No.
Fragment Data
Address 0xff
Control 0x03
PID 16/32 b
Information
Padding
FCS 16/32 b
Transmitted ML packet

Fig. 6

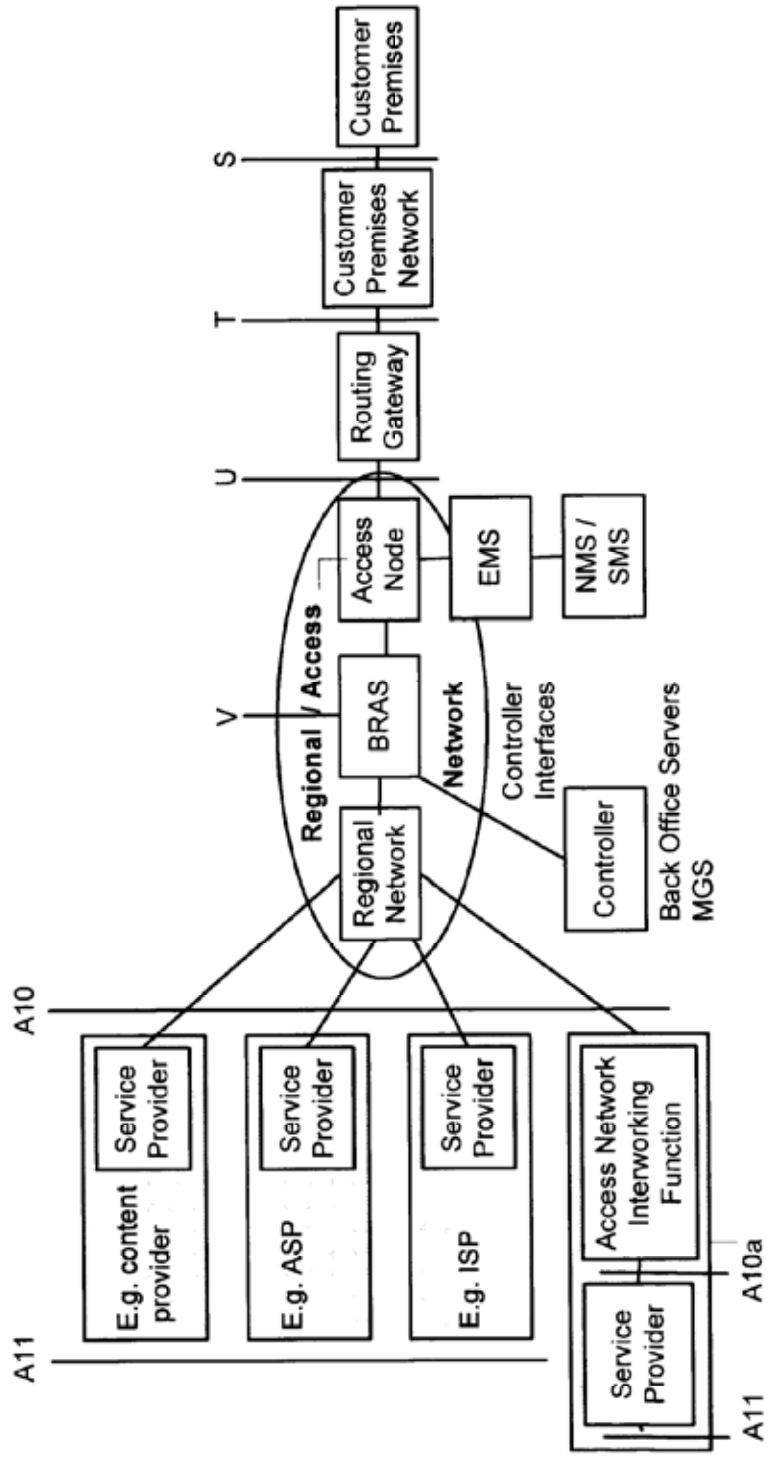


Fig. 7A

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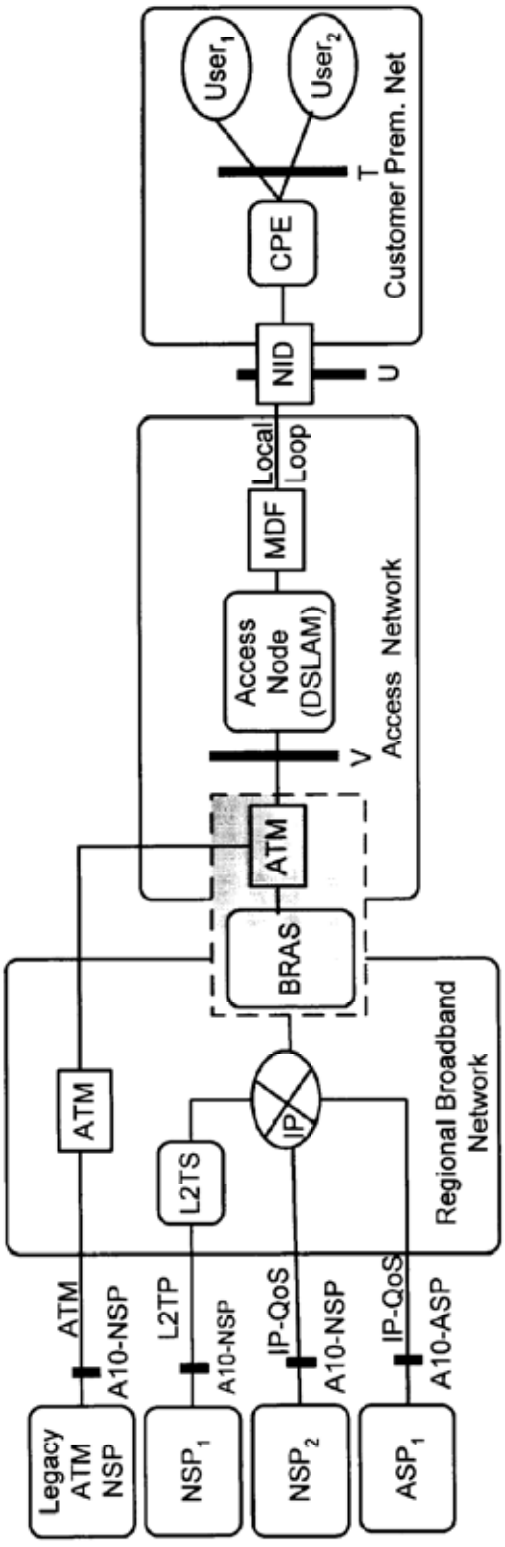


Fig. 7B

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Page #1211

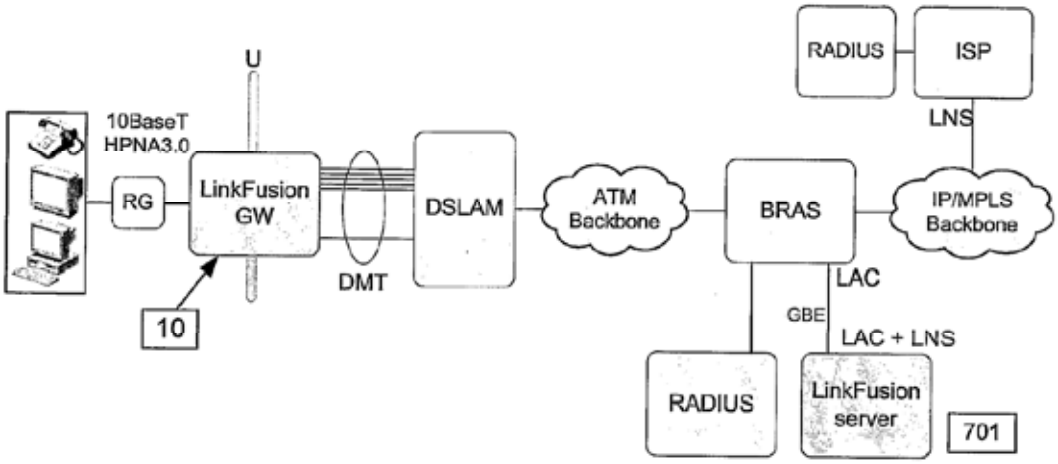

U
10BaseT
HPNA3.0
RG
LinkFusion
GW
DMT
DSLAM
ATM
Backbone
BRAS
RADIUS
ISP
LNS
IP/MPLS
Backbone
LAC
GBE
LAC + LNS
RADIUS
LinkFusion
server
701
10

Fig. 7C

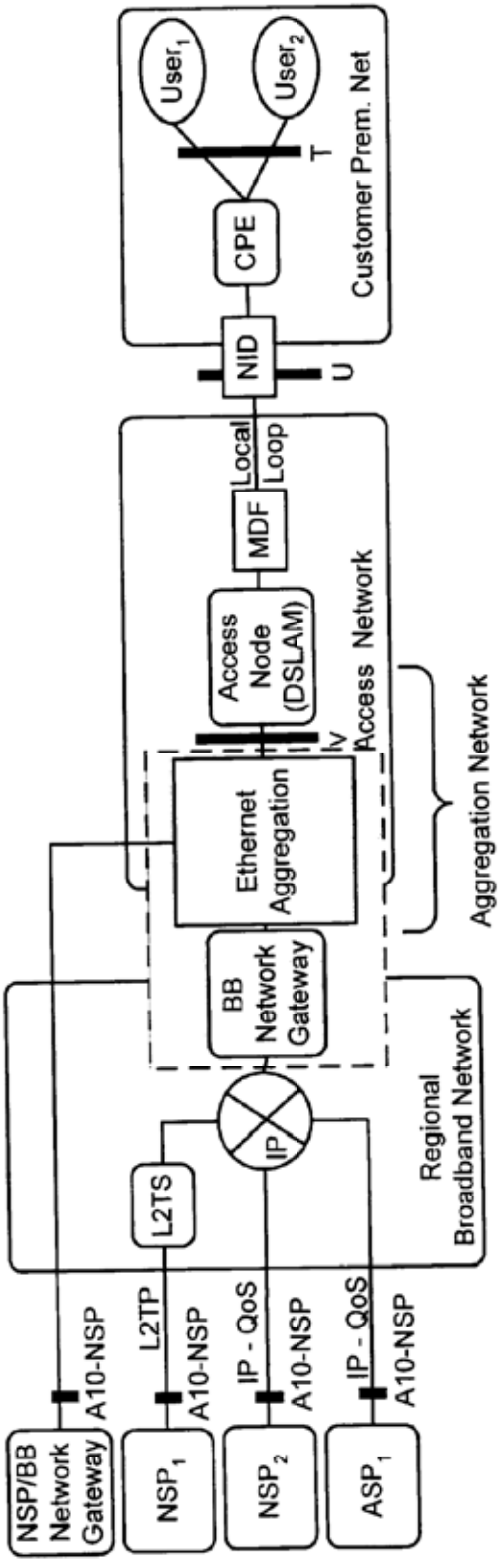


Fig. 7D

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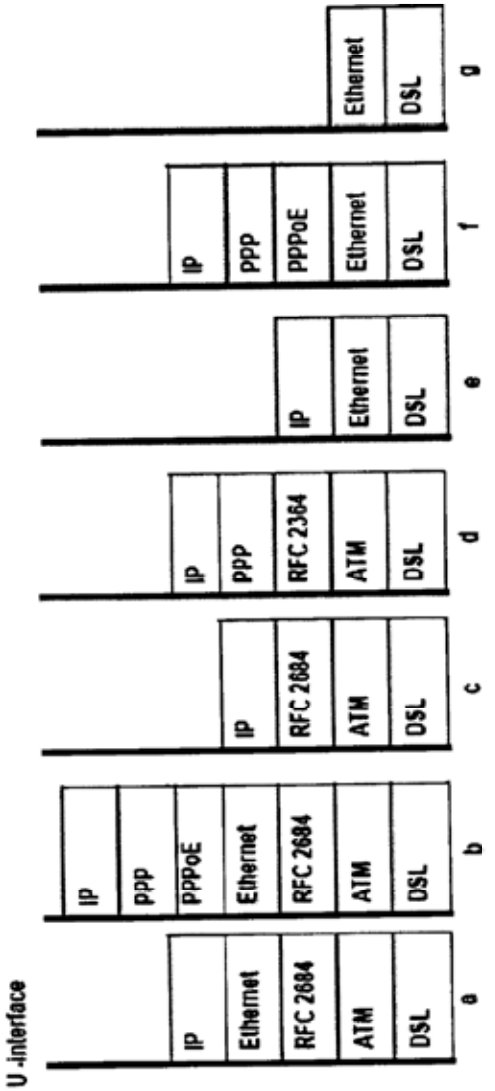


Fig. 8A

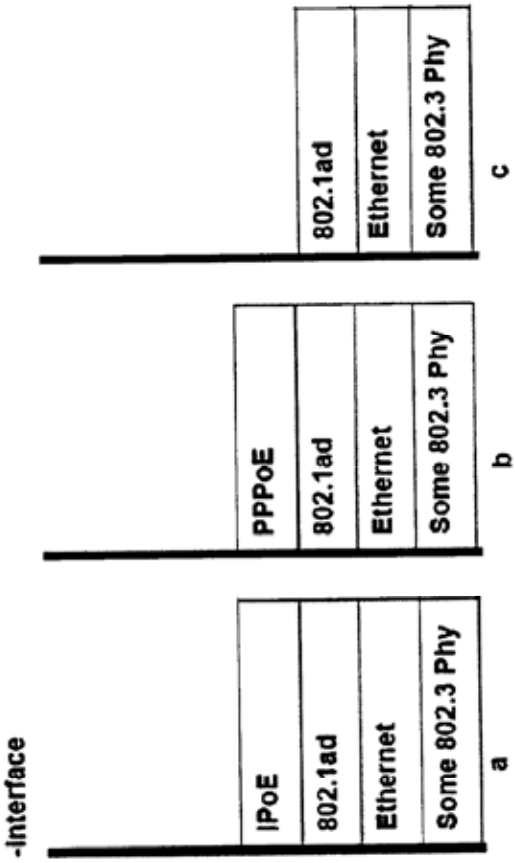


Fig. 8B

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Page #1214

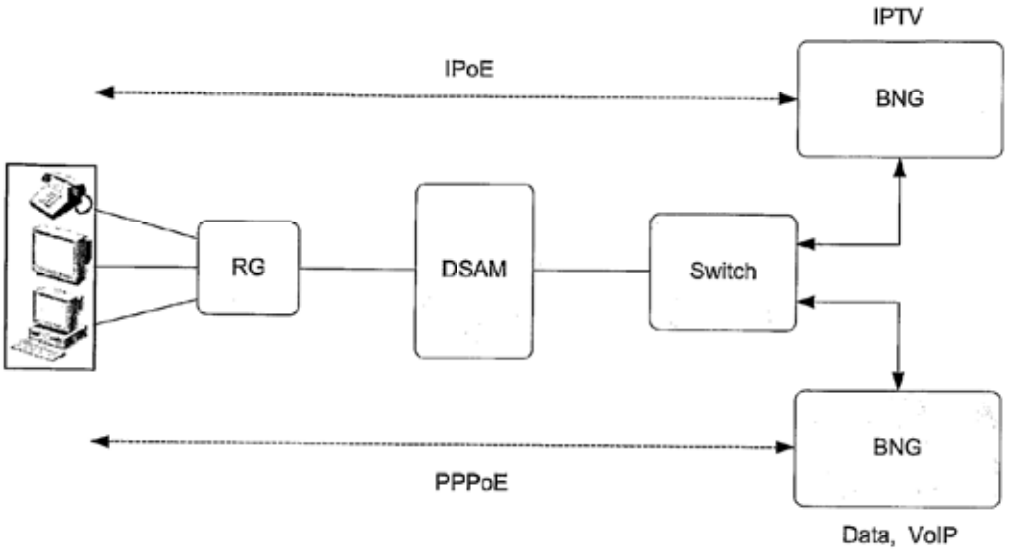


Fig. 9

15/15

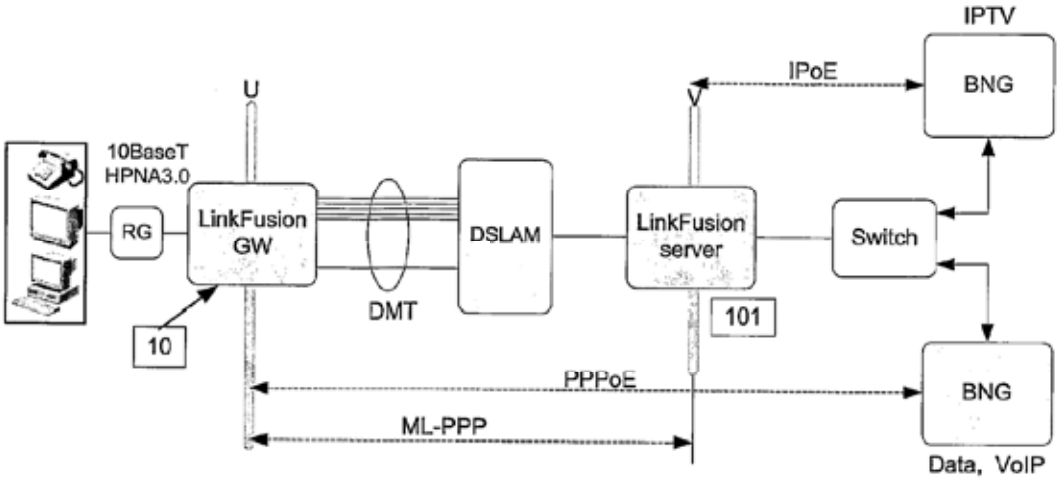

IPTV
IPoE
BNG
U
V
10BaseT
HPNA3.0
RG
LinkFusion
GW
DSLAM
LinkFusion
server
Switch
DMT
101
10
PPPoE
BNG
ML-PPP
Data, VoIP

Fig. 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/IL2007/000470

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04L12/28 H04L12/56 H04L29/06 H04M11/06 H04L12/18

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04L H04M H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, INSPEC, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2003/108063 A1 (JOSEPH MOSES S [US] ET AL) 12 June 2003 (2003-06-12) abstract figure 2 paragraph [0041] paragraphs [0046] - [0052] paragraphs [0055], [0057] paragraphs [0072] - [0078]	1-29
Y	EP 1 134 932 A1 (CIT ALCATEL [FR]) 19 September 2001 (2001-09-19) abstract paragraphs [0001] - [0003] paragraphs [0008] - [0010] paragraphs [0024] - [0026]	1-29

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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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
29 August 2007	06/09/2007

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	Bonnet, Jérôme

Form PCT/ISA/210 (second sheet) (April 2005)

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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 1 094 646 A2 (VIRTUAL ACCESS IRELAND LTD [IE] VIRTUAL ACCESS TECHNOLOGY LTD [IE]) 25 April 2001 (2001-04-25) abstract figure 16 paragraphs [0119] - [0151]	1-29
A	SIF M ET AL: "OPTIMIZING THE BROADBAND AGGREGATION NETWORK FOR TRIPLE PLAY SERVICES : The aggregation network needs to be optimized and versatile to meet the combined demands of voice, video and high-speed Internet services" ALCATEL TELECOMMUNICATIONS REVIEW, ALCATEL, PARIS CEDEX, FR, October 2004 (2004-10), XP007010170 ISSN: 1267-7167 the whole document	1-29

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IL2007/000470

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2003108063 A1	12-06-2003	NONE	
EP 1134932 A1	19-09-2001	AT 318036 T	15-03-2006
		DE 60026006 T2	27-07-2006
		ES 2253195 T3	01-06-2006
		US 2002010782 A1	24-01-2002
EP 1094646 A2	25-04-2001	AT 347223 T	15-12-2006
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		GB 2362539 A	21-11-2001
		JP 2001197082 A	19-07-2001

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Page #1219

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

(19) World Intellectual Property Organization
International Bureau

PCT

(43) International Publication Date
29 November 2007 (29.11.2007)

(10) International Publication Number
WO 2007/136337 A2

(51) International Patent Classification: Not classified

(21) International Application Number:
PCT/SE2007/050216

(22) International Filing Date: 4 April 2007 (04.04.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
11/438,921 23 May 2006 (23.05.2006) US

(71) Applicant *(for all designated States except US)*: **TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)** [SE/SE]; S-164 83 Stockholm (SE).

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:
— *without international search report and to be republished upon receipt of that report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: METHOD AND APPARATUS FOR GENERATING CHANNEL QUALITY INFORMATION FOR WIRELESS COMMUNICATION

(57) Abstract: A method and apparatus for generating channel quality information, such as may be used for transmit link adaptation, provide different operating modes, such as a first mode that may be used when propagation channel estimates are not reliable, and a second mode that may be used when the propagation channel estimates are reliable. In one or more embodiments, channel quality information is generated using receiver performance informatio that characterizes receiver performance in terms of a defined channel quality metric, e.g., supported data rates, for different values of receiver input signal quality over a range of propagation channel realizations. Channel quality information can be generated by selecting channel quality metrics according to receiver input signal quality and a desired probability of meeting a defined performance requirement over a range of propagation channel realizations, or by selecting channel quality metrics according to receiver input signal quality and particularized propagation channel realizations.

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METHOD AND APPARATUS FOR GENERATING CHANNEL QUALITY INFORMATION FOR WIRELESS COMMUNICATION

BACKGROUND

The present invention generally relates to generating wireless communications, and particularly relates to generating channel quality information.

Channel quality information can be expressed in a number of ways, such as a channel quality indicator identifying the effective signal quality of a wireless communication receiver. The effective signal quality represents the benefits of any interference cancellation gains, diversity combining gains, coding gains, etc., that may be provided by the receiver. In other words, the output signal quality of a given receiver may be significantly better than the receiver's input signal quality, which generally is expressed as the "raw," uncompensated ratio of received signal energy to background noise and interference.

Those skilled in the wireless communications art will appreciate the value of generating channel quality information based on the output signal quality rather than the input signal quality, because the output signal quality better represents the actual signal quality bearing on the quality of demodulation and decoding performance. That is, assuming that the channel quality information is used for link adaptation, e.g., picking the modulation and coding scheme (MCS) that is appropriate for transmitting to the receiver, using input signal quality rather than output signal quality would result in chronically underutilizing the transmission link.

Accurately determining output signal quality as part of ongoing receiver operations is not, however, a straightforward proposition for some types of receivers. In particular, non-linear receivers generally have a complex relationship between input signal quality and output signal quality. Examples of non-linear receivers include multi-stage receivers employing successive interference cancellation, and joint-detection receivers.

Further, even assuming the calculability of output signal quality, such calculations may be inaccurate under some circumstances. For example, the performance achievable by a given receiver depends on a number of variables, including propagation channel conditions. Some channel conditions translate into better receiver performance than others. Thus, even for the same receiver input signal, the receiver output signal quality will vary as a function of changing channel conditions. If channel conditions are changing rapidly, or the input signal is too weak to make reliable channel estimates, reporting output signal quality, or some metric relating to output signal quality, may lead to control errors.

For example, a supporting base station may perform transmit link adaptation responsive to receiving channel quality information from a wireless communication device, that identifies the quality of the channel in terms of some metric, such as a channel quality indicator, a rate selection indicator, or the like. Thus, the base station can adjust the transmit data rate, for example, in accordance with the channel quality indicators reported by the device. This control

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mechanism works well if the actual channel conditions change slowly in comparison to the link adaptation control lag. However, performing link adaptation in consideration of actual propagation channel conditions becomes unreliable if those conditions change rapidly in comparison to the link adaptation control timing.

SUMMARY

According to one or more method and apparatus embodiments taught herein, different modes of operation are used for determining channel quality information for a wireless communication device, depending on, for example, the reliability of propagation channel estimates for the wireless communication device. For example, in one embodiment, channel quality information is determined in a first mode by mapping receiver input signal quality to a data rate that can be supported at a desired probability over a range of propagation channel realizations. A supported data rate may be defined as an allowable data rate that can be achieved with a desired performance requirement, e.g., Block Error Rate (BLER). Further, in the second mode, the channel quality information is determined by mapping receiver input signal quality to a data rate that can be supported for a particular propagation channel realization, or that can be supported for a constrained range of propagation channel conditions, corresponding to the current channel estimates obtained by the wireless communication device.

Thus, the first mode provides for generating channel quality information as a function of long-term propagation channel conditions when short-term propagation channel estimates are not reliable, such as where the time lag associated with transmit link adaptation is large compared to the coherent time of propagation channel fading. Conversely, the second mode provides for generating channel quality information as a function of short-term propagation channel conditions when short-term propagation channel estimates are reliable. Modal operation can be driven by determining whether the channel estimates being generated by the wireless communication device are reliable. Reliability may be determined by evaluating the mobility—e.g., rate of movement, Doppler frequency, etc.—of the wireless communication device, or by evaluating the channel estimates.

With the above in mind, in one embodiment, a method of determining channel quality information for a transmit propagation channel associated with a wireless communication device comprises in a first mode, generating channel quality information according to a first algorithm that does not depend on channel estimates, and in a second mode, generating channel quality information according to a second algorithm that depends on channel estimates. Receiver performance data characterizing receiver performance for a type of receiver associated with the wireless communication device may be used to generate the channel quality feedback in the first and second modes, and such generation may be performed by the wireless communication device itself, or by a base station in a supporting wireless communication network.

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For example, a wireless communication device or a base station may comprise one or more processing circuits configured to determine channel quality information for one or more signals received by the wireless communication device, based on, in a first mode, generating channel quality information according to a first algorithm that does not depend on channel estimates, and in a second mode, generating channel quality information according to a second algorithm that depends on channel estimates. The processing circuit(s) are, in one or more embodiments, configured to operate selectively in the first or second mode based on whether the channel estimates are reliable.

Complementing the above method of channel quality information generation, one embodiment of a receiver performance characterization method comprises, at each of a number of receiver input signal qualities, computing an error rate expected for each of a number of propagation channel realizations, and, for each of the error rates computed, computing a data rate that can be supported for each propagation channel realization at each receiver input signal quality, and, for each receiver input signal quality, computing the cumulative distribution function (CDF) of the supported data rates corresponding to the propagation channel realizations. Such performance characterization data may be stored by the wireless communication device, or by the supporting wireless communication network. Generally, the performance characterization data is specific for a receiver type, and different data can be stored for different receiver types. For example, a particular type of Generalized RAKE (G-RAKE) or other Minimum Mean Squared Error (MMSE) receiver would have different characterization data than would a particular type of Joint Detection (JD) receiver. Similarly, different performance characterization data can be stored for different transmit/reception modes (MISO, MIMO, etc.), even for the same receiver type.

A corresponding method of providing rate adaptation feedback from a wireless communication device to a supporting wireless communication network operates in a first mode by selecting a supported data rate using the receiver performance data according to a receiver input signal quality corresponding to measurements obtained by the wireless communication device, and a desired probability of achieving the selected data rate for a range of propagation channel realizations. In the second mode, the channel quality information is generated using the receiver performance data by selecting a supported data rate according to receiver input signal quality and a particular propagation channel realization, or a constrained range of the propagation channel realizations, corresponding to channel estimates obtained by the wireless communication device.

Of course, the present invention is not limited to the above features and advantages. Indeed, those skilled in the art will recognize additional features and advantages upon reading the following detailed description, and upon viewing the accompanying drawings.

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BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of a base station and a wireless communication device, such as a mobile station, wherein channel quality information is generated according to one or more method embodiments taught herein.

Fig. 2 is a logic flow diagram for one embodiment of processing logic for modal generation of channel quality information.

Fig. 3 is a logic flow diagram for one embodiment of selecting operating modes in the context of Fig. 2.

Fig. 4 is a logic flow diagram for another embodiment of selecting operating modes in the context of Fig. 2.

Fig. 5 is a logic flow diagram for one embodiment of a receiver performance characterization method.

Figs. 6 and 7 are graphs depicting receiver performance characterizations obtained by the receiver performance characterization method of Fig. 5, for different types of wireless communication device receivers.

Fig. 8 is a logic flow diagram for one embodiment of modally generating channel quality information using receiver performance data.

Fig. 9 is a block diagram for one embodiment of a wireless communication device that is configured to generate channel quality information.

Figs. 10 and 11 are block diagrams of embodiments of processing circuits used in generating channel quality information.

Fig. 12 is a block diagram of one embodiment of a base station that is configured to generate channel quality information based on receiving channel quality measurements for the wireless communication device.

DETAILED DESCRIPTION

Fig. 1 illustrates a base station 10 and a wireless communication device 12, wherein the channel quality information generated for the downlink between the base station 10 and the wireless communication device 12 is, in a first mode of operation, not dependent on current propagation channel estimates, and, in a second mode, is dependent on current propagation channel estimates. Thus, the first mode of generating channel quality information may be used where estimates of the downlink propagation channel are not reliable, such as when the wireless communication device 12 is moving at a high rate relative to the base station 10, or is otherwise experiencing fast fading conditions, or when the received signal strength is too low for reliable channel estimation.

Before describing various embodiments of the above method of generating channel quality information, it should be understood that the processing logic associated with generating the channel quality information can be performed wholly in the wireless communication

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device 12, wholly in the base station 10, or performed cooperatively using both the base station 10 and the wireless communication device 12. In all such cases, the attendant processing may be implemented in hardware, software, or any combination thereof. Moreover, it should be understood that the base station 10 and the wireless communication device 12 are not limited to any particular configuration, nor are they limited to any particular wireless communications standards or protocols.

For example, in one or more embodiments, the wireless communication device 12 comprises a cellular radiotelephone or other type of mobile station, configured for operation with a supporting wireless communication network that includes the base station 10. In such embodiments, the base station 10 may comprise a Wideband CDMA (WCDMA) base station configured to provide High Speed Downlink Packet Access (HSDPA) services.

Correspondingly, the wireless communication device 12 may comprise a WCDMA-based access terminal configured to provide channel quality information, or related feedback, to the base station 10, in support of adapting downlink transmit data rates to changing reception conditions at the wireless communication device 12. In general, however, the wireless communication device 12 may comprise a mobile station or other type of handset, a pager, a Portable Digital Assistant (PDA), a palmtop or laptop computer, or a wireless communication module for use therein, or essentially any other type of communication device.

Keeping the method's broad applicability in mind, Fig. 2 illustrates one embodiment of a method of generating channel quality information, wherein it should be understood that at least some of the illustrated processing steps may be performed in other than the illustrated order. Further, although illustrated as serial processing, actual implementation of the method may involve concurrent, parallel processing, as part of ongoing communication operations. Also, it should be understood that the illustrated processing may be implemented in the base station 10, the wireless communication device 12, or in some combination thereof.

Processing "begins" with a determination of whether to operate in a first mode of generating channel quality information (Step 100). If the first mode is selected, processing continues with generating channel quality information according to a first algorithm that does not depend on channel estimates (Step 102). Conversely, if the first mode is not selected, i.e., the second mode of operation is selected, processing continues with generating channel quality information according to a second algorithm that depends on channel estimates (Step 104).

In at least one embodiment taught herein, the first mode of generating channel quality information is used during fast fading conditions, or whenever conditions are such that the short-term channel estimates obtained by the wireless communication device 12 are "unreliable." The second mode of generating channel quality information is used during slow fading conditions, or, more generally, whenever the channel estimates are reliable. In other words, channel quality information is generated as a function of long-term propagation channel characteristics when short-term estimates of the channel are not reliable. Conversely, channel

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quality information is generated as a function of the short-term propagation channel characteristics when the channel estimates are reliable.

It should be understood that various methods of assessing channel estimation reliability are contemplated herein, and it should be understood that conditions deemed to give rise to unreliable channel estimations in one application may not be considered as such in another application. For example, the reliability of a short-term channel estimate may be viewed in terms of fading speed versus link adaptation control lag. That is, channel estimates may be deemed more or less reliable in dependence on how quickly channel conditions change relative to the transmit link adaptations being made. In some embodiments, the link adaptation lag—i.e., the time between a reported channel quality metric and the corresponding transmit link adjustment—may be used to influence whether, or to what extent, short-term propagation channel conditions are considered in generating channel quality information.

With such variations in mind, Fig. 3 illustrates one embodiment of processing logic for determining whether to operate in the first or second modes of Fig. 2. Modal selection processing "begins" with evaluating propagation channel fading conditions (Step 106). As will be detailed later herein, the evaluation may comprise assessing the reliability of the channel estimates to determine whether fast-fading conditions apply. In other embodiments, fast-fading may be recognized by evaluating mobility, such as by evaluating the Doppler frequency shift of transmissions on the downlink and/or uplink channels between the base station 10 and the wireless communication device 12. Of course, other indicators bearing on the reliability of short-term channel estimates may be used. For example, certain service areas may make channel estimates inherently suspect, such as radio sectors in downtown or urban areas.

If fast fading conditions apply (Step 108), channel quality generation operates in the first mode, wherein channel quality information is generated in a manner that is not dependent on channel estimates (Step 110). Conversely, if fast fading conditions do not apply, channel quality information is generated in a manner that is dependent on channel estimates (Step 112).

Fig. 4 illustrates another embodiment of processing logic for determining whether to operate in the first or second modes of Fig. 2. Modal selection processing "begins" with evaluating the network usage or load conditions (Step 114). In a lightly loaded wireless network, the reliability of the channel estimates and the derived channel quality information can be compromised even if the propagation channel fading conditions change slowly or remain static. For example, because of bursty and fast varying of inter-cell interference that is characteristic of a lightly load network, the channel quality and hence the supportable data rate realized during actual transmission of the data can be rather different than what was measured prior to the transmission.

Thus, if the network is lightly loaded (Step 116), it can be advantageous to select the first mode of determining channel quality information (Step 118). Conversely, if the network is more heavily loaded, or the loading is otherwise more stable, channel quality information can be

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determined according to the second mode of operation (Step 119). The selection of which operating mode to use for channel quality information determination can be evaluated and/or applied to individual wireless communication devices 12, or can be applied to sets or subsets of wireless communication devices 12, within a given sector or cell of the network. For example, the first mode may be used for some wireless communication devices 12, while the second mode may be used for others. The determination of which mode to use may be set according to the service needs of individual wireless communication devices 12, for example.

Note that this modal selection can be implemented in ways that are non-transparent or transparent to the wireless communication devices 12. In one embodiment, a base station 10 in the wireless communication network can instruct one or more devices in a plurality of wireless communication devices 12 to feed back information that is compatible with the preferred operating mode. Alternatively, based on the network load conditions, the base station 10 can receive information supporting the second mode of operation, but can choose to ignore all or some of that information, in favor of operating in the first mode. In other words, the base station 10 may choose not to use all of the feedback that it receives.

In some circumstances, the radio resource cost required to support operation in the second mode is higher than that for operation in the first mode. For instance, to support operation in the second mode, feedback generally has to been sent by the wireless communication devices 12 more frequently than is required for operation in the first mode, to reflect changing propagation channel conditions. The amount of feedback also could be larger to describe the propagation channel conditions in sufficient detail for operation in the second mode. The strain on the feedback channel is further exacerbated by the fact that a plurality of wireless communication devices 12 simultaneously transmits feedback information to the network. Thus, the first mode of operation may be preferred even when operation in the second mode is viable, simply based on propagation channel condition considerations.

In one or more embodiments, channel quality information determination considers the potentially higher radio resource costs on the feedback channel associated with operation in the second mode. More particularly, the second mode of operation can be reserved for contractually privileged devices or services. The privilege level of a given communication device 12 can be referenced from a database with the identification number of the device. Channel quality information can be determined according to operation in the second mode for devices with higher privilege. The contractual requirement of a service can also be a factor in considering the appropriate operation mode. For instance, for services with stringent delay or jitter requirements such as packet voice services, the quality of service can be more easily maintained if channel quality information is determined according to operation in the second mode.

Deciding whether to determine channel quality information according to the first or second modes of operation also may be adapted to transmission schemes that consist of

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separable components. Non-limiting examples of these types of transmission schemes include multi-carrier CDMA and orthogonal frequency division multiplexing (OFDM) transmission. To support operation in the second mode, the amount of feedback can scale directly with the number of separable components, e.g., four feedback values for four-carrier CDMA or eighty values for OFDM with eighty frequency resource units. For large packets or data units that would occupy entire or large portions of the components, the relative benefits of operating in the second mode instead of the first mode can be significantly smaller than for small packets or data units that would occupy small portions of the components. To conserve radio resources, it is therefore advantageous to include packet or data unit lengths as a factor in operating mode selection.

Such operation is, in one or more embodiments, supported by the use of receiver performance data that characterizes the performance of the wireless communication device's receiver type over a range of propagation channel conditions, such that the performance data indicates the expected performance of the receiver over a range of propagation channel conditions, and for particularized propagation channel conditions. Determining channel propagation conditions for channel quality information determination—e.g., for supportable rate computation—may be required for operation in the first and/or second modes of operation. For the first operating mode, long-term channel propagation conditions are determined and, in one or more embodiments, the propagation channel conditions include one or more of the following quantities: a characterization of the fading speed of the channel (for example, based on the estimated Doppler frequency, known mobile speed, rate of negative acknowledgements - i.e. NACK rate, ...); and an estimate of the power delay profile (PDP) of the propagation channel associated with the wireless communication device 12, assuming that the PDP does not change quickly over time.

In one or more embodiments, the estimation of long-term propagation channel conditions is used for any one or more of the following processing actions: construction of a CDF of the achievable (supportable) data rates; selection of an achievable data rate curve CDF from a table of CDF curves that most closely matches the estimated long-term propagation channel conditions. Thus, it should be understood that in one or more embodiments, CDF curves may be predefined. In such embodiments, the received signal quality and/or long-term characterization of the propagation channel associated with the wireless communication device 12 can be used to select a point or range along a predefined CDF curve to identify channel quality information for the wireless communication device 12—e.g., to identify an achievable data rate. In one or more other embodiments, the long-term propagation channel conditions as estimated are used to partially or wholly construct one or more CDF curves, which can then be used to identify achievable data rates, for example, as a function of measured signal quality at the wireless communication device 12.

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In more detail, for purposes of CDF curve construction, the PDP is considered a known quantity, and estimates of the delay tap (channel) coefficient values can be generated and used to further determine the propagation channel realization for the given PDP. At least one embodiment estimates propagation channel coefficients based on pilot or other measurements, to support characterization of long-term propagation channel conditions. It should be understood that traditional techniques for propagation channel estimation may be used as needed or desired. Note that the estimation of channel coefficients represents a longer-term estimate, rather than the short-term (instantaneous) estimates that are generally used in the second mode of operation.

In any case, it should be understood that, however they are constructed, the CDF curves characterize the (expected) performance of a particular receiver type, or types. Fig. 5 illustrates one method of characterizing receiver performance based on CDF curves, but it should be understood that other methodology may be used to characterize receiver performance for long-term and short-term propagation channel conditions.

In more detail, Fig. 5 illustrates an embodiment of a receiver performance characterization method that may be performed using empirical testing, software simulation, dynamic measurements, or any combination thereof. Because different receiver types offer different levels of performance, such characterization is done for the particular receiver type associated with the wireless communication device 12. (If the channel quality information is generated by the wireless communication device 12, the receiver performance data can be stored in the wireless communication device 12. If the channel quality information is generated in the base station 10, the base station 10 may store characterization data for different types of receivers, and use the appropriate sets of receiver performance data for different wireless communication devices.)

In any case, processing begins by computing an expected error rate for each one in a number of receiver input signal quality values, for each one in a number of modulation and coding schemes, and for each one in a number of propagation channel realizations (Step 120). Error rate may be expressed, for example, as Bit Error Rate (BER), Block Error Rate (BLER), Frame Error Rate (FER), etc., and the particular manner in which error rate is expressed may be based on the type of data transmissions involved.

As used herein, unless otherwise noted, the term "receiver input signal quality" denotes the ratio of total received signal energy per chip, E_T, over the noise plus interference, N_o. Measurements of receiver input signal quality represent the "raw" input signal quality for the receiver embodied within the wireless communication device 12, and does not depend on the receiver's interference suppression and signal gain performance, and thus does not depend on the accuracy of short-term propagation channel estimates. Moreover, receiver input signal quality measurements are the same for simple and complex receiver structures, e.g., the same whether the device's receiver is a simple linear receiver, or a complex non-linear receiver.

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Further, as used herein, the term "propagation channel realization" represents a particular combination of propagation channel tap weights. For example, a plurality of three-tap characterizations of the propagation channel comprises different combinations of three complex tap coefficients, corresponding to different propagation channel conditions. The different propagation channel realizations may be based on a fixed Power Delay Profile (PDP). Alternatively, a given fast fading realization may be used for different PDPs, and different CDFs may be used for the different PDPs.

In any case, each propagation channel realization may be understood as representing a particular hypothesis of actual propagation channel conditions for the transmit link between the base station 10 and the wireless communication device 12. For the same input signal quality, the wireless communication device 12 will exhibit different output signal quality for different channel realizations.

For each receiver input signal quality and each modulation and coding scheme, receiver performance characterization processing continues by, for each of the error rates computed, computing the data rate (R) that can be achieved (supported) for each propagation channel realization (Step 122). The achievable data rate, also referred to as the supported data rate, represents the data rate (R) that can be used for transmitting to the wireless communication device 12 while still meeting a defined performance requirement, e.g., a BLER target. For example, if the computed error rate is less than the target BLER, i.e., BLER < BLER(target), the data rate (R_{mcs}) corresponding the modulation and coding scheme can be the supported data rate ($R = R_{mcs}$), otherwise the supported data rate can be zero ($R = 0$). If ARQ is used, then the supported data rate (R) can be calculated as $R = R_{mcs}(1\text{-BLER})$, where R_{mcs} is the data rate corresponding the modulation and coding scheme and BLER is the computed error rate. If HARQ is used, then the supported data rate can be calculated as $R_{mcs}/(1+\text{BLER})$.

Processing continues by, for each receiver input signal quality, computing the cumulative distribution function (CDF) of the supported data rates corresponding to the propagation channel realizations (Step 124). Note that the generation of CDF curves can be a one-time process, or can be wholly or partially a dynamic process. For example, as was noted earlier, ongoing estimation of one or more parameters bearing on the longer-term propagation channel conditions for the wireless communication device 12. Again, such parameters can include, but are not limited to, any one or more of the PDP, estimated channel coefficients, current data service type and/or data characteristics such as packet size, mobility/rate-of-travel estimates, etc.

Fig. 6 graphically depicts receiver performance data generated according to the method of Fig. 5 for a Minimum Mean Square Error (MMSE) receiver type. More particularly, Fig. 6 graphs receiver input signal quality (SNR) curves stepped from -22 dB to +12 dB in 2 dB increments over defined data rate points, according to the CDFs of the supported data rates for the hypothesized set of propagation channel realizations. The leftmost curve corresponds to

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input SNR of -22 dB, whereas the rightmost curve corresponds to input SNR of +12 dB. Fig. 7 depicts similar performance characterization data for a Joint Detection (JD) receiver architecture, and it should be understood that the particular receiver performance data used for the wireless communication device 12 would be matched to its particular receiver type. (Further, because some types of receivers have different reception modes that yield different performance characteristics, different receiver performance data can be used in each such mode.)

In determining channel quality information using the performance curves of Fig. 6, for example, consider the case of higher rates of travel, where the channel fading conditions become more temporally uncorrelated between the measurement time at which propagation channel conditions are estimated, and the transmit time at which transmit link adaptations based on those channel estimates are performed. If the channel conditions are changing more rapidly than link adaptation control can keep up with, link adaptation—e.g., transmit data rate selection—should be based on the statistical propagation characteristics determined by the path gain and shadowing, rather than based on the channel estimates.

Given signal quality measured by the wireless communication device 12, the transmit data rate can be selected from the corresponding signal quality curve in the receiver performance data, according to a desired CDF level. For example, choosing the tenth percentile for the appropriate SNR curve corresponds to the data rate achievable for ninety-percent of the hypothesized propagation channel realizations. The particular value to choose generally depends on the particular performance requirements of the system, such as determined by a defined performance requirement, like maximum tolerable BLER. In one or more embodiments, the signal quality represents a long-term signal quality—average input SNR—as measured by the wireless communication device, or as averaged by the network. In other embodiments, such as where channel estimates are reliable, the instantaneous or short-term receiver input signal quality may be used.

In either case, the above approach effectively quantizes the rate values in the performance characterization graph to the rates represented by quantized input signal quality measurements, which is sufficient for slow link adaptation in a rapidly varying channel. That is, for fast fading conditions, the channel quality information may be generated as data rate selections based on selecting an SNR curve from the graph corresponding to long-term measured signal quality at the wireless communication device 12, and then identifying the data rate that is achievable at a desired probability for the defined performance requirement, e.g., for a defined BLER limit. Effectively, the method amounts to generating channel quality information as a function of long-term propagation channel characteristics based on mapping a receiver input signal quality measurement to a data rate selection that is achievable at a desired probability over a range of short-term propagation channel characteristics.

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As the channel becomes more reliable, for example, when vehicle speeds become slower or actual input SNR at the receiver becomes larger due to improved path gain, the channel quality information generation process can be transitioned to a mode where more refined information is generated, i.e., a mode where the short-term propagation channel conditions prevailing at the wireless communication device 12 are explicitly considered. The same performance characterization data that was used for slow adaptation during fast fading may be used for fast adaptation during slow fading. In other words, the same receiver performance curves can be used for slow and fast link adaptation in a hierarchical manner. That is, channel quality metrics can be used to characterize the long-term properties of the channel, which can then be characterized further for fast link adaptation when the channel becomes more reliable.

One method for accomplishing the above operation is to quantize the channel state values for each input signal quality (SNR) and store the quantized values in a codebook. For specific input SNR and channel estimates obtained at the wireless communication device 12, the quantized values can be looked up in the codebook, and the corresponding data rate selected for channel quality information reporting.

Fig. 8 illustrates one embodiment of hierarchical channel quality information generation, wherein the channel quality information is generated in terms of data rate reports. Such processing may be performed at the wireless communication device 12, at the base station 10, or cooperatively. In any case, processing begins with evaluation of the propagation channel conditions (Step 130). Evaluation may comprise evaluating short-term propagation channel estimates being generated by the wireless communication device 12 as a means of determining whether the estimates are reliable, or may comprise checking Doppler shifts, etc.

If the channel estimates are not reliable (Step 132), a supported data rate is selected using receiver performance data, such as illustrated in Figs. 6 and 7. More particularly, if the channel estimates are not reliable, the measured receiver input signal quality can be mapped to one of the quantized SNR curves, and a corresponding supported data rate can be identified according to the desired probability of achieving that rate over the range of propagation channel realizations used to generate the performance data (Step 134). A tenth percentile selection means that ninety-percent of the hypothesized propagation channel realizations will support the selected data rate at the desired error rate performance.

As such, if the channel estimates are not reliable, the transmit data rate is selected probabilistically, rather than based on any specific consideration of the short-term propagation channel conditions existent at the wireless communication device 12. Further, in cases where the channel estimates are not reliable, the receiver input signal quality used to select the appropriate quantized SNR curve may be a long-term (average) receiver input signal quality. Averaging may be done at the wireless communication device 12, or instantaneous values reported by the wireless communication device 12 may be averaged by the network.

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On the other hand, if the channel estimates are reliable (Step 132), the measured receiver input signal quality may represent a shorter term, e.g., instantaneous, measurement. Of course, averaged values may still be used. In either case, with the availability of reliable channel estimates, the receiver input signal quality can be mapped to one of the quantized SNR curves and a particular propagation channel realization, or a constrained range of propagation channel realizations, corresponding to the channel estimates (Step 136). In one variation of this approach, different SNR/CDF curves can be stored for long-term and short-term SNR measurements, with the different SNR curves reflecting different probabilistic characteristics. Then, in operation, the set of curves to be used is selected depending on whether long-term or short-term SNR values are being used, which may switch as a function of channel estimate reliability.

This hierarchical approach to channel quality information generation can be implemented in the wireless communication device 12, such as by including appropriately configured processing circuits in the device 12, along with storing appropriate receiver performance data. Fig. 9 illustrates one embodiment of the wireless communication device 12, configured for carrying out a method of channel quality information generation using receiver performance data. The illustrated embodiment comprises a receive/transmit antenna 20, a switch/duplexer 21, a receiver front-end 22, a transmitter 24, a baseband (BB) controller 26, a system controller 28, input/output (I/O) interface circuits 30, and a user interface (UI) 32.

Of particular interest regarding channel quality information generation, the baseband controller 26 includes one or more processing circuits 40, which are configured for channel quality information generation, and which have access, direct or indirect, to a memory 42 storing receiver performance data. The stored data may comprise a data structure representing quantized SNR curves and corresponding CDFs of supported rates for a plurality of propagation channel realizations, e.g., a set of 1000 channel realizations, such as illustrated in Fig. 6 or 7. However, at least some of the performance data may be obtained using curve-fitting calculations—e.g., polynomials—and it should be understood that various methods of storing and representing receiver performance data are contemplated herein.

In operation according to one embodiment, the wireless communication device 12 maintains a long-term estimate of receiver input signal quality—average SNR—and further maintains short-term (instantaneous) propagation channel estimates. If the propagation channel estimates are not reliable, the wireless communication device 12 operates in a first mode of channel quality information generation. In the first mode, the wireless communication device 12 maps measured, average receiver input signal quality to the closest corresponding receiver input signal quality represented in the receiver performance data, and then uses that SNR curve to identify the data rate that can be supported at a desired probability over a range of propagation channel realizations. As such, the wireless communication device 12 returns channel quality information to the base station 10 in the form of updated transmit data rate

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selections that are identified probabilistically, without regard to the actual channel estimates. A transmit link adaptation control circuit 38 in the base station 10 uses the reported data rate selections to adjust the transmit data rate used to send traffic to the wireless communication device 12.

If the propagation channel estimates are reliable, the wireless communication device 12 operates in a second mode. In the second mode, the wireless communication device 12 selects the SNR value in the receiver performance data most closely corresponding to the average receiver input signal quality as measured by the wireless communication device 12, and further selects a propagation channel realization, or a constrained range of propagation channel realizations, in the receiver performance data that most closely corresponds with current channel estimates. The wireless communication device 12 thus uses the receiver performance data to identify the data rates that can be supported for measured receiver input signal quality and corresponding channel estimates, and reports the identified data rate selections to the base station 10.

In both the first and second modes, the base station 10 receives channel quality information in the form of data rate selections, and the base station 10 performs corresponding transmit data rate adjustments for forward link transmissions to the wireless communication device 12. As such, whether the channel quality information is being generated in consideration of current channel estimates may be transparent to the base station 10. That is, from the base station's perspective, link adaptation may transparently shift between the first and second modes, without need for explicit signaling. In some embodiments, however, the mode of channel quality information generation may be signaled, or otherwise indicated. For example, the rate at which channel quality information is reported to the base station 10 may change in dependence on whether channel quality information is being generated in the first or second modes.

Figs. 10 and 11 illustrate embodiments of processing circuits that may be included in, or associated with, the baseband controller 40 of the wireless communication device 12, and used to implement generation of channel quality information in the first and second modes. Fig. 10, in particular, illustrates the processing circuit(s) 40 as comprising a channel quality information generation circuit 44, which generates channel quality information, e.g., rate selection data, in first and second modes. The circuit 44 may be configured to provide an indication of the type of channel quality information being generated, i.e., it may indicate the mode that it is operating in.

The processing circuit(s) 40 may further include, or may further be associated with, a channel estimate reliability evaluation circuit 46 and a channel estimation circuit 48. The channel estimate reliability evaluation circuit 46 is configured to estimate the reliability of the channel estimates being generated by the channel estimation circuit 48, which generates instantaneous propagation channel estimates based on the received signal and pilot information. The channel estimate reliability evaluation circuit 46 may receive, among other

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things, the channel estimates from the channel estimation circuit 48 and/or the pilot values. Operation may be switched between the first and second modes based on the reliability indicator output by the reliability evaluation circuit 46.

Note, too, that the channel quality information generation circuit 44 may be configured to perform the receiver input signal quality measurements, i.e., the E_T/N_o calculations, or another functional circuit may be included for that purpose in the processing circuit(s) 40. On that point, it should be understood that illustrations of the processing circuit(s) 40 may represent functional rather than physical circuit elements. For example, the processing circuit(s) 40 may comprise all or a portion of a microprocessor-based circuit, an FPGA, ASIC, etc.

Continuing with function circuit descriptions, Fig. 11 illustrates one embodiment of the channel quality information generation circuit 44 that is depicted in Fig. 10. One sees that the reliability indicator drives a mode select circuit 50, which selects the source circuit for the channel quality information being output. If the reliability indicator indicates that the channel estimates are not reliable, the mode select circuit 50 selects a long-term channel quality information estimation circuit 52 as the source circuit. The long-term channel quality information estimation circuit 52 selects supported data rates using the receiver performance data based on long-term estimates of receiver input signal quality and desired CDF probabilities.

Conversely, if the reliability indicator indicates that the channel estimates are reliable, the mode select circuit 50 selects an instantaneous (short-term) channel quality information estimation circuit 54 as the source circuit. In one embodiment, the instantaneous channel quality information estimation circuit 54 selects supported data rates using the receiver performance data based on long-term estimates of receiver input signal quality and the channel estimates. In another embodiment, instantaneous channel quality information is generated by calculating receiver output signal quality. In such embodiments, channel quality information is determined in the first mode using receiver input signal quality, and determined in the second mode using receiver output signal quality.

In any case, it should be understood that the base station 10 can be configured to generate channel quality information according to any of the above embodiments, based on the wireless communication device feeding back channel quality measurements. For example, Fig. 12 illustrates a channel quality information generation circuit 60 and a memory 62, which may be included in the base station 10. The memory 62 stores receiver performance data for one or more receiver types, with at least one set of receiver performance data matching the type of receiver implemented in the wireless communication device 12.

More generally, in such embodiments, the base station 10 comprises one or more processing circuits configured to determine channel quality information for a transmit propagation channel corresponding to the wireless communication device 12. Such generation may be based on, in a first mode, generating channel quality information according to a first algorithm that does not depend on channel estimates for the wireless communication device 12,

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and in a second mode, generating channel quality information according to a second algorithm that depends on the channel estimates.

In one embodiment, in the first mode, the base station 10 receives at least receiver input signal quality information for the wireless communication device 12. As described, the first algorithm may comprise mapping receiver input signal quality to a data rate that is achievable at a desired probability over a range of propagation channel realizations. For the second mode of operation, the base station 10 receives receiver input signal quality information and propagation channel information from the wireless communication device 12—e.g., quantized long-term SNR values and quantized short-term propagation channel estimates.

If the base station 10 stores code books of SNR values and propagation channel realizations, the wireless communication device 12 need only return code book indices corresponding to its measurements. In any case, the second algorithm may comprise mapping receiver input signal quality to a data rate that is achievable for a particular propagation channel realization, or for a constrained range of propagation channel realizations, corresponding to the propagation channel estimates.

As such, the base station 10 can be configured to select operation in the first mode if it receives receiver input signal quality information for the wireless communication device 12 without receiving corresponding channel estimates. Alternatively, the wireless communication device 12 can be configured always to report channel estimates and signal quality, and the base station 10 can be configured to select operation in the first or second modes based on evaluating the reliability of the channel estimates. In at least one embodiment, the base station 10 selects the mode based on determining whether the wireless communication device 12 is operating in fast fading conditions. If the wireless communication device 12 is operating in fast fading conditions, the base station 10 operates in the first mode. If the wireless communication device 12 is not operating in fast fading conditions, the base station 10 operates in the second mode. Of course, it should be understood that first and second modes of operation may be managed independently for individual ones in a plurality of wireless communication devices being supported by the base station 10.

Further, and more generally, it should be understood that channel quality information generation as taught in one or more embodiments described herein uses receiver performance data to determine channel quality information metrics, such as supported data rates, based on using receiver performance data. The receiver performance data characterizes supported data rates in terms of propagation channel realizations, for each in a plurality of quantized receiver input signal qualities. In a first mode of operation, the data rate that can be achieved at a desired probability over a range of propagation channel conditions, e.g., all hypothesized propagation channel realizations, are selected for the receiver input signal quality value that corresponds to measurements obtained by the wireless communication device 12. As such, the data rate is not set in consideration of the instantaneous channel conditions prevailing at the

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wireless communication device 12, but rather set probabilistically, in consideration of the long-term channel conditions. As such, the first mode of operation can be selected whenever reliable channel estimates are not available.

In a second mode of operation, where reliable channel estimates are available, data rates are selected using receiver input signal qualities and propagation channel realizations corresponding to measurements obtained at the wireless communication device 12. In other words, short-term propagation channel conditions are considered when the estimates of those conditions are reliable. In this regard, the same receiver performance data can be used to generate channel quality information metrics with or without using current propagation channel estimates. As such, it is convenient to modify transmit link adaptation to switch between slow link adaptation—i.e., the first mode of operation—and fast link adaptation—i.e., the second mode of operation.

Of course, the present invention is not limited by the foregoing discussion, nor is it limited by the accompanying drawings. Indeed, the present invention is limited only by the following claims, and their legal equivalents.

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CLAIMS

What is claimed is:

1. A method of determining channel quality information for a transmit propagation channel associated with a wireless communication device (12), the method characterized by:

in a first mode, generating channel quality information according to a first algorithm that does not depend on current propagation channel estimates; and

in a second mode, generating channel quality information according to a second algorithm that depends on current propagation channel estimates.

2. The method of claim 1, further characterized by determining whether to operate in the first mode or in the second mode as a function of propagation channel fading conditions.

3. The method of claim 1, further characterized by determining whether to operate in the first mode or in the second mode responsive to evaluating a reliability of propagation channel estimates made by the wireless communication device (12).

4. The method of claim 1, wherein generating channel quality information according to a first algorithm that does not depend on current propagation channel estimates comprises mapping a receiver input signal quality for the wireless communication device (12) to a data rate selection that is achievable at a desired probability over a range of propagation channel conditions.

5. The method of claim 4, wherein mapping a receiver input signal quality for the wireless communication device (12) to a data rate selection that is achievable at a desired probability over a range of propagation channel conditions comprises using a Cumulative Distribution Function (CDF) and the receiver input signal quality to identify a data rate that is achievable with respect to a desired error limit over a range of hypothesized propagation channel realizations.

6. The method of claim 5, wherein using a Cumulative Distribution Function (CDF) and the receiver input signal quality to identify a data rate that is achievable with respect to a desired error limit over a range of hypothesized propagation channel realizations comprises selecting a CDF curve that relates received signal quality to achievable data rates over a set of hypothesized propagation channel realizations.

7. The method of claim 6, further characterized by generating one or more CDF curves to support mapping of the received signal quality based on estimating long-term propagation channel conditions for the propagation channel associated with the wireless communication device (12).

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8. The method of claim 7, wherein generating one or more CDF curves to support mapping of the received signal quality based on estimating long-term propagation channel conditions for the propagation channel associated with the wireless communication device (12) comprises generating the one or more CDF curves based on one or more of long-term propagation channel estimates, rate-of-travel of the wireless communication device (12), type of data services active for or requested for the wireless communication device (12), downlink bandwidth assigned to or available for the wireless communication device (12), and a modulation and coding scheme being used for or desired for the wireless communication device (12).

9. The method of claim 1, wherein generating channel quality information according to a second algorithm comprises mapping a receiver input signal quality for the wireless communication device (12) to a data rate selection that is achievable for propagation channel conditions corresponding to the current propagation channel estimates.

10. The method of claim 1, wherein the wireless communication device (12) generates the channel quality information as feedback for transmit link adaptation.

11. The method of claim 1, wherein the wireless communication device (12) generates channel quality measurements and a base station (10) in a supporting wireless communication network generates the channel quality information based on receiving the channel quality measurements.

12. The method of claim 11, wherein the channel quality measurements for the first mode comprise at least receiver input signal quality measurements, and wherein the channel quality measurements for the second mode comprise receiver input signal quality measurements and corresponding propagation channel estimates.

13. The method of claim 1, further characterized by storing receiver performance data for use in generating the channel quality information in at least the first mode, said receiver performance data characterizing a type of receiver corresponding to the wireless communication device (12) and identifying, for each in a plurality of receiver input signal qualities, supported data rates for a plurality of propagation channel realizations.

14. The method of claim 13, wherein generating the channel quality information according to the first algorithm comprises selecting a receiver input signal quality corresponding to a receiver input signal quality measurement made by the wireless communication device (12), and identifying a data rate that can be supported for the receiver input signal quality over a range of propagation channel realizations.

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15. The method of claim 13, wherein generating the channel quality information according to the second algorithm comprises selecting a receiver input signal quality corresponding to receiver input signal quality measurements made by the wireless communication device (12), selecting a propagation channel realization or a constrained range of propagation channel realizations corresponding to propagation channel estimates made by the wireless communication device (12), and identifying a data rate that can be supported for the receiver input signal quality and the selected propagation channel realization or constrained range of propagation channel realizations.

16. The method of claim 1, further characterized by selectively operating in the first and second modes as a function of at least one of (a) packet lengths of data to be transmitted by the wireless communication device (12), (b) delay requirements associated with packet data to be transmitted by the wireless communication device (12), (c) delay requirements associated with a communication service active at the wireless communication device (12), (d) identification of the wireless communication device (12), and (e) network usage or congestion levels.

17. A wireless communication device (12) comprising one or more processing circuits (40) configured to determine channel quality information for one or more signals received by the wireless communication device (12), operation of said one or more processing circuits for determing the channel quality information characterized by:

in a first mode, generating channel quality information according to a first algorithm that does not depend on current propagation channel estimates; and

in a second mode, generating channel quality information according to a second algorithm that depends on current propagation channel estimates.

18. The wireless communication device (12) of claim 17, wherein the one or more processing circuits (40) comprise a channel quality information generation circuit (44) that is configured to generate the channel quality information by selectively operating in the first and second modes.

19. The wireless communication device (12) of claim 18, wherein the one or more processing circuits (40) include a reliability evaluation circuit (46) to generate a reliability indicator indicating whether propagation channel estimates being generated at the wireless communication device (12) are reliable, and wherein the channel quality information generation circuit (44) is configured to select the first mode of operation if the reliability indicator indicates that the propagation channel estimates are not reliable, and to select the second mode of operation if the reliability indicator indicates that the channel estimates are reliable.

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20. The wireless communication device (12) of claim 17, wherein one or more processing circuits (40) are configured to determine whether to operate in the first mode or in the second mode according to a reliability of propagation channel estimates made by the wireless communication device (12).

21. The wireless communication device (12) of claim 17, wherein the first algorithm comprises mapping a receiver input signal quality for the wireless communication device (12) to a data rate selection that is achievable at a desired probability over a range of propagation channel conditions.

22. The wireless communication device (12) of claim 21, wherein mapping a receiver input signal quality for the wireless communication device (12) to a data rate selection that is achievable at a desired probability over a range of propagation channel conditions comprises using a Cumulative Distribution Function (CDF) and the receiver input signal quality to identify a data rate that is achievable with respect to a desired error limit over a range of hypothesized propagation channel realizations.

23. The wireless communication device (12) of claim 22, wherein using a Cumulative Distribution Function (CDF) and the receiver input signal quality to identify a data rate that is achievable with respect to a desired error limit over a range of hypothesized propagation channel realizations comprises selecting a CDF curve that relates received signal quality to achievable data rates over a set of hypothesized propagation channel realizations.

24. The wireless communication device (12) of claim 23, wherein the one or more processing circuits (40) are configured to generate one or more CDF curves to support mapping of the received signal quality based on estimating long-term propagation channel conditions for the propagation channel associated with the wireless communication device (12).

25. The wireless communication device (12) of claim 24, wherein the one or more processing circuits (4) are configured to generate one or more CDF curves to support mapping of the received signal quality based on estimating long-term propagation channel conditions for the propagation channel associated with the wireless communication device (12) by generating the one or more CDF curves based on one or more of long-term propagation channel estimates, rate-of-travel of the wireless communication device (12), type of data services active for or requested for the wireless communication device (12), downlink bandwidth assigned to or available for the wireless communication device (12), and a modulation and coding scheme being used for or desired for the wireless communication device (12).

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26. The wireless communication device (12) of claim 17, wherein the second algorithm comprises mapping a receiver input signal quality for the wireless communication device (12) to a data rate selection that is achievable for propagation channel conditions corresponding to the current propagation channel estimates.

27. The wireless communication device (12) of claim 17, wherein the wireless communication device (12) includes memory (42) storing receiver performance data for use by the one or more processing circuits (40) in generating the channel quality information in at least the first mode, said receiver performance data characterizing a type of receiver corresponding to the wireless communication device (12) and identifying, for each in a plurality of receiver input signal qualities, supported data rates for a plurality of propagation channel realizations.

28. The wireless communication device (12) of claim 27, wherein the first algorithm comprises selecting a receiver input signal quality corresponding to a receiver input signal quality measurement made by the wireless communication device (12), and identifying a data rate that can be supported for the receiver input signal quality over a range of propagation channel realizations.

29. The wireless communication device (12) of claim 27, wherein the second algorithm comprises selecting a receiver input signal quality corresponding to a receiver input signal quality measurement made by the wireless communication device (12), selecting a propagation channel realization or a constrained range of propagation channel realizations corresponding to propagation channel estimates made by the wireless communication device (12), and identifying a data rate can be supported for the receiver input signal quality and the selected propagation channel realization or constrained range of propagation channel realizations.

30. A base station (10) comprising one or more processing circuits (60) configured to determine channel quality information for a transmit propagation channel corresponding to a wireless communication device (12) associated with the base station (10), based on:

in a first mode, generating channel quality information according to a first algorithm that does not depend on current propagation channel estimates for the wireless communication device (12); and

in a second mode, generating channel quality information according to a second algorithm that depends on current propagation channel estimates for the wireless communication device (12).

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31. The base station (10) of claim 30, wherein, in the first mode, the base station (10) receives at least receiver input signal quality information for the wireless communication device (12), and wherein the first algorithm comprises mapping receiver input signal quality to a data rate that is achievable at a desired probability over a range of propagation channel realizations.

32. The base station (10) of claim 31, wherein the base station (10) is configured to map a receiver input signal quality for the wireless communication device (12) to a data rate selection that is achievable at a desired probability over a range of propagation channel conditions comprises using a Cumulative Distribution Function (CDF) and the receiver input signal quality to identify a data rate that is achievable with respect to a desired error limit over a range of hypothesized propagation channel realizations.

33. The base station (10) of claim 32, wherein using a Cumulative Distribution Function (CDF) and the receiver input signal quality to identify a data rate that is achievable with respect to a desired error limit over a range of hypothesized propagation channel realizations comprises selecting a CDF curve that relates received signal quality to achievable data rates over a set of hypothesized propagation channel realizations.

34. The base station (10) of claim 33, wherein the base station (10) is configured to generate one or more CDF curves to support mapping of the received signal quality based on estimating long-term propagation channel conditions for the propagation channel associated with the wireless communication device (12).

35. The base station (10) of claim 34, wherein the base station (10) is configured to generate one or more CDF curves to support mapping of the received signal quality based on estimating long-term propagation channel conditions for the propagation channel associated with the wireless communication device (12) by generating the one or more CDF curves based on one or more of long-term propagation channel estimates, rate-of-travel of the wireless communication device (12), type of data services active for or requested for the wireless communication device (12), downlink bandwidth assigned to or available for the wireless communication device (12), and a modulation and coding scheme being used for or desired for the wireless communication device (12).

36. The base station (10) of claim 30, wherein, in the second mode, the base station (10) receives receiver input signal quality information and propagation channel estimates for the wireless communication device (12), and wherein the second algorithm comprises mapping receiver input signal quality to a data rate that is achievable for a particular propagation channel

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realization, or for a constrained range of propagation channel realizations, corresponding to the propagation channel estimates.

37. The base station (10) of claim 30, wherein the base station (10) is configured to select operation in the first mode if it receives receiver input signal quality information for the wireless communication device (12) without receiving corresponding propagation channel estimates for the wireless communication device (12).

38. The base station (10) of claim 30, wherein the base station (10) is configured to select operation in the first mode if it determines that propagation channel estimates for the wireless communication device (12) are not reliable.

39. The base station (10) of claim 30, wherein the base station (10) is configured to select operation in the first mode if the wireless communication device (12) is operating in fast fading conditions, and is configured to select operation in the second mode if the wireless communication device (12) is not operating in fast fading conditions.

40. The base station (10) of claim 30, wherein the base station (10) includes memory (62) storing receiver performance data for use by the one or more processing circuits (60) in generating the channel quality information in at least the first mode, said receiver performance data characterizing a type of receiver corresponding to the wireless communication device (12) and identifying, for each in a plurality of receiver input signal qualities, supported data rates for a plurality of propagation channel realizations.

41. The base station (10) of claim 40, wherein the first algorithm comprises using the receiver performance data to select a receiver input signal quality corresponding to a receiver input signal quality measurement made by the wireless communication device (12), and identify a data rate that can be supported for the receiver input signal quality over a range of propagation channel realizations.

42. The base station (10) of claim 40, wherein the second algorithm comprises using the receiver performance data to select a receiver input signal quality corresponding to a receiver input signal quality measurement made by the wireless communication device (12), select a propagation channel realization or a constrained range of propagation channel realizations, corresponding to propagation channel estimates made by the wireless communication device (12), and identify a data rate can be supported for the receiver input signal quality and the selected propagation channel realization or constrained range of propagation channel realizations.

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43. A method of characterizing receiver performance, said method characterized by:

for each of a number of receiver input signal qualities and each of a number of modulation and coding schemes, computing an error rate expected for each of a number of propagation channel realizations;

for each of said receiver input signal qualities and each of said modulation and coding schemes, computing a data rate that can be supported for each propagation channel realization; and

for each receiver input signal quality, computing the cumulative distribution function of the supported data rates corresponding to the propagation channel realizations.

44. The method of claim 43, wherein computing a data rate that can be supported for each propagation channel realization comprises determining the data rate (R) that can be supported as a function of a data rate (R_{mcs}) corresponding to the modulation and coding scheme, and a Block Error Rate (BLER) expected for the propagation channel realization.

45. The method of claim 44, wherein determining the data rate (R) that can be supported as a function of a data rate (R_{mcs}) corresponding to the modulation and coding scheme, and a Block Error Rate (BLER) expected for the propagation channel realization comprises calculating R as $R = R_{mcs}(1\text{-BLER})$.

46. The method of claim 44, wherein determining the data rate (R) that can be supported as a function of a data rate (R_{mcs}) corresponding to the modulation and coding scheme, and a Block Error Rate (BLER) expected for the propagation channel realization comprises calculating R as $R = R_{mcs}/(1\text{-BLER})$.

47. The method of claim 43, wherein computing a data rate that can be supported for each propagation channel realization comprises determining the data rate (R) that can be supported as a function of a data rate (R_{mcs}) corresponding to the modulation and coding scheme, a Block Error Rate (BLER) expected for the propagation channel realization, and a target Block Error Rate (BLER(target)).

48. The method of claim 47, wherein determining the data rate (R) that can be supported as a function of a data rate (R_{mcs}) corresponding to the modulation and coding scheme, a Block Error Rate (BLER) expected for the propagation channel realization, and a target Block Error Rate (BLER(target)) comprises determining R as $R = R_{mcs}$ if BLER < BLER(target), and otherwise determining R as R = 0.

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49. A method of providing rate adaptation feedback from a wireless communication device (12) to a supporting wireless communication network characterized by storing receiver performance data determined according to the method of characterizing receiver performance of claim 43, and, in a first mode of operation, selecting a supported data rate using the receiver performance data according to a receiver input signal quality corresponding to measurements made by the wireless communication device and a desired probability of achieving the selected data rate for a range of propagation channel realizations, and, in a second mode of operation, selecting a supported data rate using the receiver performance data according to a receiver input signal quality corresponding to measurements made by the wireless communication device and a particular propagation channel realization, or a constrained range of the propagation channel realizations, corresponding to propagation channel estimates for the wireless communication device (12).

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FIG. 1

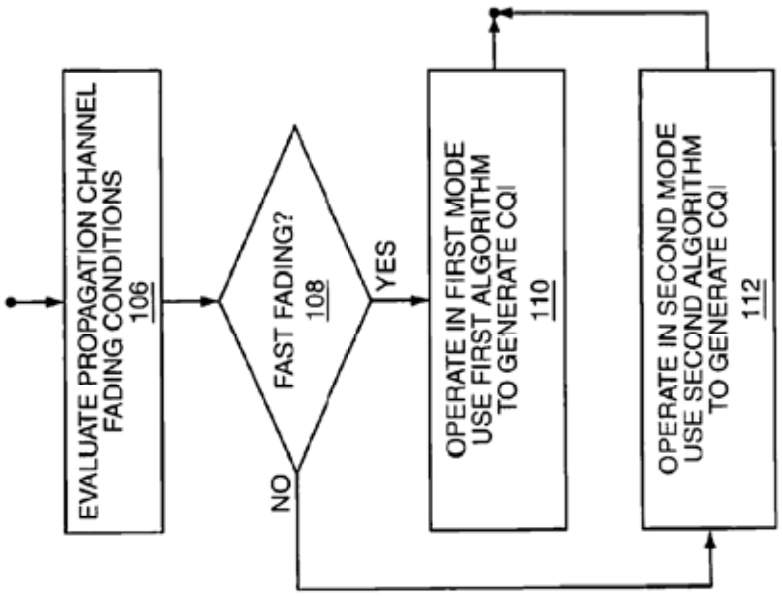


FIG. 3

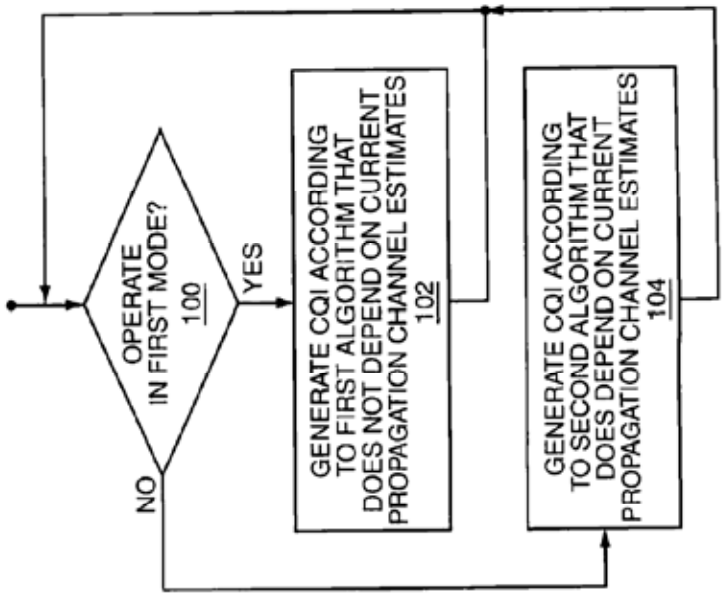


FIG. 2

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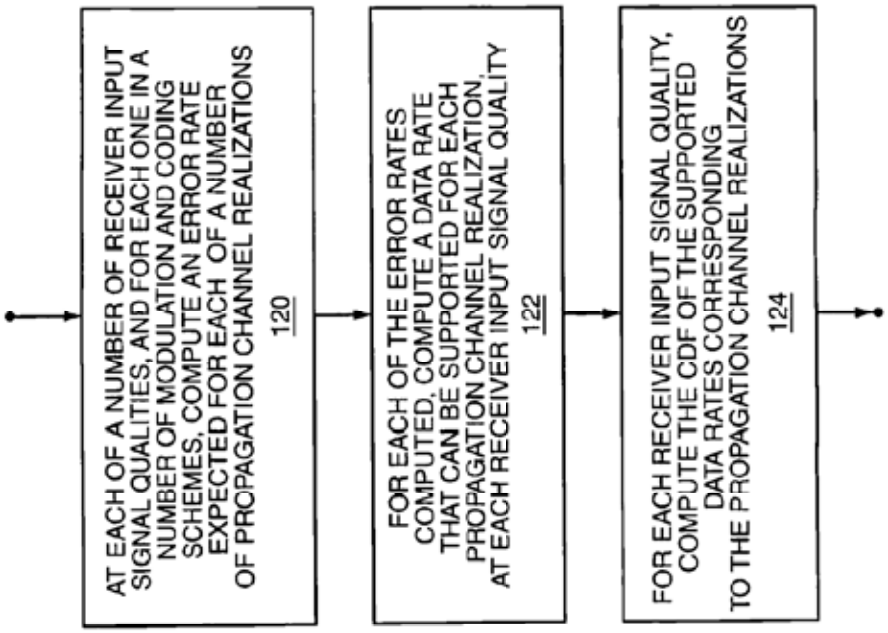


FIG. 5

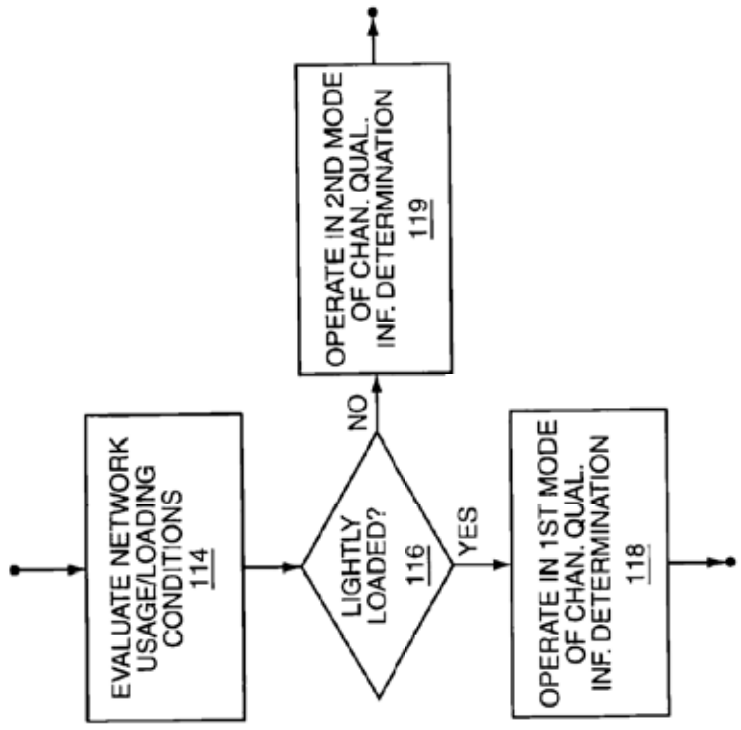


FIG. 4

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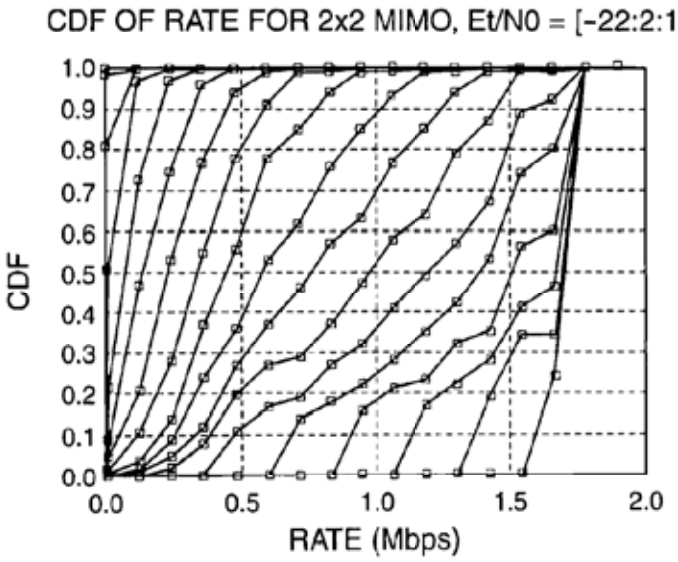


FIG. 6

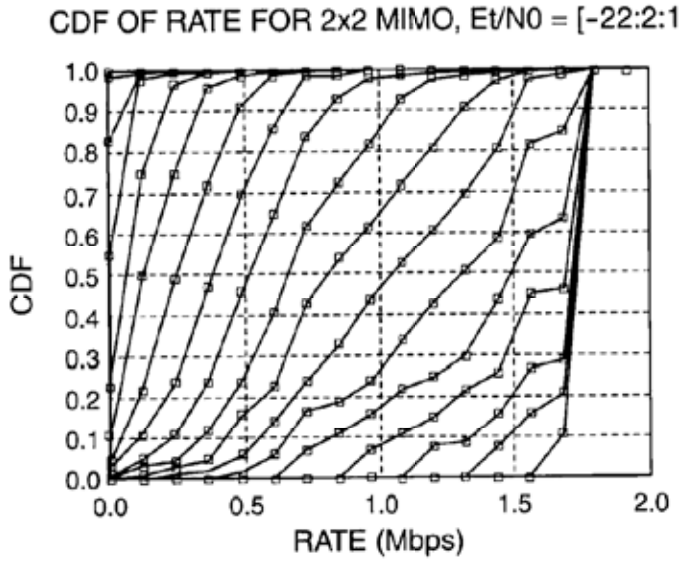


FIG. 7

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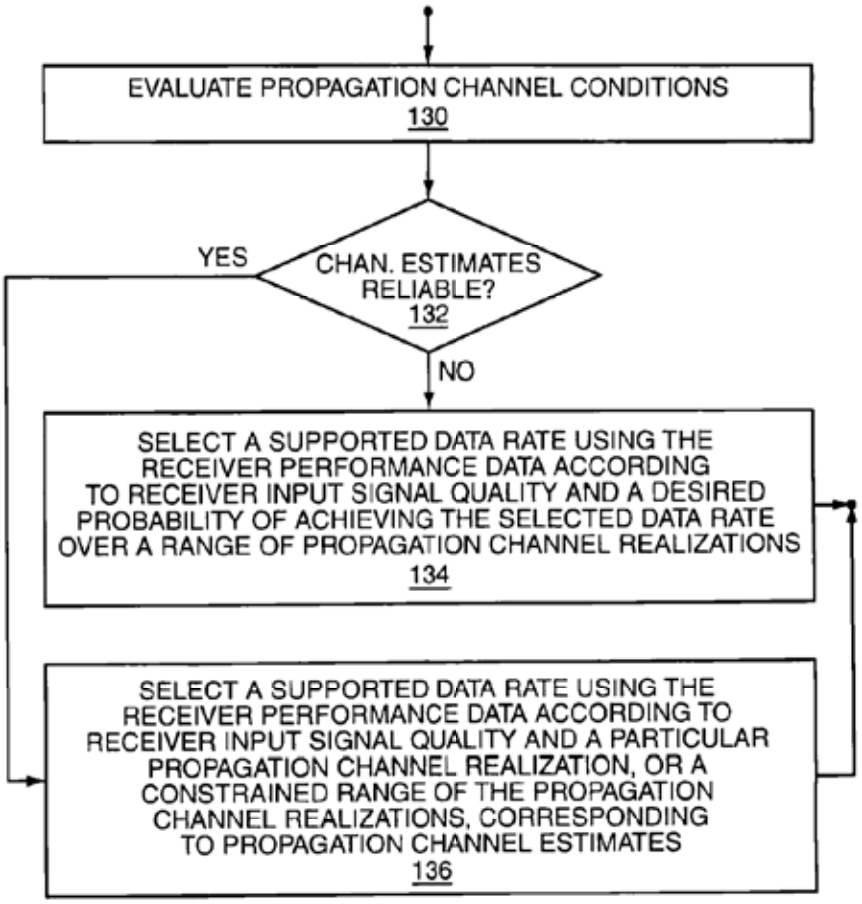


FIG. 8

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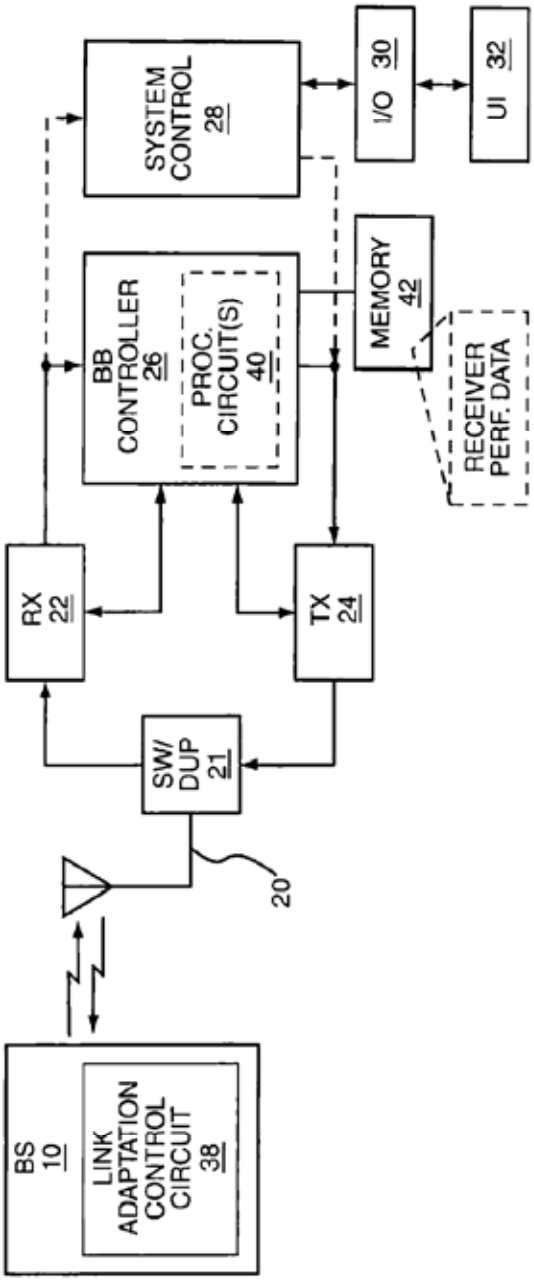


FIG. 9

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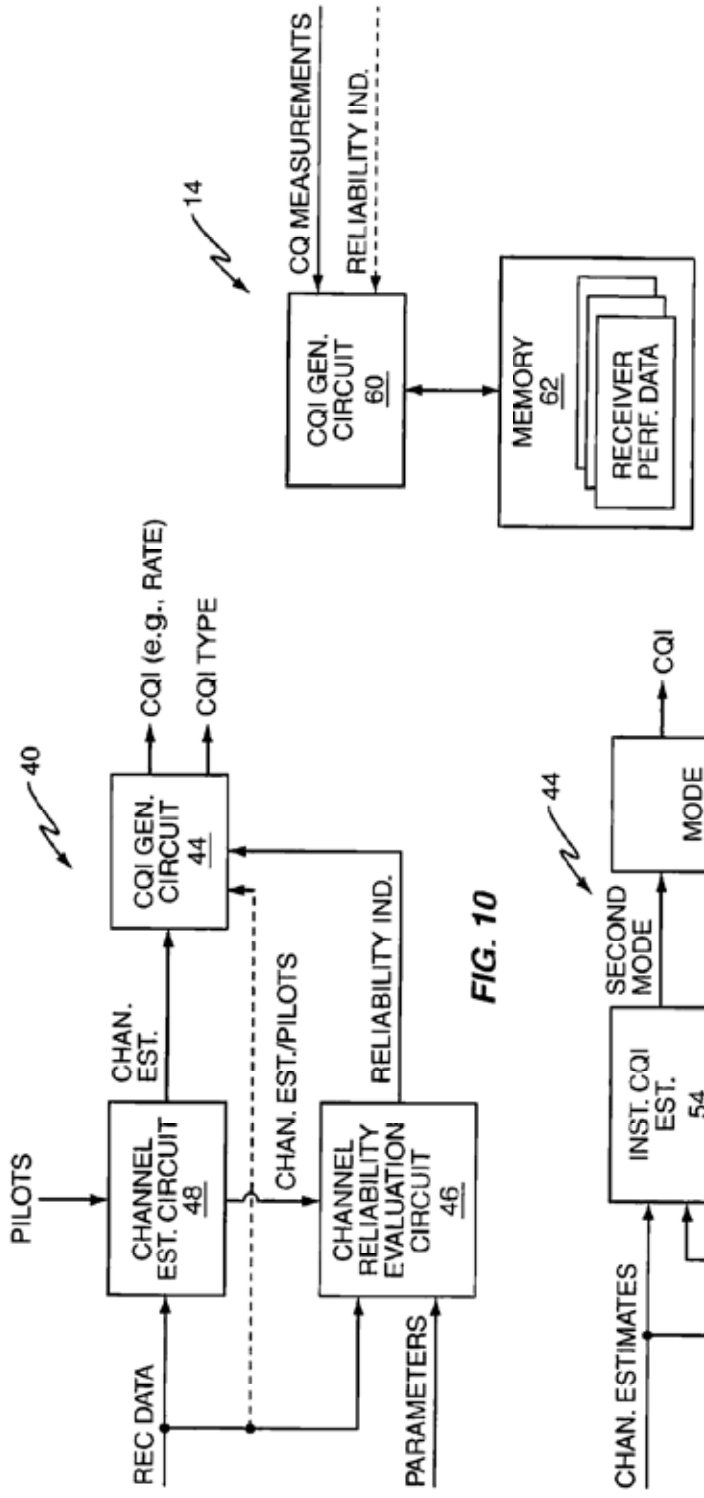


FIG. 10

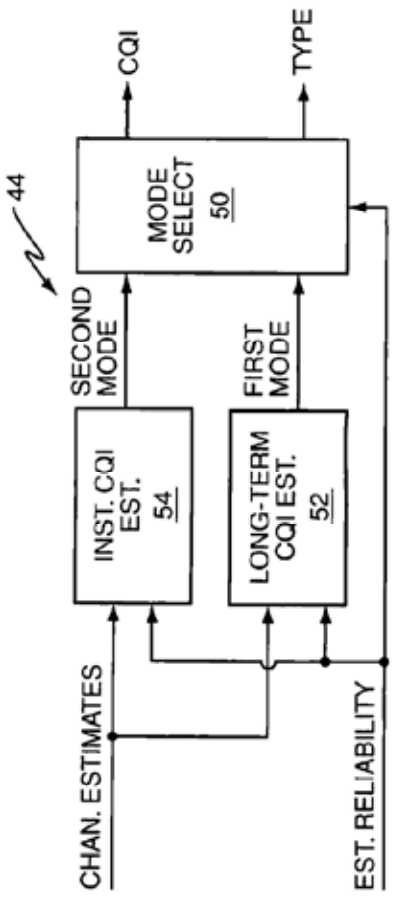


FIG. 11

FIG. 12

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(12) 按照专利合作条约所公布的国际申请

(19) 世界知识产权组织
国 际 局

(43) 国际公布日
2011 年 7 月 7 日 (07.07.2011)

PCT

(10) 国际公布号
WO 2011/079612 A1

(51) 国际专利分类号:
H04W 28/08 (2009.01)

(21) 国际申请号: PCT/CN2010/074869

(22) 国际申请日: 2010 年 6 月 30 日 (30.06.2010)

(25) 申请语言: 中文

(26) 公布语言: 中文

(30) 优先权:
200910238810.X 2009 年 12 月 29 日 (29.12.2009) CN

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(54) **Title**: METHOD FOR LINK ADAPTATION AND APPARATUS THEREOF

(54) **发明名称** : 一种链路自适应方法及装置

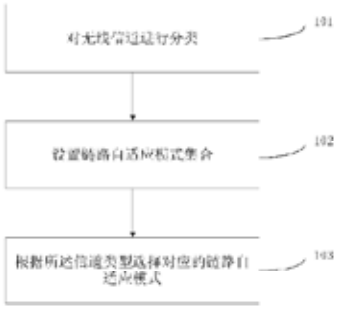


图 1 / **Fig.** 1

101 CLASSIFY RADIO CHANNELS
102 SET A SET OF LINK ADAPTATION MODES
103 SELECT A CORRESPONDING LINK ADAPTATION MODE ACCORDING TO THE TYPE OF THE RADIO CHANNEL

(57) **Abstract**: A method for link adaptation comprises: classifying radio channels; setting a set of link adaptation modes; and selecting a corresponding link adaptation mode according to the type of the radio channel. An apparatus for link adaptation comprises: classification module for classifying radio channels; setting module for setting a set of link adaptation modes; and mode selection module for selecting a corresponding link adaptation mode from the setting module according to the type of the classified radio channel. By accordingly selecting effective link adaptation modes in accordance with different types of radio channels, realizing the throughput maximization of system in different fading channels can be ensured, and the stable and reliable link quality can be maintained.

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本国际公布:

— 包括国际检索报告(条约第 21 条(3))。

(57) 摘要:

一种链路自适应方法，其包括：对无线信道进行分类；设置链路自适应模式集合；以及根据所述无线信道的类型选择对应的链路自适应模式。一种链路自适应装置，其包括：分类模块，用于对无线信道进行分类；设置模块，用于设置链路自适应模式集合；以及模式选择模块，用于根据所述分类的无线信道类型从设置模块中选择对应的链路自适应模式。本发明根据无线信道的不同类型有针对性地选择有效的链路自适应模式，能够保证在不同的衰落信道下实现系统的吞吐量最大化，保持稳定可靠的链路质量。

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一种链路自适应方法及装置

技术领域

本发明涉及无线通信系统，尤其涉及一种链路自适应的技术。

背景技术

在无线通信系统中，由于无线信道复杂多变，且无固定的变化规律可循，为了实现无线通信系统的吞吐量最大化，就希望无线通信系统能够根据信道条件变化自动调整传输速率，即链路自适应技术。常规的链路自适应的方法就是将最新的信道质量的测量结果作为未来链路速率选择的依据。

发明内容

现有技术中的常规的链路自适应的方法是将最新的信道质量的测量结果作为未来链路速率选择的依据，该方法存在以下问题:

信道质量测量结果总会包含测量误差和随机干扰影响，即测量结果并不能准确反映实际信道条件;

无线信道条件总是随着时间的变化而随机变化，也就是说过去的测量结果并不能完全反映未来的信道条件。

鉴于此，本发明要解决的技术问题是提出一种链路自适应方法和装置，能够保证在不同的衰落信道下实现系统的吞吐量最大化，保持稳定可靠的链路质量。

为了解决以上技术问题，本发明一方面提供了一种链路自适应的方法，其包括:

对无线信道进行分类;

设置链路自适应模式集合; 以及

根据所述无线信道的类型选择对应的链路自适应模式。

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对无线信道进行分类的步骤中，是根据无线信道的时变特性进行分类的。

对无线信道进行分类的步骤中，是将无线信道分类为：

平坦信道、慢衰落信道和快衰落信道；或者

慢衰落信道和快衰落信道；或者

慢衰落信道、快衰落信道和突变信道。

所述链路自适应模式集合包括：即时值预测模式、历史值预测模式、统计分位数预测模式和突变处理模式。

根据所述无线信道的类型选择对应的链路自适应模式的步骤包括：通过分析无线信道的历史测量信息，判断得出当前无线信道的类型，根据所述当前无线信道的类型从所述链路自适应模式集合中选择对应的链路自适应模式。

根据所述无线信道的类型选择对应的链路自适应模式的步骤之后，所述方法还包括：根据所述无线信道类型和对应的链路自适应模式，得出待调度时刻的信道预测信息，选择与所述待调度时刻的信道预测信息匹配的链路速率。

本发明另一方面还提供了一种链路自适应装置，包括：

分类模块，其设置为：对无线信道进行分类；

设置模块，其设置为：设置链路自适应模式集合；以及

模式选择模块，其设置为：根据所述分类的无线信道类型从设置模块中选择对应的链路自适应模式。

所述分类模块是设置为根据无线信道的时变特性对无线信道进行分类的。

所述分类模块是设置为将无线信道分类为：

平坦信道、慢衰落信道和快衰落信道；或者

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慢衰落信道和快衰落信道；或者

慢衰落信道、快衰落信道和突变信道。

所述链路自适应模式集合包括：即时值预测模式、历史值预测模式、统计分位数预测模式和突变处理模式。

所述模式选择模块是设置为按如下方式根据所述无线信道的类型选择对应的链路自适应模式：

通过分析无线信道的历史测量信息，判断得出当前无线信道的类型，根据所述当前无线信道的类型从所述链路自适应模式集合中选择对应的链路自适应模式。

所述装置还包括：

信道学习模块，其设置为：分析处理无线信道的历史测量信息，得出当前无线信道的类型；以及

链路速率确定模块，其设置为：根据所述无线信道类型和对应的链路自适应模式，得出待调度时刻的信道预测信息，选择与所述待调度时刻的信道预测信息匹配的链路速率。

通过采用本发明的技术，根据无线信道的不同分类有针对性的选择有效的链路自适应处理模式，能够保证在不同的衰落信道下实现系统的吞吐量最大化，保持稳定可靠的链路质量。

附图概述

此处所说明的附图用来提供对本发明的进一步理解，构成本申请的一部分，本发明的示意性实施例及其说明用于解释本发明，并不构成对本发明的不当限定。在附图中：

图 1 为本发明链路自适应方法的流程图；

图 2 为本发明实施例一的链路自适应方法的流程图；

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图 3 为无线信道的一种分类示意图;

图 4 为本发明链路自适应的装置框图。

本发明的较佳实施方式

下面结合附图和实施例，对本发明的具体实施方式做详细说明。

本发明的链路自适应方法基本思想原理如图 1 所示，包括:

步骤 101，对无线信道进行分类;

步骤 102，设置链路自适应模式集合;

步骤 103，根据所述无线信道的类型来选择对应的链路自适应模式。

实施例 1

如图 2 所示，本实施例包括以下步骤:

步骤 201，对无线信道进行分类，并设置相应的链路自适应模式集合。

具体地，本实施例中，根据无线信道的时变特性将无线信道类型分为三种，如图 3 所示，为：平坦信道、慢衰落信道和快衰落信道;

进而根据信道衰落分类，设置与之相应的链路自适应模式集合;

相应的链路自适应模式集合为：即时值预测模式、历史值预测模式和统计分位数预测模式。其中:

即时值预测模式指，以最新的信道测量结果作为信道待调度时刻的链路速率选择依据。

历史值预测模式指，根据信道的历史测量结果，采用曲线拟合的方式预测待调度时刻的信道条件用于链路速率的选择。

统计分位数预测模式指，采用历史测量结果的累积分布函数的某个分位数作为待调度时刻的链路速率选择依据。例如:

（1）平坦信道：即时值预测模式下，可预测的，即预测误差在可接收的范围内;

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设:

t 时刻的信道测量结果记为 SINR(t)，当前时刻记为 t0，待调度时刻为 t0+n，其中 n 为系统处理时延与空口传输时延总和；当前时刻获得的最新测量结果为 SINR(tx)，tx⩽t0，则：即时值预测结果 SINR_estimate(t0+n)为 SINR_estimate(t0+n)=SINR(tx)，t 时刻的估计误差记为 Err(t)，则：

Err(t)= |SINR_estimate(t)-SINR(t)|

可预测的（可估计的）可能的公式表达为:

概率函数 P(Err(t)⩽Error_threhold | t = t0-w+1,t0-w+2,…,t0) ⩾P1，0⩽P1⩽1，w⩾0，其中 Error_threhold 为估计误差的门限，当 Err(t)⩽Error_threhold 表示 t 时刻估计正确，否则估计错误，Error_threhold 越小估计精度要求越高，反之则估计精度越低；P1 表示估计正确的概率门限，即正确估计的概率为 P1。当正确估计的概率大于门限值 P1 时，称信道在该预测模式下是可估计的（或称可预测的）。其中，w 表示统计时间窗长，w 越低，信道模式之间的切换就越慢，统计结果就越准确，发展模式切换就越快，判断精确性会下降。

（2）慢衰落信道：历史值预测模式下，可预测的，即预测误差在可接收的范围内。

可预测的概念同上，此处不赘述;

历史值预测模式是指，利用历史的信道测量结果 SINR(t0-w’ +1), SINR(t0-w’ +2),…, SINR(t0)，采用选取基函数 f(t)对 SINR（t），t= t0-w’ +1, t0-w’ +2,…,t0 做曲线拟合，求出 f(t)的数学表达式，使得 f(t)=SINR(t), t = t0-w’ +1, t0-w’ +2。历史值预测结果 SINR_estimate（t）= f（t）。其中 w’ 表示历史测量结果的个数；f(t)可以取任何基函数，例如三角函数、幂函数、对数函数以及多项式函数等。

（3）快衰落信道：其它情况，即，不可以预测;

对于以上两种方法均不可预测的，则判定为快衰落信道，与之对应的链路自适应模式为统计分位数预测模式;

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统计分位数预测模式，即采用概率分布函数的模式:

P(x) = P（SINR(t)<x | t =t= t0-w’’+1, t0-w’’+2,…,t0），取 P(x)的 alpha 点分位数，作为统计分位数预测结果 SINR_estimate(t)，即，SINR_estimate(t) = P^{-1}（alpha），P^{-1}(x)为 P(x)的反函数；0≤alpha≤1，alpha 越大速率越高可靠性越差，反之速率越低可靠性越高;

步骤 202，根据对无线信道的历史测量信息的分析获得无线信道的衰落类型，即通过信道学习来获得无线信道的衰落类型。

步骤 202 包括:

202.1，对历史测量结果进行去噪处理，采用一般的去噪方式即可，如:滤波方式或滑动窗口平均方式;

202.2,观察历史的 N 次测量结果,如果是在即时值预测模式下可预测的，则该信道为平坦信道；如果是在历史值预测模式下可预测的，则该信道为慢衰落信道；否则为快衰落信道。

步骤 203，根据步骤 202 中获取的无线信道衰落类型，在链路自适应模式集合中选择链路自适应模式;

如果信道为平坦信道，则选取即时值预测模式；如果信道为慢衰落信道，则选取历史值预测模式；如果信道为快衰落信道，则选取统计分位数预测模式。

步骤 204，根据无线信道的分类和链路自适应模式，给出待调度时刻的信道条件预测信息;

此处的信道条件预测信息可以包括：信干噪比（Signal Interference Noise Ratio, SINR）、误块率（Block Error Rate, BLER）等;

设，最新的测量历史值为 SINR(t)，待调度时刻为 SINR_estimate(tx);

信道分类结果对应的信道条件预测信息如下:

平坦信道下：SINR_estimate(tx)=SINR(t)

慢衰落信道下： SINR_estimate(tx)=f(tx);

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快衰落信道下：SINR_estimate(tx)=P^{-1}(tx)。

步骤 205，根据步骤 204 得到的信道条件预测信息，获得与之相匹配的链路速率；

设：信道的信干噪比（Signal Interference Noise Ratio，SINR）预测结果为 SINR1，业务的误块率（Block Error Rate,BLER）要求是 BLER1；在 SINR=SINR1，BELR=BLER1 的条件下链路所能达到的最大速率为调制编码方式 1（Modulation Code Scheme，即 MCS1），则本步骤输出结果为 MCS1。

步骤 206，链路自适应过程完成。

实施例 2

另，本发明还可以根据无线信道的时变特性将无线信道分为两种：即慢衰落信道和快衰落信道。处理方式如实施例 1，此处不赘述。

实施例 3

另，本发明还可以根据无线信道的时变特征将无线信道分为：快衰落信道、慢衰落信道和突变信道。

其中快衰落信道和慢衰落信道的处理方式如实施例 1，此处不赘述。

突变信道，即信道突然变好或变坏，对应的链路自适应模式为突变处理模式。

对于突变信道，采用突变处理模式，突变处理模式是指：清除历史信息，采用初始默认的信道预测方法，初始默认预测方法可采用历史值预测模式或即时值预测模式中的任意一种，具体选择视数据可靠性要求而定。

实施例 4

基于同一发明构思，本发明实施例中还提供了一种用于链路自适应的装置，由于该装置解决问题的原理与链路自适应的方法相似，因此该装置的实施可以参见方法的实施，重复之处不再赘述。

图 4 示出了本发明链路自适应的装置结构示意图，如图 4 所示，该装置包括分类模块、设置模块和模式选择模块。其中：

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分类模块 401 设置为：对无线信道进行分类；

设置模块 402 设置为：设置链路自适应模式集合；

模式选择模块 403 设置为：根据所述分类的无线信道类型从设置模块中选择对应的链路自适应模式。

优选地，本发明的链路自适应装置还包括信道学习模块和链路速率确定模块；其中：

信道学习模块设置为：分析处理无线信道的历史测量信息，得出当前无线信道的类型；

链路速率确定模块设置为：根据所述无线信道类型和对应的链路自适应模式，得出待调度时刻的信道预测信息，选择与之匹配的链路速率。

本领域普通技术人员可以理解上述方法中的全部或部分步骤可通过程序来指令相关硬件完成，所述程序可以存储于计算机可读存储介质中，如只读存储器、磁盘或光盘等。可选地，上述实施例的全部或部分步骤也可以使用一个或多个集成电路来实现。相应地，上述实施例中的各模块/单元可以采用硬件的形式实现，也可以采用软件功能模块的形式实现。本发明不限制于任何特定形式的硬件和软件的结合。

以上详细说明了本发明的原理，但这只是为了便于理解而举的一些实施例，并不构成对本发明保护范围的限定。在不背离本发明精神及实质的情况下，本领域技术人员当可根据本发明作出各种相应的改变和变形，但这些相应的改变和变形都属于本发明所付的权利要求的保护范围。

工业实用性

通过采用本发明的技术，根据无线信道的不同分类有针对性的选择有效的链路自适应处理模式，能够保证在不同的衰落信道下实现系统的吞吐量最大化，保持稳定可靠的链路质量。

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权 利 要 求 书

1、一种链路自适应方法，其包括:

对无线信道进行分类;

设置链路自适应模式集合; 以及

根据所述无线信道的类型选择对应的链路自适应模式。

2、根据权利要求 1 所述的方法，其中，对无线信道进行分类的步骤中，是根据无线信道的时变特性进行分类的。

3、根据权利要求 2 所述的方法，其中，对无线信道进行分类的步骤中，是将无线信道分类为:

平坦信道、慢衰落信道和快衰落信道; 或者

慢衰落信道和快衰落信道; 或者

慢衰落信道、快衰落信道和突变信道。

4、根据权利要求 1 所述的方法，其中，所述链路自适应模式集合包括: 即时值预测模式、历史值预测模式、统计分位数预测模式和突变处理模式。

5、根据权利要求 4 所述的方法，其中，根据所述无线信道的类型选择对应的链路自适应模式的步骤包括:

通过分析无线信道的历史测量信息，判断得出当前无线信道的类型，根据所述当前无线信道的类型从所述链路自适应模式集合中选择对应的链路自适应模式。

6、根据权利要求 5 所述的方法，其中，根据所述无线信道的类型选择对应的链路自适应模式的步骤之后，所述方法还包括:

根据所述无线信道类型和对应的链路自适应模式，得出待调度时刻的信

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道预测信息，获得与所述待调度时刻的信道预测信息匹配的链路速率。

7、一种链路自适应装置，其包括：

分类模块，其设置：对无线信道进行分类；

设置模块，其设置为：设置链路自适应模式集合；以及

模式选择模块，其设置为：根据所述分类的无线信道类型从设置模块中选择对应的链路自适应模式。

8、根据权利要求 7 所述的装置，其中，所述分类模块是设置为根据无线信道的时变特性对无线信道进行分类的。

9、根据权利要求 8 所述的装置，其中，所述分类模块是设置为将无线信道分类为：

平坦信道、慢衰落信道和快衰落信道；或者

慢衰落信道和快衰落信道；或者

慢衰落信道、快衰落信道和突变信道。

10、根据权利要求 7 所述的装置，其中，所述链路自适应模式集合包括：即时值预测模式、历史值预测模式、统计分位数预测模式和突变处理模式。

11、根据权利要求 10 所述的装置，其中，所述模式选择模块是设置为按如下方式根据所述无线信道的类型选择对应的链路自适应模式：

通过分析无线信道的历史测量信息，判断得出当前无线信道的类型，根据所述当前无线信道的类型从所述链路自适应模式集合中选择对应的链路自适应模式。

12、根据权利要求 7 所述的装置，其还包括：

信道学习模块，其设置为：分析处理无线信道的历史测量信息，得出当前无线信道的类型；以及

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链路速率确定模块，其设置为：根据所述无线信道类型和对应的链路自适应模式，得出待调度时刻的信道预测信息，获得与所述待调度时刻的信道预测信息匹配的链路速率。

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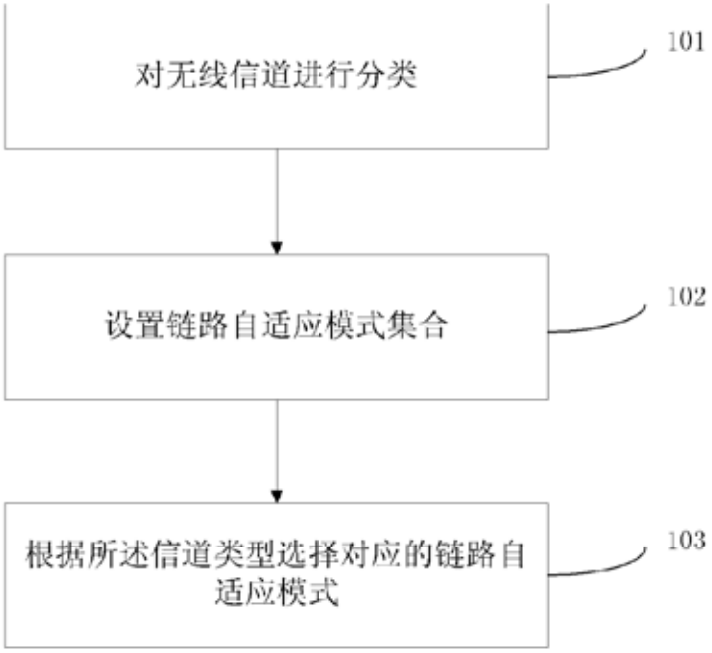


图 1

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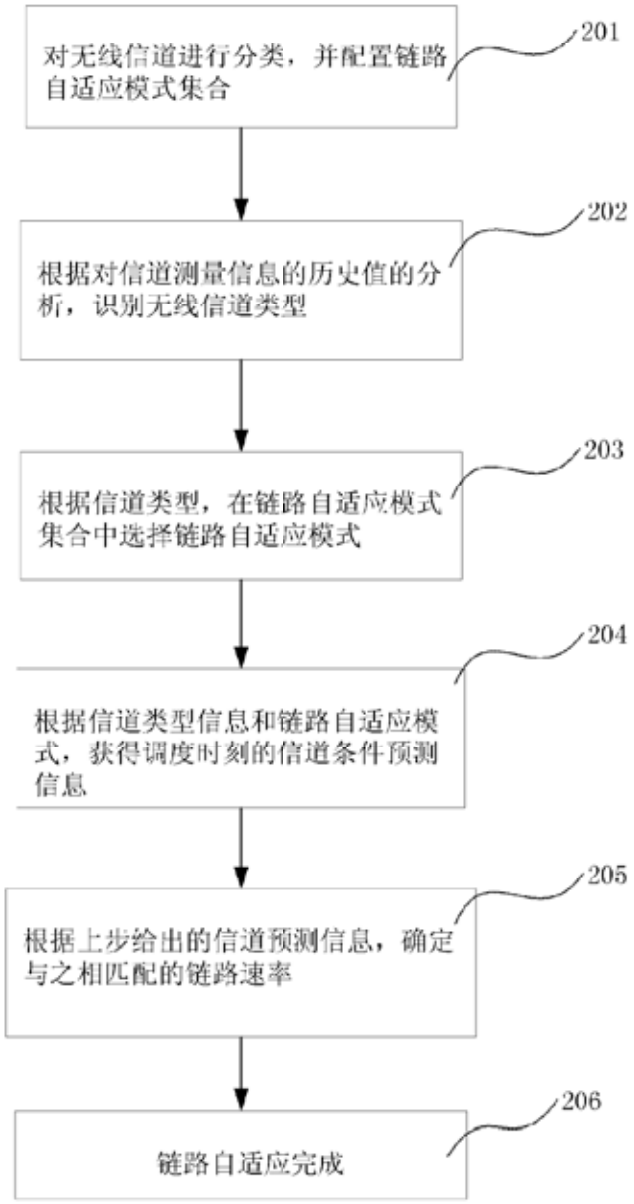


图 2

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平坦信道



快衰落信道



慢衰落信道

图 3

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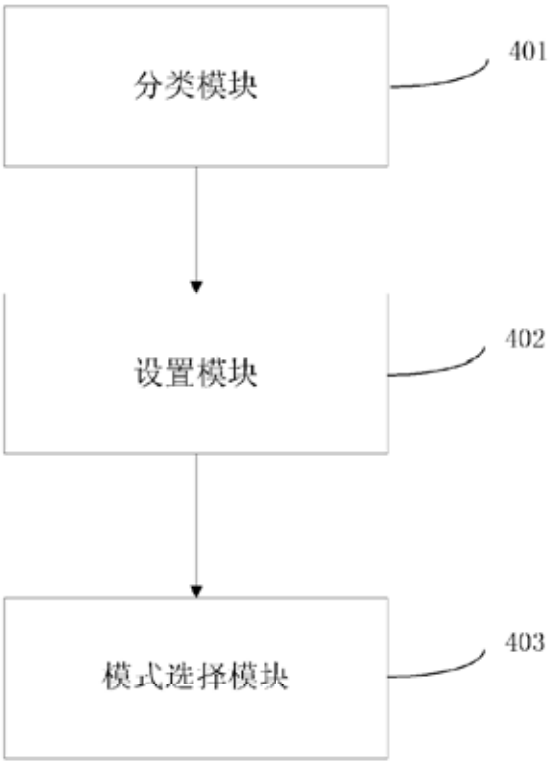


图 4

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2010/074869

A. CLASSIFICATION OF SUBJECT MATTER

H04W 28/08 (2009.01) i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: H04W H04L H04J H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

CNPAT; CNKI; WPI; EPODOC; link?, channel?, adaptation, adaptive, classif+, type?, mode?, pattern?, rate, throughput, fading, predict+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN1829113A (MATSUSHITA ELECTRIC IND CO LTD) 06 Sep. 2006 (06.09.2006)	1-3,7-9
Y	description, page 2, lines 1-7, page 3, lines 14-19, figures 3, 6	4-6,10-12
Y	CN1399436A (INTEL CORP) 26 Feb. 2003 (26.02.2003) description, page 4, line 3 to page 6, line 22, page 10, line 19 to page 11, line 31, figures 2-5	4-6,10-12
A	CN1862995A (ZHONGXING COMMUNICATION CO LTD SHENZHEN) 15 Nov. 2006 (15.11.2006) full text	1-12
A	US20090310550A1(BECEEM COMMUNICATIONS INC)17 Dec. 2009(17.12.2009) full text	1-12

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 Sep. 2010 (25.09.2010)	**28 Oct. 2010 (28.10.2010)**
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer Meng, Tiange Telephone No. (86-10)62411653

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

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2010/074869

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN1829113A	06.09.2006	none	
CN1399436A	26.02.2003	US2003017835A1	23.01.2003
		WO03009493A1	30.01.2003
		KR20030009140A	29.01.2003
		JP2003143065A	16.05.2003
		EP1410528A1	21.04.2004
		AU2002355087A1	03.03.2003
		TW574793A	01.02.2004
		CN1181634C	22.12.2004
		EP1410528B1	19.04.2006
		DE60210777E	24.05.2006
		JP3790723B2	28.06.2006
		SG125901A1	30.10.2006
		US7174178B2	06.02.2007
		DE602107777T2	19.04.2007
		KR100654282B1	05.12.2006
CN1862995A	15.11.2006	none	
US20090310550A1	17.12.2009	none	

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国际检索报告

国际申请号
PCT/CN2010/074869

A. 主题的分类

H04W 28/08 (2009.01) i

按照国际专利分类(IPC)或者同时按照国家分类和 IPC 两种分类

B. 检索领域

检索的最低限度文献(标明分类系统和分类号)

IPC: H04W H04L H04J H04B

包含在检索领域中的除最低限度文献以外的检索文献

在国际检索时查阅的电子数据库(数据库的名称，和使用的检索词（如使用）)

CNPAT; CNKI; WPI; EPODOC; 链路，信道，自适应，分类，类型，模式，速率，吞吐量，容量，衰落，预测; link?, channel?, adaptation, adaptive, classif+, type?, mode?, pattern?, rate, throughput, fading, predict+

C. 相关文件

类 型*	引用文件，必要时，指明相关段落	相关的权利要求
X	CN1829113A（松下电器产业株式会社）06.9 月 2006（06.09.2006）	1-3,7-9
Y	说明书第 2 页第 1-7 行，第 3 页第 14-19 行，图 3，6	4-6,10-12
Y	CN1399436A（英特尔公司）26.2 月 2003（26.02.2003） 说明书第 4 页第 3 行至第 6 页第 22 行，第 10 页第 19 行至第 11 页第 31 行，图 2-5	4-6,10-12
A	CN1862995A（中兴通讯股份有限公司）15.11 月 2006（15.11.2006） 全文	1-12
A	US20090310550A1（BECEEM COMMUNICATIONS INC）17.12 月 2009（17.12.2009）全文	1-12

☐ 其余文件在 C 栏的续页中列出。　　☒ 见同族专利附件。

* 引用文件的具体类型：

"A" 认为不特别相关的表示了现有技术一般状态的文件

"E" 在国际申请日的当天或之后公布的在先申请或专利

"L" 可能对优先权要求构成怀疑的文件，或为确定另一篇引用文件的公布日而引用的或者因其他特殊理由而引用的文件（如具体说明的）

"O" 涉及口头公开、使用、展览或其他方式公开的文件

"P" 公布日先于国际申请日但迟于所要求的优先权日的文件

"T" 在申请日或优先权日之后公布，与申请不相抵触，但为了理解发明之理论或原理的在后文件

"X" 特别相关的文件，单独考虑该文件，认定要求保护的发明不是新颖的或不具有创造性

"Y" 特别相关的文件，当该文件与另一篇或者多篇该类文件结合并且这种结合对于本领域技术人员为显而易见时，要求保护的发明不具有创造性

"&" 同族专利的文件

国际检索实际完成的日期	国际检索报告邮寄日期
25.9 月 2010（25.09.2010）	**28.10 月 2010 (28.10.2010)**
ISA/CN 的名称和邮寄地址： 中华人民共和国国家知识产权局 中国北京市海淀区蓟门桥西土城路 6 号 100088 传真号： (86-10)62019451	受权官员 孟田苹 电话号码：(86-10) **62411653**

PCT/ISA/210 表(第 2 页) (2009 年 7 月)

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国际检索报告
关于同族专利的信息

国际申请号
PCT/CN2010/074869

检索报告中引用的专利文件	公布日期	同族专利	公布日期
CN1829113A	06.09.2006	无	
CN1399436A	26.02.2003	US2003017835A1	23.01.2003
		WO03009493A1	30.01.2003
		KR20030009140A	29.01.2003
		JP2003143065A	16.05.2003
		EP1410528A1	21.04.2004
		AU2002355087A1	03.03.2003
		TW574793A	01.02.2004
		CN1181634C	22.12.2004
		EP1410528B1	19.04.2006
		DE60210777E	24.05.2006
		JP3790723B2	28.06.2006
		SG125901A1	30.10.2006
		US7174178B2	06.02.2007
		DE60210777T2	19.04.2007
		KR100654282B1	05.12.2006
CN1862995A	15.11.2006	无	
US20090310550A1	17.12.2009	无	

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(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 426 983 A1

(12) EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:
07.03.2012 Bulletin 2012/10

(21) Application number: **10840401.3**

(22) Date of filing: **30.06.2010**

(51) Int Cl.:
H04W 28/08 *(2009.01)*

(86) International application number:
PCT/CN2010/074869

(87) International publication number:
WO 2011/079612 (07.07.2011 Gazette 2011/27)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK SM TR

(30) Priority: **29.12.2009 CN 200910238810**

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(54) **METHOD FOR LINK ADAPTATION AND APPARATUS THEREOF**

(57) A method for link adaptation includes: classifying a radio channel; setting a set of link adaptation modes; and selecting a corresponding link adaptation mode according to a radio channel type. An apparatus for link adaptation includes: a classification module for performing a classification on a radio channel; a setting module for setting a set of link adaptation modes; and a mode selection module for selecting a corresponding link adaptation mode from the setting module according to a radio channel type of the classification. The present invention accordingly selects effective link adaptation modes in accordance with different types of radio channels, and is able to ensure to implement the maximum system throughput in different fading channels and maintain the stable and reliable link quality.

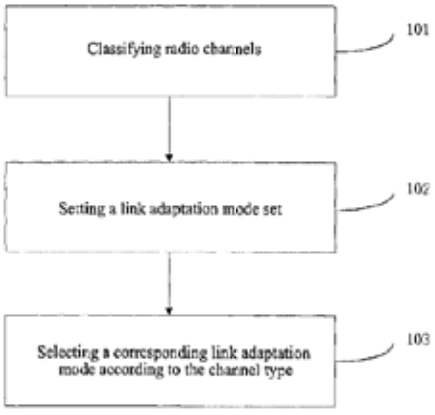


FIG. 1

EP 2 426 983 A1

Printed by Jouve, 75001 PARIS (FR)

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Description

Technical Field

[0001] The present invention relates to wireless communication systems, and more particularly, to a link adaptation technique.

Background of the Related Art

[0002] In wireless communication systems, since the radio channel is complex and there is no fixed rules to follow, in order to implement the maximum throughput of the wireless communication systems, wireless communication systems are expected to be able to automatically adjust the transmission rate according to the channel condition change, namely the link adaptation technique. The conventional method for link adaptation is taking the latest channel quality measurement result as a basis of selecting the future link rate.

Summary of the Invention

[0003] In the prior art, the conventional method for link adaptation is taking the latest channel quality measurement results as a basis of selecting the future link rate, and this method has the following problems:

the channel quality measurement results always contain measurement errors and random interference affects, namely the measurement results cannot accurately reflect the actual channel conditions;

radio channel conditions randomly change with the change of the time, and that is to say that the past measurement results cannot completely reflect the future channel conditions.

[0004] In view of this, the technical problem to be solve in the present invention is to provide a method and an apparatus for link adaptation, which are able to ensure the maximum throughput of the system implemented in different fading channels and maintain the stable and reliable link quality.

[0005] To solve the above technical problem, one aspect of the present invention is to provide a method for link adaptation, and the method comprises:

classifying a radio channel;

setting a link adaptation mode set; and

selecting a corresponding link adaptation mode according to a radio channel type.

[0006] In the step of classifying the radio channel, the radio channel is classified based on a time-variant characteristic of the radio channel.

[0007] In the step of classifying the radio channel, the radio channel is classified into:

a flat channel, a slow fading channel and a fast fading channel; or

the slow fading channel and the fast fading channel; or

the slow fading channel, the fast fading channel and a mutant channel.

[0008] The link adaptation mode set includes: an instantaneous value prediction mode, a historical value prediction mode, a statistical quantile prediction mode and a mutation processing mode.

[0009] The step of selecting the corresponding link adaptation mode according to the ratio channel type comprises: determining a current radio channel type by analyzing historical measurement information of the radio channel, and selecting the corresponding link adaptation mode from the link adaptation mode set according to the current radio channel type.

[0010] After the step of selecting the corresponding link adaptation mode according to the radio channel type, the method also comprises: obtaining channel prediction information at a to-be scheduling time according to the radio channel type and the corresponding link adaptation mode, and obtaining a link rate matching with the channel prediction information at the to-be scheduling time.

[0011] Another aspect of the present invention also provides an apparatus for link adaptation, which comprises:

a classification module, which is configured to classify a radio channel;

a setting module, which is configured to set a link adaptation mode set; and

a mode selection module, which is configured to select a corresponding link adaptation mode from the setting module according to a radio channel type in the classification.

[0012] The classification module is configured to perform the classification on the radio channel based on a time-variant characteristic of the radio channel.

[0013] The classification module is configured to classify the radio channels into:

a flat channel, a slow fading channel and a fast fading channel; or

the slow fading channel and the fast fading channel; or

the slow fading channel, the fast fading channel and

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a mutant channel.

[0014] The link adaptation mode set includes: an instantaneous value prediction mode, a historical value prediction mode, a statistical quantile prediction mode and a mutation processing mode.

[0015] The mode selection module is configured to select the corresponding link adaptation mode according to the radio channel type in a following way:

determining a current radio channel type by analyzing historical measurement information of the radio channel, and selecting the corresponding link adaptation mode from the link adaptation mode set according to the current radio channel type.

[0016] The apparatus also comprises:

a channel learning module, which is configured to analyze and process the historical measurement information of the radio channel to obtain a the current radio channel type; and

a link rate determination module, which is configured to: obtain the channel prediction information at a to-be scheduling time according to the radio channel type and the corresponding link adaptation mode, and select a link rate matching with the channel prediction information at the to-be scheduling time.

[0017] With the technique in the present invention, an effective link adaptation processing mode can be selected specifically according to different radio channel types, which is able to ensure to implement the maximum system throughput in different fading channels and to maintain a stable and reliable link quality.

Brief Description of Drawings

[0018] The drawings described herein is used to provide a better understanding of the present invention and forms a part of this application, the illustrative examples of the present invention and their descriptions are used to explain the present invention rather than forming the improper restriction on the present invention. In the drawings:

FIG. 1 is a flow chart of the method for link adaptation in accordance with the present invention;

FIG. 2 is a flow chart of the method for link adaptation in accordance with the example 1 of the present invention;

FIG. 3 is a schematic diagram of the classification of the radio channels;

FIG. 4 is a block diagram of the apparatus for link adaptation in accordance with the present invention.

Preferred Embodiments of the Present Invention

[0019] The specific embodiments of the present invention will be illustrated in detail with reference to drawings and examples.

[0020] The basic idea of the method for link adaptation in accordance with the present invention is shown in FIG. 1, which comprises:

step 101, the radio channels are classified;

step 102, a link adaptation mode set is set;

step 103, a corresponding link adaptation mode is selected according to the radio channel type.

Example 1

[0021] As shown in FIG. 2, this example comprises the following steps of:

step 201, the radio channels are classified, and the corresponding link adaptation mode set is set.

[0022] Specifically, in this example, the radio channels are classified into three types according to the time-variant characteristics of the radio channels, and as shown in FIG. 3, the three types of radio channels are: flat channels, slow fading channels and fast facing channels;
then further a corresponding link adaptation mode set is set according to the channel fading types;
the corresponding link adaptation mode set includes: an instantaneous value prediction mode, a historical value prediction mode and statistical quantile prediction mode, wherein:

the instantaneous value prediction mode refers to take the latest channel measurement result as a basis to select a link rate at the channel scheduling time.

[0023] The historical value prediction mode refers to use the curve fitting method to predict the channel conditions at the to-be scheduling time according to the historical channel measurement results for use by selecting the link rate.

[0024] The statistical quantile prediction mode refers to take a certain quantile of the cumulative distribution function of the historical measurement results as the basis to select the link rate at the to-be scheduling time. For example:

(1) flat channels: in the instantaneous value prediction mode, and predictable, that is, the prediction error is in the acceptable range;
suppose:

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the channel measurement result at the time t is denoted as SINR(t), the current time is denoted as t0, the to-be scheduling time is t0+n, where n is the sum of the system processing delay and the air interface transmission delay; the latest measurement result obtained at the current time is SINR(tx), and tx≤t0, therefore: the instantaneous value prediction result SINR_estimate (t0+n) is SINR_estimate(t0+n)=SINR(tx), the estimation error at the time t is denoted as Err (t), then: Err(t) = ISINR_estimate(t)-SINR(t)I
The predictable (estimable) probability is expressed as:
the probability function P(Err(t)≤Error_threholdI t = t0-w+1,t0-w+2,...,t0) ≥P1, 0≤P1≤1, w≥0, where Error_threshold is the estimation error threshold, when Err(t)≤Error_threhold, it indicates that the estimation at the time t is correct, otherwise, it indicates that the estimation is wrong, and the smaller the Error_threshold is, the higher the estimation precision is, otherwise, the estimation precision is lower; P1 denotes the probability threshold of the correct estimation, and that is, the probability of correct estimation is P1. When the probability of correct estimation is larger than the threshold P1, it indicates that the channel is estimable in this prediction mode (or predictable). Where, w indicates the statistical time window length, and the smaller the w is, the lower the switching between the channel modes is, the more accurate the statistical result is, the faster the switching between the development modes is and the lower the judgment precision is.

(2) Slow fading channels: in the historical value prediction mode, and predictable, that is, the prediction error is in the acceptable range.
The concept of predictability is as the above description and is not repeated herein;
the historical value prediction mode refers to: use the historical channel measurement results SINR(t0-w' +1), SINR(t0-w' +2),···, SINR(t0), use the selected basis function f(t) to perform the curve fitting on SINR (t), t = t0-w, + 1, t0-w, +2, -, t0 to obtain the mathematical expression of f(t), so that f (t) = SINR (t), t= t0-w' +1, t0-w' +2,···,t0. The historical value prediction result SINR_estimate (t) = f (t). Where w' denotes the number of historical measurement results; f(t) can be any basis functions such as the trigonometric function, the power function, the logarithmic function as well as the polynomial function and so on.

(3) Fast Fading Channels: other cases, that is, unpredictable;
those are unpredictable by the above two methods are determined as the fast fading channels, and the corresponding link adaptation mode is the statistical quantile prediction mode;
the statistical quantile prediction mode is the mode applying the probability distribution function:

P(x) = P(SINR(t)<x I t =t= t0-w"+1, t0-w"+2,..., t0), the quantile at the point of alpha of the P(x) is taken as the statistical quantile prediction result SINR_estimate(t), that is, SINR_estimate(t) = P^{-1}(alpha) , and P^{-1}(x) is the inverse function of P(x); 0≤alpha≤1, the larger the alpha is, the higher the rate is, and the worse the reliability is, otherwise, the lower the rate is, and the better the reliability is;
step 202, the fading type of the radio channel is obtained according to the analysis of the historical measurement information of the radio channel, and that is, the fading type of the radio channel is obtained via the channel learning.

[0025] Step 202 comprises:

202.1, the historical measurement results are denoised, and a general de-noising way can be used, for example the filtering way or the sliding window average way;

202.2 N historical measurement results are observed, and if the channel is predictable in the instantaneous value prediction mode, the channel is a flat channel; if the channel is predictable in the historical value prediction mode, the channel is a slow fading channel; otherwise the channel is a fast fading channel.

[0026] Step 203, a link adaptation mode is selected from the link adaptation mode set according to the fading type of the radio channel obtained in step 202;
if the channel is a flat channel, the instantaneous value prediction mode is selected; if the channel is a slow fading channel, the historical value prediction mode is selected; and if the channel is a fast fading channel, the statistical quantile prediction mode is selected.

[0027] Step 204, the channel condition prediction information at the to-be scheduling time point is obtained according to the radio channel type and link adaptation mode;
the channel condition prediction information might include the Signal Interference Noise Radio (SINR), and the Block Error Rate (BLER), and so on;
it is assumed that the latest historical measurement value is SINR(t), and measurement value at the to-be scheduling time is SINR-estimate(tx);
the channel condition prediction information corresponding to the channel classification results is as follows:

in flat channels: SINR estimate(tx) = SINR(t);

in slow fading channels: SINR estimate(tx) = f(tx);

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in fast fading channels: SINR_estimate(tx)=P^{-1}(tx).

step 205, the matching link rate is obtained according to the channel condition prediction information obtained in step 204;

It is assumed that the channel SINR prediction result is SINR1 and the service BLER requirement is BLER1; the maximum rate that can be reached by the link in the conditions of SINR=SINR1 and BELR=BLER1 is the Modulation Code Scheme 1 (MCS1), therefore, the output result in this step is MCS1.

[0028] Step 206, the link adaptation process is complete.

Example 2

[0029] In addition, the present invention can further classify the radio channels into two types according to the time-variant characteristics of the radio channels, namely: slow fading channels and fast fading channels. The processing method is as the example 1 and is not repeated herein.

Example 3

[0030] In addition, the present invention can further classify the radio channels into: fast fading channels, slow fading channels and mutant channels according to the time-variant characteristics of the radio channels.

[0031] Wherein, the method for processing the fast fading channels and the slow fading channels is as the example 1 and is not repeated herein.

[0032] For a mutant channel, the channel is suddenly good or bad, the corresponding link adaptation mode is the mutation processing mode.

[0033] For the mutant channel, the mutant processing mode is applied, and the mutation processing mode refers to: clear the historical information, use the initial default channel prediction way which might use any one of the historical value prediction mode or the instantaneous value prediction mode, and the specific selection is determined according to the data reliability requirements.

Example 4

[0034] Based on the same inventive concept, the example of the present invention also provides an apparatus for link adaptation, since the principle of the apparatus for solving the problem is similar to the method for link adaptation, the implementation of the apparatus can refer to the implementation of the method, and the overlaps are not repeated herein.

[0035] FIG. 4 shows a schematic diagram of the structure of the apparatus for link adaptation in accordance of the present invention, and as shown in FIG. 4, the apparatus comprises a classification module, a setting module and a mode selection module, wherein

the classification module 401 is configured to perform a classification on the radio channels;

the setting module 402 is configured to set a link adaptation mode set;

the mode selection module 403 is configured to select the corresponding link adaptation mode from the setting module according to the radio channel type in the classification.

[0036] Preferably, the apparatus for the link adaptation in the present invention also comprises a channel learning module and a link rate determination module, wherein the channel learning module is configured to analyze and process the historical measurement information of the radio channels to obtain the current radio channel type; the link rate determination module is configured to obtain the channel prediction information at the to-be scheduling time according to the radio channel type and the corresponding link adaptation mode, and to select the matching link rate.

[0037] It can be understood by those skilled in the art that some or all steps in the above mentioned method can be fulfilled by instructing the relevant hardware with a program, and said program is stored in a computer readable storage medium such as the read only memory, the magnetic disk or the optical disk. Optionally, some or all steps in the above mentioned examples can be implemented with one or more integrated circuits. Correspondingly, each module/unit in the above mentioned examples can be implemented in the form of hardware or in the form of software function module, or their combinations.

[0038] The principle of the present invention is illustrated in detail in the above description, however, the description is only a plurality of examples illustrated for understanding the present invention rather than the restriction of the protection scope of the present invention. For those skilled in the art, various corresponding modifications and transformations can be made according to the present invention without departing from the spirit and essence of the present invention, and such modification or transformations should fall into the protection scope of the appended claims of the present invention.

Industrial Applicability

[0039] With the technique in the present invention, an effective link adaptation processing mode can be selected specifically according to different radio channel types, which is able to ensure the maximum system throughput in different fading channels and to maintain a stable and reliable link quality.

Claims

1. A method for link adaptation, wherein, the method

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comprising:

classifying a radio channel;
setting a link adaptation mode set; and
selecting a corresponding link adaptation mode according to a radio channel type.

2. The method of claim 1, wherein, in the step of classifying the radio channel, the radio channel is classified based on a time-variant characteristic of the radio channel.

3. The method of claim 2, wherein, in the step of classifying the radio channel, the radio channel is classified into:

a flat channel, a slow fading channel and a fast fading channel; or
the slow fading channel and the fast fading channel; or
the slow fading channel, the fast fading channel and a mutant channel.

4. The method of claim 1, wherein the link adaptation mode set includes: an instantaneous value prediction mode, a historical value prediction mode, a statistical quantile prediction mode and a mutation processing mode.

5. The method of claim 4, wherein the step of selecting the corresponding link adaptation mode according to the ratio channel type comprises:

determining a current radio channel type by analyzing historical measurement information of the radio channel, and selecting the corresponding link adaptation mode from the link adaptation mode set according to the current radio channel type.

6. The method of claim 5, after the step of selecting the corresponding link adaptation mode according to the radio channel type, the method also comprising:

obtaining channel prediction information at a to-be scheduling time according to the radio channel type and the corresponding link adaptation mode, and obtaining a link rate matching with the channel prediction information at the to-be scheduling time.

7. An apparatus for link adaptation, comprising:

a classification module, which is configured to perform a classification on a radio channel;
a setting module, which is configured to set a link adaptation mode set; and
a mode selection module, which is configured to select a corresponding link adaptation mode from the setting module according to a radio channel type in the classification.

8. The apparatus of claim 7, wherein the classification module is configured to perform the classification on the radio channel based on a time-variant characteristic of the radio channel.

9. The apparatus of claim 8, wherein the classification module is configured to classify the radio channel into:

a flat channel, a slow fading channel and a fast fading channel; or
the slow fading channel and the fast fading channel; or
the slow fading channel, the fast fading channel and a mutant channel.

10. The apparatus of claim 7, wherein the link adaptation mode set includes: an instantaneous value prediction mode, a historical value prediction mode, a statistical quantile prediction mode and a mutation processing mode.

11. The apparatus of claim 10, wherein the mode selection module is configured to select the corresponding link adaptation mode according to the radio channel type in a following way:

determining a current radio channel type by analyzing historical measurement information of the radio channel, and selecting the corresponding link adaptation mode from the link adaptation mode set according to the current radio channel type.

12. The apparatus of claim 7, the apparatus also comprising:

a channel learning module, which is configured to analyze and process historical measurement information of the radio channel to obtain a current radio channel type; and
a link rate determination module, which is configured to: obtain the channel prediction information at a to-be scheduling time according to the radio channel type and the corresponding link adaptation mode, and select a link rate matching with the channel prediction information at the to-be scheduling time.

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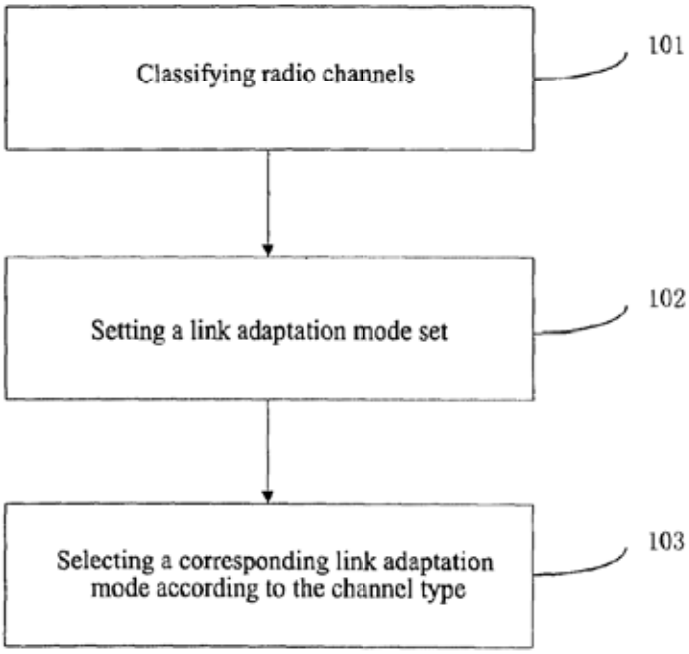


FIG. 1

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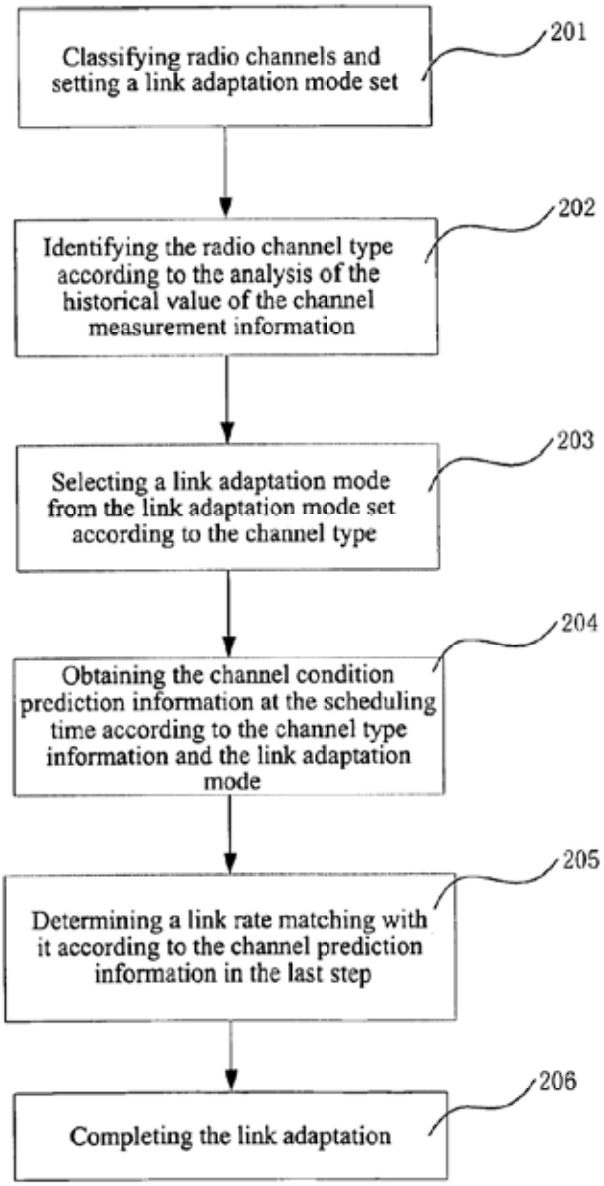


FIG. 2

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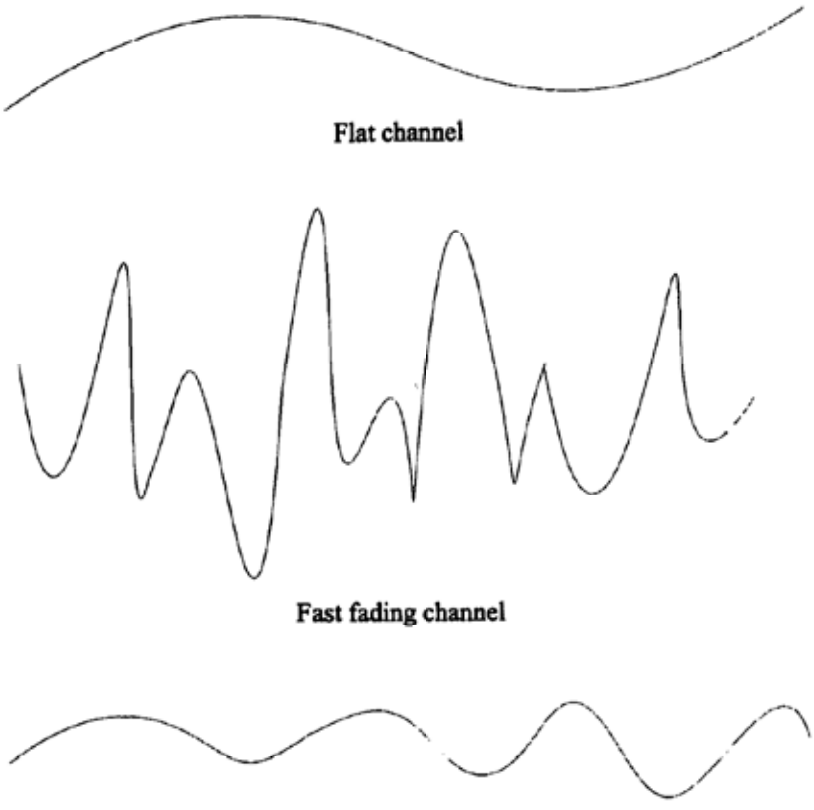


FIG. 3

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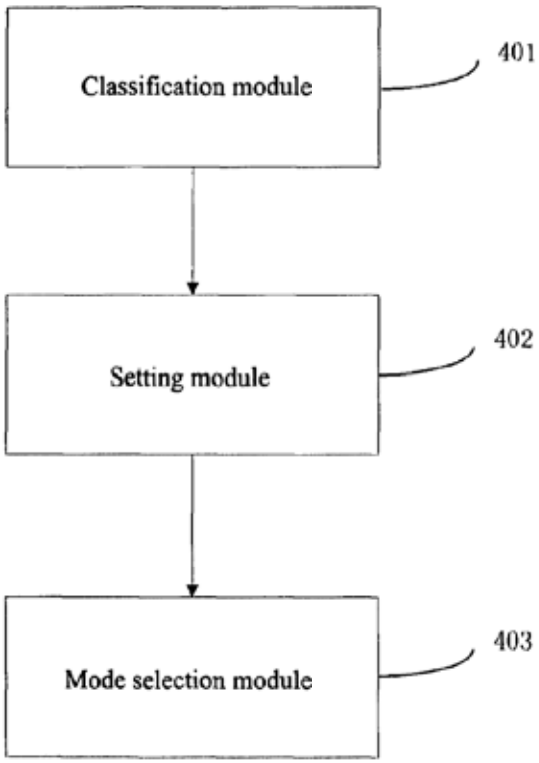


FIG. 4

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2010/071869

A. CLASSIFICATION OF SUBJECT MATTER

H04W 28/08 (2009.01) i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: H04W H04L H04J H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

CNPAT; CNKI; WPI; EPODOC; link?, channel?, adaptation, adaptive, classif+, type?, mode?, pattern?, rate, throughput, fading, predict+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN1829113A (MATSUSHITA ELECTRIC IND CO LTD) 06 Sep. 2006 (06.09.2006)	1-3,7-9
Y	description, page 2, lines 1-7, page 3, lines 14-19, figures 3, 6	4-6,10-12
Y	CN1399436A (INTEL CORP) 26 Feb. 2003 (26.02.2003) description, page 4, line 3 to page 6, line 22, page 10, line 19 to page 11, line 31, figures 2-5	4-6,10-12
A	CN1852995A (ZHONGXING COMMUNICATION CO LTD SHENZHEN) 15 Nov. 2006 (15.11.2006) full text	1-12
A	US20090310550A1(BECHEM COMMUNICATIONS INC)17 Dec. 2009(17.12.2009) full text	1-12

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

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 Sep. 2010 (25.09.2010)	**28 Oct. 2010 (28.10.2010)**
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer Meng, Tiange Telephone No. (86-10)62411653

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

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2010/074869

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CN1829113A	06.09.2006	none	
CN1399436A	26.02.2003	US2003017835A1	23.01.2003
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US20090310550A1	17.12.2009	none	

Form PCT/ISA/210 (patent family annex) (July 2009)

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[19] 中华人民共和国国家知识产权局

[51] Int. Cl.
H04Q 7/00 (2006.01)

[12] 发明专利申请公布说明书

[21] 申请号 200680005801.0

[43] 公开日 2008 年 4 月 2 日

[11] 公开号 CN 101156458A

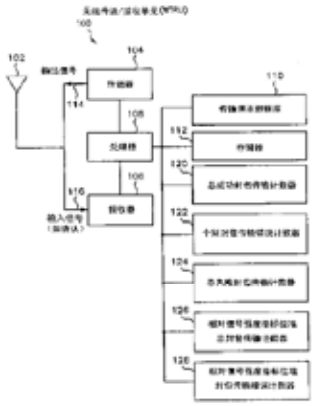
[22] 申请日 2006.1.30
[21] 申请号 200680005801.0
[30] 优先权
[32] 2005.2.23 [33] US [31] 60/655,770
[32] 2005.9.30 [33] US [31] 11/240,146
[86] 国际申请 PCT/US2006/004618 2006.1.30
[87] 国际公布 WO2006/091391 英 2006.8.31
[85] 进入国家阶段日期 2007.8.23
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代理人 郭蔚
权利要求书 10 页 说明书 15 页 附图 7 页

[54] 发明名称

动态适应封包传输速率的无线通信方法及装置

[57] 摘要

一种由第一收发器(如无线传送/接收单元，存取点，节点)所使用的方法与装置，用以基于自第二收发器所接收信号为基础调整传送至该第二收发器的封包传输速率的方法及装置。一实施例中，传输封包错误率(TxPER)处理系用来调整封包传输速率。另一实施例中，相对信号强度指针(RSSI)为基础处理系用来决定于该第一收发器处自该第二收发器所接收封包的相对信号强度指针，以调整封包传输速率。另一实施例中，传输品质指针系于该第二收发器处测量且被传送至该第一收发器测量，其可以该品质指针为基础来驱动新封包传输速率。传输封包错误率及相对信号强度指针为基础处理可分别、组合或结合其它处理使用。



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1. 一种于一无线通信系统用于调整一无线传送/接收单元的一封包传输速率的方法，该无线通信系统包含复数无线传送/接收单元，该方法包含：

(a)该无线传送/接收单元的第一者决定一传送可用封包的一封包传输速率；

(b)该第一无线传送/接收单元以步骤(a)中所被选择的该传输速率将该封包传送至该无线传送/接收单元的一第二者；及

(c)该第一无线传送/接收单元以该传送封包为基础实施一相对信号强度指针训练处理。

2. 根据权利要求 1 的方法，其特征在于，进一步包含：

(d)该第一无线传送/接收单元决定在一预定时间区间内自该第二无线传送/接收单元所接收的至少一封包是否可获得至少一有效相对信号强度指针测量。

3. 根据权利要求 2 所述的方法，其特征在于，若步骤(d)的决定为肯定，则该方法进一步包含：

(e)该第一无线传送/接收单元决定该至少一可用相对信号强度指针测量的该相对信号强度指针位准；及

(f)该第一无线传送/接收单元决定于步骤(e)中所决定的该相对信号强度指针位准是否于该预定时间区间内先被该相对信号强度指针训练处理使用。

4. 根据权利要求 3 所述的方法，其特征在于，若步骤(f)的决定为肯定，则该方法进一步包含：

(g)该第一无线传送/接收单元设定该封包传输速率为依据该相对信号强度指针训练处理所决定针对该相对信号强度指针位准所建立的一较佳封包传输速率。

5. 根据权利要求 2 所述的方法，其特征在于，若步骤(d)的决定为否定，则该方法进一步包含：

(e)该第一无线传送/接收单元实施一传输封包错误率为基础处理来决定该封包传输速率。

6. 根据权利要求 3 所述的方法，其特征在于，若步骤(f)的决定为否定，则该方法进一步包含：

(g)该第一无线传送/接收单元实施一传输封包错误率为基础处理来决定该封包传输速率。

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7. 根据权利要求 1 所述的方法，其特征在于，该相对信号强度指针训练处理包含：

(i)若该第二无线传送/接收单元，将一确认(ACK)信息传送至该第一无线传送/接收单元，以响应接收由该第一无线传送/接收单元所传送的该封包，则该第一无线传送/接收单元决定该确认(ACK)信息的一相对信号强度指针测量的相对信号强度指针位准，及增加该相对信号强度指针位准的一总封包传输计数；及

(ii)该第一无线传送/接收单元更新该相对信号强度指针位准的一较佳封包传输速率。

8. 一种于无线通信系统中用于调整一存取点的封包传输速率的方法，其中该无线通信系统包含至少一该及存取点及至少一无线传送/接收单元，该方法包含：

(a)该存取点决定传送一可用封包的一封包传输速率；

(b)该存取点以步骤(a)中所选择的该传输速率传送该封包至该无线传送/接收单元；及

(c)该存取点以该传送封包为基础实施一相对信号强度指针训练处理。

9. 根据权利要求 8 所述的方法，其特征在于，进一步包含：

(d)该存取点决定在一预定时间区间内自该无线传送/接收单元所接受的至少一封包是否可获得至少一有效相对信号强度指针测量。

10. 根据权利要求 9 所述的方法，其特征在于，若步骤(d)的决定为肯定，则该方法进一步包含：

(e)该存取点决定该至少一有效相对信号强度指针测量的该相对信号强度指针位准；及

(f)该存取点决定被决定于步骤(e)中所决定的该相对信号强度指针位准是否于该预定时间区间内先由该相对信号强度指针训练处理所使用。

11. 根据权利要求 10 所述的方法，其特征在于，若步骤(f)的决定为肯定，则该方法进一步包含：

(g)该存取点设定该封包传输速率为依据该相对信号强度指针训练处理所决定为该相对信号强度指针位准所建立的一较佳封包传输速率。

12. 根据权利要求 9 所述的该方法，其特征在于，若步骤(d)的决定为否定，则该方法进一步包含：

(e)该存取点实施一传输封包错误率为基础处理来决定该封包传输速率。

13. 根据权利要求 10 所述的方法，其特征在于，若步骤(f)的决定为否定，则

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该方法进一步包含：

(g)该存取点实施传输封包错误率为基础处理来决定该封包传输速率。

14. 根据权利要求 8 所述的方法，其特征在于，相对信号强度指针训练处理系包含：

(i)若该无线传送/接收单元将一确认(ACK)信息传送至该存取点以响应接收由该存取点所传送的该封包，则该存取点决定该确认(ACK)信息的一相对信号强度指针测量的相对信号强度指针位准，及增加该相对信号强度指针位准的一总封包传输计数；及

(ii)该存取点更新该相对信号强度指针位准的较一佳封包传输速率。

15. 一种可调整一封包传输速率的存取点，该存取点包含：

(a)一处理器，可决定该存取点的一封包传输速率；及

(b)一传送器，以该处理器所决定的该速率传送一封包至一无线传送/接收单元，其中该处理器系可对该封包实施相对信号强度指针训练处理，并可决定在一预定时间区间内被接收自该无线传送/接收单元所接收的至少一封包是否可获得至少一相对信号强度指针测量。

16. 根据权利要求 15 所述的存取点，其特征在于，若一预定时间区间内自该无线传送/接收单元所接受的至少一封包可获得至少一相对信号强度指针测量，则该处理器决定该至少一可用相对信号强度指针测量的该相对信号强度指针位准，及决定该相对信号强度指针位准是否于该预定时间区间内先被该相对信号强度指针训练处理使用。

17. 根据权利要求 15 所述的存取点，其特征在于，若预定时间区间内被接收自该无线传送/接收单元所接受的至少一封包不可获得至少一相对信号强度指针测量，则该处理器实施一传输封包错误率为基础处理来决定该封包传输速率。

18. 根据权利要求 17 所述的存取点，其特征在于，若该相对信号强度指针位准于该预定时间区间内不先被该相对信号强度指针训练处理使用，则该处理器实施一传输封包错误率为基础处理来决定该封包传输速率。

19. 根据权利要求 17 所述的存取点，其特征在于，若该相对信号强度指针位准于该预定时间区间内先被该相对信号强度指针训练处理使用，则该处理器设定该封包传输速率为依据该相对信号强度指针训练处理所决定为该相对信号强度指针位准所建立的一较佳位准。

20. 根据权利要求 15 所述的存取点，其特征在于，若该无线传送/接收单元传

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送一确认(ACK)信息以响应接收由该存取点所传送的该封包，则该处理器决定该确认(ACK)信息的一相对信号强度指针测量的相对信号强度指针位准，及增加该相对信号强度指针位准的一总封包传输计数，及更新该相对信号强度指针位准的一较佳封包传输速率。

21. 根据权利要求 15 所述的存取点，其特征在于，若该有取点为接收到对该封包的一确认(ACK)信息以响应传送该封包，则该处理器决定在该预定时间区间内自该第二无线传送/接收单元所接受的任何封包是否可获得任何相对信号强度指针测量，若是，则决定该封包的一相对信号强度指针位准，及增加该相对信号强度指针位准的一总传输计数及一错误计数，及更新该相对信号强度指针位准的一较佳封包传输速率。

22. 一种并入一收发器中以用于可调整该收发器的封包传输速率的集成电路(IC)，该集成电路包含：

(a)一处理器，可决定该存取点的一封包传输速率；及

(b)一传送器，以该处理器所决定的该速率传送一封包至另一收发器，其中该处理器可对该封包实施一相对信号强度指针训练处理，并可决定在一预定时间区间内自该其它收发器所接收的至少一封包是否可获得至少一相对信号强度指针测量。

23. 根据权利要求 22 所述的集成电路，其特征在于，若一预定时间区间内自该其它收发器所接收的至少一封包可获得至少一相对信号强度指针测量，则该处理器决定该至少一可用相对信号强度指针测量的该相对信号强度指针位准，及可决定该相对信号强度指针位准是否于该预定时间区间内先被该相对信号强度指针训练处理使用。

24. 根据权利要求 22 所述的集成电路，其特征在于，若预定时间区间内自该其它收发器所接收的至少一封包不可获得至少一相对信号强度指针测量，则该处理器实施一传输封包错误率为基础处理来决定该封包传输速率。

25. 根据权利要求 24 所述的集成电路，其特征在于，若该相对信号强度指针位准于该预定时间区间内不先被该相对信号强度指针训练处理使用，则该处理器实施一传输封包错误率为基础处理来决定该封包传输速率。

26. 根据权利要求 24 所述的集成电路，其特征在于，若该相对信号强度指针位准于该预定时间区间内先被该相对信号强度指针训练处理使用，则该处理器设定该封包传输速率为依据该相对信号强度指针训练处理所决定针对该相对信号强度指针位准所建立的一较佳位准。

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27. 根据权利要求 22 所述的集成电路，其特征在于，若该其它收发器传送一确认(ACK)信息以响应接收该封包，则该处理器决定该确认(ACK)信息的一相对信号强度指针测量的相对信号强度指针位准，及增加该相对信号强度指针位准的一总封包传输计数，及更新该相对信号强度指针位准的一较佳封包传输速率。

28. 根据权利要求 22 所述的集成电路，其特征在于，若该收发器未接收到对该封包的一确认(ACK)信息以响应传送该封包，则该处理器决定该确认(ACK)信息的一相对信号强度指针测量的该相对信号强度指针位准，及更新该相对信号强度指针位准的一较佳封包传输速率。

29. 一种无线传送/接收单元，可调整该无线传送/接收单元经由一天线传送的一封包的封包传输速率，该无线传送/接收单元包含：

(a)一传送器，以特定封包传输速率传送至少一封包传送至一节点；

(b)一接收器，其从接收及确认该至少一封包接收的该节点接收一确认(ACK)信号；

(c)一处理器，其与该传送器及该接收器通信；

(d)一内存，其与该处理器通信；

(e)一传输速率数据库，其与该处理器通信；及

(f)复数封包传输计数器，其与该处理器通信。

30. 根据权利要求 29 所述的无线传送/接收单元，其特征在于，该特定封包传输速率系被初始设定为一预设速率。

31. 根据权利要求 29 所述的无线传送/接收单元，其特征在于，该封包传输计数器包含一总成功封包传输计数器及一个别封包传输错误计数器。

32. 根据权利要求 31 所述的无线传送/接收单元，其特征在于，当该接收器从该节点接收一确认(ACK)时，该总成功封包传输计数器会增加。

33. 根据权利要求 32 所述的无线传送/接收单元，其特征在于，当该接收器从该节点接收一确认(ACK)时，将该个别封包传输错误计数器重设为零。

34. 根据权利要求 33 所述的无线传送/接收单元，其特征在于，该封包传输计数器更包含一总失败封包传输计数器，而该处理器以该总成功封包传输计数器的一第一计数值及该总失败封包传输计数器的一第二计数值的加总为基础来调整该特定封包传输速率。

35. 根据权利要求 34 所述的无线传送/接收单元，其特征在于，若该加总大于等于封包传输速率增加所需的预定封包值，则该特定封包传输速率系被增加。

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36. 根据权利要求 35 所述的无线传送/接收单元，其特征在于，若该第二计数值对该第一计数值的比率小于一预定封包传输速率增加比率，则该特定封包传输速率系被增加。

37. 根据权利要求 29 所述的无线传送/接收单元，其特征在于，该封包传输计数器包含一总失败封包传输计数器及一个别封包传输错误计数器。

38. 根据权利要求 37 所述的无线传送/接收单元，其特征在于，当该接收器于传送该至少一封包至该节点时并不从该节点接收一确认(ACK)时，该总失败封包传输计数器及该个别封包传输错误计数器会增加。

39. 根据权利要求 38 所述的无线传送/接收单元，其特征在于，该特定封包传输速率系以该个别封包传输错误计数器的一计数值为基础，由该传输速率数据库所指定的一或多个支持速率步骤所降低。

40. 根据权利要求 29 所述的该无线传送/接收单元，其特征在于，该封包传输计数器包含一接收信号强度指针位准总封包传输计数器。

41. 根据权利要求 40 所述的无线传送/接收单元，其特征在于，若一相对信号强度指针训练处理不先用来决定该特定封包传输速率，则在传送该至少一封包至该节点后自该内存从该节点所被接收的一确认(ACK)的相对信号强度指针测量检索，该相对信号强度指针测量系由该处理器决定，而该相对信号强度指针位准的该相对信号强度指针位准总封包传输计数器会增加。

42. 根据权利要求 41 所述的无线传送/接收单元，其特征在于，该相对信号强度指针位准的一封包错误率系于该内存中更新，若该封包错误率稳定，则该相对信号强度指针位准的一较佳封包传输速率亦于该内存中进行更新。

43. 根据权利要求 40 所述的无线传送/接收单元，其特征在于，若一相对信号强度指针训练处理先用于决定该特定封包传输速率，则在传送该至少一封包至该节点后，自该内存从该节点所接收的一确认(ACK)的一相对信号强度指针测量检索，该相对信号强度指针测量由该处理器决定，而该相对信号强度指针位准的该相对信号强度指针位准总封包传输计数器会增加。

44. 根据权利要求 43 所述的无线传送/接收单元，其特征在于，该相对信号强度指针位准的一封包错误率系于该内存中更新，若该封包错误率稳定，则该相对信号强度指针位准的一较佳封包传输速率亦于该内存中进行更新。

45. 根据权利要求 40 所述的无线传送/接收单元，其特征在于，若一相对信号强度指针训练处理先被用来决定该特定封包传输速率，且不需从该节点接收一确认

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(ACK)而将该至少一封包传送至该节点后，该相对信号强度指针位准的该相对信号强度指针位准总封包传输计数器会增加。

46. 根据权利要求 45 所述的无线传送/接收单元，其特征在于，该相对信号强度指针位准的一封包错误率系于该内存中更新，若该封包错误率稳定，则该相对信号强度指针位准的一较佳封包传输速率亦于该内存中进行更新。

47. 根据权利要求 29 所述的无线传送/接收单元，其特征在于，该封包传输计数器包含一接收信号强度指针位准总封包传输计数器及一相对信号强度指针位准封包传输错误计数器。

48. 根据权利要求 47 所述的无线传送/接收单元，其特征在于，在传送该至少一封包至该节点后，从该节点所接收的一确认(ACK)的相对信号强度指针测量系被检索自该内存，而该相对信号强度指针位准的该相对信号强度指针位准总封包传输计数器系针对该确认(ACK)的相对信号强度指针位准而增加。

49. 根据权利要求 47 所述的无线传送/接收单元，其特征在于，若不需从该节点接收一确认(ACK)而将该至少一封包被传送至该节点后，决定在一最后最大持续期间内自该节点所接受的任何封包是否可获得任何相对信号强度指针测量，若是，则决定该测量的该相对信号强度指针位准，而该相对信号强度指针位准总封包传输计数器及该相对信号强度指针位准封包传输错误计数器会增加。

50. 根据权利要求 49 所述的无线传送/接收单元，其特征在于，该相对信号强度指针位准的一封包错误率系于该内存中进行更新，若该封包错误率稳定，则该相对信号强度指针位准的一较佳封包传输速率亦被于该内存中进行更新。

51. 根据权利要求 29 所述的无线传送/接收单元，其特征在于，该无线传送/接收单元以自该节点所接收的一速率指令为基础而设定该特定封包传输速率，及以该接收速率指令为基础传送封包。

52. 一种并入一无线传送/接收单元中的集成电路，该集成电路可调整该无线传送/接收单元经由一天线索传送的封包的一封包传输速率，该集成电路包含：

(a)一传送器，以一特定封包传输速率传送至少一封包至一节点；

(b)一接收器，用于从接收及确认该至少一封包接收的该节点接收一确认(ACK)信号；

(c)一处理器，其与该传送器及该接收器通信；

(d)一内存，其与该处理器通信；

(e)一传输速率数据库，其与该处理器通信；及

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(f)复数封包传输计数器，其与该处理器通信。

53. 根据权利要求 52 所述的集成电路，其特征在于，该特定封包传输速率系被初始设定为一预设速率。

54. 根据权利要求 52 所述的集成电路，其特征在于，该封包传输计数器包含一总成功封包传输计数器及一个别封包传输错误计数器。

55. 根据权利要求 54 所述的集成电路，其特征在于，当该接收器从该节点接收一确认(ACK)时，该总成功封包传输计数器会增加。

56. 根据权利要求 55 所述的集成电路，其特征在于，当该接收器从该节点接收一确认(ACK)时，将该个别封包传输错误计数器重设为零。

57. 根据权利要求 56 所述的集成电路，其特征在于，该封包传输计数器更包含一总失败封包传输计数器，而该处理器以该总成功封包传输计数器的一第一计数值及该总失败封包传输计数器的一第二计数值的加总为基础来调整该特定封包传输速率。

58. 根据权利要求 57 所述的集成电路，其特征在于，若该加总大于等于一封包传输速率增加所需的一预定封包值，则增加该特定封包传输速率。

59. 根据权利要求 58 的集成电路，其特征在于，若该第二计数值对该第一计数值的比率小于一预定封包传输速率增加比率，则增加该特定封包传输速率。

60. 根据权利要求 52 所述的集成电路，其特征在于，该封包传输计数器包含一总失败封包传输计数器及一个别封包传输错误计数器。

61. 根据权利要求 60 所述的集成电路，其特征在于，当该接收器于传送该至少一封包至该节点时并不从该节点接收一确认(ACK)时，该总失败封包传输计数器及该个别封包传输错误计数器会增加。

62. 根据权利要求 61 所述的集成电路，其特征在于，该特定封包传输速率系以该个别封包传输错误计数器的一计数值为基础，由该传输速率数据库所指定的一或更多个支持速率步骤所降低。

63. 根据权利要求 52 所述的集成电路，其特征在于，该封包传输计数器包含一接收信号强度指针位准总封包传输计数器。

64. 根据权利要求 63 所述的集成电路，其特征在于，若一相对信号强度指针训练处理不先用来决定该特定封包传输速率，则传送该至少一封包至该节点后自该内存从该节点所接收的一确认(ACK)的相对信号强度指针测量检索，该相对信号强度指针测量系该处理器决定，而该相对信号强度指针位准的该相对信号强度指针位准总封

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包传输计数器会增加。

65. 根据权利要求 64 所述的集成电路，其特征在于，该相对信号强度指针位准的一封包错误率系于该内存中更新，若该封包错误率稳定，则该相对信号强度指针位准的一较佳封包传输速率亦于该内存中更新。

66. 根据权利要求 63 所述的集成电路，其特征在于，若一相对信号强度指针训练处理先用于决定该特定封包传输速率，则在传送该至少一封包至该节点之后，自该内存从该节点所接收的一确认(ACK)的一相对信号强度指针测量检索，该相对信号强度指针测量由该处理器决定，而该相对信号强度指针位准的该相对信号强度指针位准总封包传输计数器会增加。

67. 根据权利要求 66 所述的集成电路，其特征在于，该相对信号强度指针位准的一封包错误率被于该内存中更新，若该封包错误率稳定，则该相对信号强度指针位准的一较佳封包传输速率亦于该内存中更新。

68. 根据权利要求 63 所述的集成电路，其特征在于，若相对信号强度指针训练处理先被用来决定该特定封包传输速率，且不需从该节点接收一确认(ACK)而将该至少一封包传送至该节点后，该相对信号强度指针位准的该相对信号强度指针位准总封包传输计数器会增加。

69. 根据权利要求 68 所述的集成电路，其特征在于，该相对信号强度指针位准的一封包错误率系于该内存中更新，若该封包错误率稳定，则该相对信号强度指针位准的一较佳封包传输速率亦于该内存中更新。

70. 根据权利要求 52 所述的集成电路，其特征在于，该封包传输计数器包含一接收信号强度指针位准总封包传输计数器及一相对信号强度指针位准封包传输错误计数器。

71. 根据权利要求 70 所述的集成电路，其特征在于，在传送该至少一封包至该节点后，从该节点所接收的一确认(ACK)的相对信号强度指针测量系被检索自该内存，而该相对信号强度指针位准的该相对信号强度指针位准总封包传输计数器系针对该确认(ACK)的相对信号强度指针位准而增加。

72. 根据权利要求 70 所述的集成电路，其特征在于，若不需从该节点接收一确认(ACK)而将该至少一封包传送至该节点后，决定在一最后最大持续期间内自该节点所接收的任何封包是否可获得任何相对信号强度指针测量，若是，则决定该测量的该相对信号强度指针位准，而该相对信号强度指针位准总封包传输计数器及该相对信号强度指针位准封包传输错误计数器会增加。

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73. 根据权利要求 72 所述的集成电路，其特征在于，该相对信号强度指针位准的一封包错误率系于该内存中更新，若该封包错误率稳定，则该相对信号强度指针位准的一较佳封包传输速率亦于该内存中更新。

74. 根据权利要求 52 所述的集成电路，其特征在于，该集成电路以自该节点所接收的一速率指令为基础而设定该特定封包传输速率，及以该接收速率指令为基础传送封包。

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动态适应封包传输速率的无线通信方法及装置

技术领域

本发明是有关无线通信系统中的数据传输。更特别是，本发明是有关动态适应封包传输速率以响应改变衰减条件。

背景技术

如无线局域网络(WLANs)的无线通信系统系熟知于技术领域中。通常，该系统包含收发器(也就是通信站(STAs))，其可传送及接收彼此间的无线通信信号。视系统类型而定，收发器可采用存取点(AP)，无线传送/接收单元(WTRU)，节点或类似者的型式。

图 1 显示一传统无线通信系统 10，其中存取点 12 可提供通信服务至复数无线传送/接收单元 14。存取点 12 可经由可选存取控制器(AC)16 与网络 18 通信，藉此提供附加网络服务至无线传送/接收单元 14，如对互联网或公共服务电话网络(PSTN)的存取。可替代是，存取点 12 可不需经由可选存取控制器 16 而与网络 18 直接通信。

理论上，系统 10 内所有连接均可以最高可达成传输速率操作使效能及全部系统容量最大化。然而，因为需接收器处相当高信号噪声比(SNRs)，所以并非总可以较高数据速率达到可接收品质。

视接收封包的收发器所察觉的信号噪声比情况而定，此创造对调整封包被传送的送率有利的情况。然而，系统 10 并不提供机构将被接收信号功率，信号噪声比或封包错误率(PER)型式表示的被察觉频道品质转移至封包源。因此，调整系统 10 中的存取点 12 及无线传送/接收单元 14 的传输速率的决定基础系被限制为局部传输状况。

发明内容

本发明是有关一种以第一收发器(如无线传送/接收单元，存取点，节点或类似者)接收来自第二收发器的信号为基础被该第一收发器用来调整被传送至该第二收发器的封包传输速率的方法及装置。一实施例中，传输封包错误率(TxPER)处理系被用来调整封包传输速率。另一实施例中，相对信号强度指针(RSSI)为基础处理系被使用，

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藉此被该第一收发器接收来自用该第二收发器的封包相对信号强度指针系被用来调整封包传输速率。另一实施例中，传输品质指针系系被测量于该第二收发器处且被传送至该第一收发器，其可以该品质指针为基础来驱动新封包传输速率。可选择是，该第二收发器可决定较佳封包传输速率并将其传送至该第一收发器，于是其可调整其封包传输速率。

虽然两不同决定封包传输速率的处理(也就是传输封包错误率处理及相对信号强度指针为基础处理在此被揭示，但这些处理可被个别使用，彼此连结使用，或与其它处理连结使用。

依据本发明，收发器可以收发器处的测量为基础从若干可用速率间选择较佳数据传输速率。这些测量系为被接收于该收发器处的封包被接收信号强度(Rx 功率)，及被该收发器传送的信号传输封包错误率，其可通过假设封包于每次其对应确认(ACK)不被接收自另一收发器时均错误来推断。该收发器可快速建立最佳可用数据传输速率而仍可维持可接受服务品质(QoS)。此后，该收发器可适应其传输速率以响应改变衰减条件。

附图说明

本发明可从以下较佳实施例说明及附图获得更详细了解，其中：

第 1 图显示传统无线通信系统；

图 2 为依据本发明配置的无线传送/接收单元方块图例；

图 3 为依据本发明实施的全部速率适应处理流程图；

图 4 为图 3 的全部速率适应处理的传输封包错误率为基础处理流程图；

图 5 为图 3 的全部速率适应处理的相对信号强度指针训练处理流程图；

图 6 为图 3 的全部速率适应处理的相对信号强度指针训练处理另一实施例流程图；及

图 7 为图 3 的全部速率适应处理的替代相对信号强度指针训练处理例。

缩写字表

ACK	确认
AP	存取点
BS	基地台

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CS	客户站
CTS	清理后送
MAC	媒体存取控制
NF	噪声指数
PER	封包错误率
Pwr	功率
QoS	服务品质
RSSI	相对信号强度指针
RTS	要求传送
Rx	接收
SNR	信号噪声比
STA	站
STA Tx	传送站
STA Rx	接收站
Tx	传送
TxPwr	传送功率
WLAN	无线局域网络

表 1

具体实施方式

此后，被使用的存取点名词者系包含但不限于基地台，B 节点，地址控制器，无线路由器或可提供无线传送/接收单元对该存取点连结的网络做无线存取的无线环境中的任何其它接介装置。

此后，被使用的无线传送/接收单元名词系包含但不限于客户站，使用者设备，站，行动站，固定或行动用户单元，呼叫器，或可操作于无线环境中的任何其它类型使用者装置。该无线传送/接收单元包含个人通信装置，如电话，视讯电话及具有网络连接的互联网备用电话。此外，该无线传送/接收单元包含可携式个人计算装置，如具有类似网络功能的无线调制解调器的个人数字助理(PDAs)及笔记型计算机。可携式或可改变位置的无线传送/接收单元系被称为行动单元。

此后，被使用的无线连接系被定义为彼此可传送及接收封包的一对节点间的无线通信。各无线连接系包含一对节点，其中封包的传送器及接收器角色系及时被前后交

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换于该节点之间。例如，以两无线传送/接收单元与单存取点通信的架构模式操作的无线通信系统系包含两无线连接。速率控制处理应驻留于各传送节点中，其目的系针对各主动无线连接决定各封包被传送的最佳速率。

较佳是，在此所说明的实施各传送器及接收器功能系可被并入如特定应用集成电路的单集成电路上。然而，该电路亦可轻易使用多分离组件及/或分离集成电路来实施。

在此所说明的特定传送器及接收器配置仅被提供为例证而不限制。熟练一般技术人士将了解符合本发明的其它变异及修改。

本发明是为促使收发器(也就是无线传送/接收单元，存取点，节点)依据各无线频道随时间改变传播情况被啮合一个或多无线连接来动态适应其传输速率。为了如此，本发明是视特定测量可用性及有效性而定依赖两处理来决定较佳传输速率。第一处理中，在此被称为传输封包错误率为基础处理的传输封包错误率系被用来决定最佳传输速率。可替代是，该最佳传输速率系以相对信号强度指针或与其传输功率相关，与被传送封包传输封包错误率相关连的其它被接收封包度量为基础来决定。相对信号强度指针系以在此被称为相对信号强度指针训练处理的处理被与传输封包错误率相关连。虽然相对信号强度指针被用于相对信号强度指针训练处理较佳实施例说明中，但替代实施例亦可使用如信号噪声比的其它度量。

图 2 为依据本发明配置的无线传送/接收单元 100 方块图例。在此被揭示用于无线传送/接收单元 100 的相同配置例亦可被并入存取点中。无线传送/接收单元 100 系包含至少一天线 102，一传送器 104，一接收器 106，一处理器 108，一传输速率数据库 110 及一内存 112。传送器系被配置以被选自被储存于传输速率数据库 110 中的复数可用传输速率的传输速率经由天线 102 传送输出信号 114。接收器 106 系被配置从天线 102 接收输入信号 116。处理器 108 系被耦合至传送器 104，接收器 106，传输速率数据库 110 及内存 112。处理器 108 系从该传输速率数据库 110 选择传输速率，及改变传送器 104 的目前传输速率为被选择速率。此选择可以输出信号 114 评价，输出信号 114 及输入信号 116 评价为基础，或其可以被接收于接收器 106 处的速率指令为基础。内存 112 系被用来针对输入信号 116 及/或输出信号 114，及/或针对被接收于接收器 106 处的速率指令来储存数据。处理器 108 系被配置处理被储存于内存 112 中的数据，并储存内存 112 中的该被处理数据结果以便进一步存取来选择及改变传送器 104 的传输速率。

无线传送/接收单元 100 进一步包含复数封包传输计数器，包含一总成功封包传

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输计数器 120，一个别封包传输错误计数器 122，一总失败封包传输计数器 124，一相对信号强度指针位准总封包传输计数器 126，及一相对信号强度指针位准封包传输错误计数器 128。封包传输计数器 120，122，124，126，及 128 的功能系可以个别基础或当作维持组通过一个或更多数据库，处理器，软件或类似者来实施。例如，多组封包传输计数器 120，122，124，126，及 128 及相关测量系可被维持来个别控制无线传送/接收单元 100 于特定通信链接上通信的各站，存取点，无线传送/接收单元或类似者相关连的封包传输速率。

说明本发明所实施处理之前系有利地定义被列示于下表 2 中的若干名词。虽然本发明处理将被说明于这些中，但应了解并不需使用这些名词；反的，该名词仅为说明该处理特性的便捷。一实施中，参数可被储存于内存中并如需要被更新，或可以任何适当方式被维持及更新。

参 数	说 明	例 子
最大持续期间	从传送器传送封包至的节点的测量或指令系有效的最大持续期间。最大持续期间参数较佳应表示频道的一致性时间。该被接收封包可为任何类型(如 DATA，ACK，RTS，CTS 或类似者)	100ms
可允许速率	被以上升顺序分类的传送器可支持的速率表列。可允许速率可通过被储存于内存中的向量来表示，其中向量各位置系对应特定速率。	IEEE 802.11a 的[6,9,12,18,24,36,48,54]Mbps
预设速率	当速率控制被激活时，应被传送器使用的速率。此可通过可允许速率向量起始指针来表示。	8(标示预设速率系为第 8 高支持速率，如 802.11a 系统中的 54Mbps)
目前速率	被传送器用来传送下一封包的速率。此可通过可允许速率向量目前指针来表示。	5(标示下一封包将以第 5 高支持速率，如 802.11a 系统中的 24Mbps 被传送)
最大速率指针	被支持的不同传输速率数量	8

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速率向下触发	调整传输速率以响应连续传输错误的预定模式或计划，针对再传输尝试，其标示该传输速率是否应被降低，而若是，其应被降低多少速率位准。该模式应被储存为向量。例如，IEEE 802.11a 系统中，[0,0,1,1,2,2,1,0]意指以 54Mbps 操作的无线传送/接收单元直到传输速率被降低一位准至 48Mbps 时的第三再传输(也就是三个错误之后)才不降低其传输速率。若错误产生，则该速率系于第四再传输被降低一位准至 36Mbps，且此后于第五(至 18 Mbps)及第六再传输(至 9 Mbps)降低两位准，且接着降低一位准(至 6 Mbps，最低支持速率)。	[0,0,1,1,2,2,1,0]
速率增加比率	失败对成功封包传输的最大允许比率	0.10
速率增加所需封包	自上次速率改变后必须被传送以允许传输速率增加的最大封包数	10
良好封包计数	传送至特定无线传送/接收单元的成功封包数。此计数系于速率改变被实施后被再初始化至零。	
不良封包计数	传送至特定无线传送/接收单元的失败封包数。此计数系于速率改变被实施后被再初始化至零。	
重试计数	给定封包的失败传送尝试数。当封包被成功传送时，此计数系被再初始化至零。	

表 2

图 3 为依据本发明实施的全部速率适应处理 300 流程图。传输速率系使用图 2 无线传送/接收单元 100 中的处理器 108 所实施的传输封包错误率为基础处理或相对信号强度指针为基础处理来决定。使用何处理的决定系以相对信号强度指针为基础处理先前是否以被训练，及特定相对信号强度指针位准是否可获得有效相对信号强度指针测量为基础。若是，相对信号强度指针为基础处理系被用来决定传输速率。否则，传输封包错误率为基础处理系被使用。任一例中，封包接着均以该处理的一所决定的速率传送，而封包传输的接续成功或失败系被用来动态训练相对信号强度指针为基础处理及调整传输速率。

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有效相对信号强度指针测量系被定义为预定持续期间(在此被指定为最大持续期间)内从传送器最后传送封包至的节点被接收的封包相对信号强度指针测量。最大持续期间系代表频道一致性时间。被接收封包可为任何类型，如 DATA，ACK，RTS，CTS 或类似者。

如图 3 所示，当第一站(也就是无线传送/接收单元 100)通过设定第一站的封包传输速率为预设速率准备第一次传送封包至第二站时，全部速率适应处理 300 激活(步骤 305)。当第一站具有封包传送至第二站(步骤 310)时，决定最后最大持续期间内是否具有任何可用于任何被接收自第二站的任何封包的有效相对信号强度指针测量(步骤 315)。

若该持续期间内并无任何封包被接收或无该测量可用于任何被接收封包，则传输封包错误率为基础处理系被实施来决定第一站的封包传输速率(步骤 320)，稍后其将被详述。

然而，若有效相对信号强度指针测量被决定可获得于步骤 315 中，则可用有效相对信号强度指针测量的相对信号强度指针位准决定系被执行(步骤 325)。步骤 325 中，若有效相对信号强度指针测量系被决定存在于一个以上相对信号强度指针位准，则代表性相对信号强度指针位准系被决定。该代表性相对信号强度指针位准可以最后相对信号强度指针值为基础，或可为静态(如平均值)，以若干相对信号强度指针值为基础，或以相对信号强度指针值结合其它值为基础。步骤 330 中，决定相对信号强度指针处理是否已于最后最大持续期间内被训练于此相对信号强度指针位准。若是，则第一站的封包传输速率系如该相对信号强度指针训练处理所决定被设定为该相对信号强度指针位准较佳速率(步骤 335)，该封包系被传送(步骤 340)且该相对信号强度指针训练处理系被实施(步骤 345)。当第一站具有另一封包传送至第二站时，处理 300 系返回步骤 310。如传输封包错误率为基础处理被说明后将被说明如下者，被传送封包成功或失败系被用来动态更新相对信号强度指针训练处理 345 所标示的较佳传输速率。

步骤 330 中，若决定相对信号强度指针处理于最后最大持续期间内不被训练于此相对信号强度指针位准，则传输封包错误率为基础处理被实施来决定第一站的封包传输速率(步骤 320)。封包接着被传送(步骤 340)，且该相对信号强度指针训练处理系被实施(步骤 345)。

图 4 为图 3 的全部速率适应处理 300 的传输封包错误率为基础处理 320 流程图。通常，依据传输封包错误率为基础处理 320，图 2 的无线传送/接收单元 100 中的传送器 104 系可通过反应其传送至一接收节点时所经历的传输事件来调整其封包传输

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速率。

若图 2 的无线传送/接收单元 100 的传送器 104 经历连续封包传输错误，则其封包传输速率系依据在此被指定为速率向下触发(Rate Down Trigger)的预定计划或模式而被降低。该速率向下触发可为被储存于图 2 的无线传送/接收单元 100 中的内存 112 中的一向量。各连续封包传输错误之后，该速率向下触发可指示封包传输速率是否应于下一封包再传输尝试之前被降低，且若是则有多少。若有，则该被指示速率降低接着被实施。封包传输速率系以此方式被降低直到封包被成功传送为止，或直到该封包传输速率被降低为预定最小封包传输速率为止。

例如，若无线传送/接收单元 100 被配置用于 IEEE 802.11a 系统中，则被以上升顺序步骤分类的被支持封包传输速率(也就是被支持封包传输速率位准)系为 6，9，12，18，24，36，48 及 54Mbps。该例中，[0，0，1，1，2，2，1，0] 的速率向下触发向量系指示无线传送/接收单元 100 直到第三再传输尝试之后(也就是特定封包三传输错误之后)才降低其封包传输速率，此点上，该封包传输速率将被降低一步。于是，若无线传送/接收单元 100 于第三传输错误之后以 54Mbps 操作，则传输速率将被降低一步至 48 Mbps，而封包将被再传输。若传输错误仍然产生，则第四再传输，速率接着被再降低一步至 36 Mbps，接着于第五(至 18 Mbps)及第六再传输(至 9 Mbps)被再降低两步，且接着降低一步(至 6 Mbps，最低支持速率)。

另一方面，若无线传送/接收单元 100 的传送器 104 经历一致连续封包传输错误，传送器 104 的传输速率系依据传输封包错误率为基础处理 320 被增加。该例中，针对被传送至接收节点的充份封包数量，当传送器 104 所经历的传输封包错误率下降低于特定门槛时，传输速率系被增加至下一支持步骤。

如图 4 所示，若确认(ACK)被接收(步骤 405)，则无线传送/接收单元 100 中的总成功封包传输计数器 120 系被增加，而无线传送/接收单元 100 中的个别封包传输错误计数器 122 系被重设为零(步骤 430)。如以下说明，这些计数器 120，122 系被用来决定传输速率是否应被增加。

若确认不被接收于步骤 405，则无线传送/接收单元 100 中的总失败封包传输计数器 124 系被增加，而个别封包传输错误计数器 122 亦被增加(步骤 410)。速率向下触发向量系被检验来决定封包传输速率是否应针对个别封包传输错误计数值被降低，而若是，有多少步骤(步骤 415)。若速率向下触发指示封包传输速率不应被降低，则相同封包系被准备再传输。然而，若速率向下触发于步骤 415 指示封包传输速率应被降低一或更多步，则封包传输速率系被降低速率向下触发所指示的步骤数，且总成功

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封包传输计数器 120 及总失败封包传输计数器 124 系被重设为零(步骤 420)。相同封包接着被准备以速率向下触发所指示的封包传输速率做再传输(步骤 425)。传输封包错误率为基础处理 320 可于通信对话期间被重复，直到封包传输速率等于最低支持传输速率或直到确认(ACK)被接收为止。

触动传输速率降低之前要求经历连续错误事件系导致倾向区隔不良信号情况所产生的错误事件及封包冲突所产生的错误事件。其亦促成较考虑封包错误事件数平均的准则为快的速率降低反应时间，并于已被实施速率降低不产生更可靠通信时提供附加传输速率降低。

当确认(ACK)被决定被接收以响应步骤 405 中的被传送封包时，总成功封包传输计数器 120 系被增加，而个别封包传输错误计数器 122 系被重设为零(步骤 430)。接着，决定传输速率增加是否可预期。通常，当传输速率增加时，导致传输错误的封包传输比例亦增加。较佳传输速率系为可被使用而仍达到可接受服务品质的最高支持速率。例如，该服务品质可被表示为传输封包错误率或传输错误对成功传输的比率。若传送器经历较维持可接受服务品质所需为低的传输错误对成功传输的比率，则传输速率增加可预期。

传输封包错误率为基础处理 320 可决定传输速率增加是否可通过第一加总总成功封包传输计数及总失败封包传输计数(也就是自传输开始或自最后封包传输速率改变之后找寻封包传输总数)来预期。此加总系被与门槛值相较(在此被标示为速率增加所需的封包)(步骤 435)。速率增加所需的封包系指出自速率增加被允许所产生最后封包传输速率改变发生之后必须被传送的最小封包数。若该加总不大于或等于速率增加所需的封包，则不允许任何封包传输速率调整且该封包传输速率不被增加。

若总成功封包传输计数及总失败封包传输计数加总大于或等于速率增加所需的封包(步骤 435)，则处理 320 可决定速率增加是否被保证。速率增加系被保证传输失败比例是否小于被允许维持可预期服务品质。例如，传输失败比例可通过决定传输失败对成功传输比率或以任何其它适当方式被指出。封包传输速率增加系被决定被保证总成功封包传输计数对总失败封包传输计数比率是否小于维持可接受服务品质所需者。维持可接受服务品质所需的比率系为一门槛(在此被指定为速率增加比率)。若总失败封包传输计数对总成功封包传输计数比率于步骤 440 被决定不小于速率增加比率，则封包传输速率增加不被保证，且封包传输速率不被调整。

然而，若总失败封包传输计数对总成功封包传输计数比率于步骤 440 被决定小于速率增加比率，则封包传输速率增加系被增加至次高步(也就是次高支持封包传输速

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率)，若可获得一者，而总成功封包传输计数器 120 及总失败封包传输计数器 124 系被重设为零(步骤 445)。通信对话期间，处理 25 可被重复直到最大支持传输速率被达成或确认(ACK)不被接收为止。

当通信进行于第一站(其中本发明被实施)及第二站之间时，相对信号强度指针处理系被动态训练于第一站处。当相对信号强度指针处理被训练时，该相对信号强度指针处理系较佳决定第一站的较佳传输速率。相对信号强度指针为基础速率适应处理系通过反应被接收于第一站处来自第二站的被接收封包功率变异来适应封包被第一站传送至第二站的封包传输速率。实施例中，被接收功率系被反映于被接收封包的测量相对信号强度指针中；然而，与该被接收功率相关的信号噪声比或其它度量亦可被使用。

相对信号强度指针为基础处理可动态地将被第一站传送至第二站的封包传输封包错误率与被接收于第一站处来自第二站的封包相对信号强度指针产生相关。此动态相关在此系被称为训练相对信号强度指针为基础处理。该相关系分别针对该第一站所使用的各支持传输速率所做。其有助于分为被接收信号功率预期范围分离位准。例如，若被接收信号功率预期范围为-97dBm 至-64dBm，则该范围可被轻易地分为 3dBm 所间隔的位准：如针对总共 12 分离功率位准的-97dBm 至-94dBm，-94dBm 至-91dBm，…-67dBm 至-64dBm。任何小于-97dBm 的被接收功率均可被组合一起为附加功率位准，而任何大于-64dBm 的被接收功率均可被组合一起为再另一功率位准。应了解该范围系从-97 至-64，该范围被分为 3dBm 所间隔的位准，而第 12 分离位准仅被用作例证且不做限制。传输封包错误率及被接收封包相对信号强度指针系通过针对从第一站被传送至第二站及从第二站被传送至第一站的各封包收集第一站测量及信息来决定。有关从第一站被传送至第二站的各封包被收集信息，系包含该封包被传送的传输速率及该传输是否成功(ACK(确认)被接收)或导致传输错误(ACK(确认)不被接收)。从此信息，传输封包错误率系被计算于被使用的各传输速率处。

有关从第二站被传送至第一站的各封包被收集信息，系包含各被接收封包信号强度测量(如相对信号强度指针)及该封包被接收信息。相对信号强度指针测量系被视为仅于被指定最大持续时间一段长度有效。针对相对信号强度指针训练，应注意所有封包类型均可被使用(也就是 DATA，ACK，RTS，CTS 或类似者)。若一个以上封包于最大持续时间内被接收自第二站，则该处理可使用来自该最后被接收封包的相对信号强度指针或以若干封包为基础来计算统计值(如平均值)。由于封包被传送及 ACK(确认)被接收之间耗费简短时间，确认成功传输例中被传送封包的 ACK(确认)帧的相对信号强

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度指针测量系特别有关联。因此，第一实施例中，仅 ACK(确认)信号的相对信号强度指针被使用。

此实施例中，相对信号强度指针训练处理系有关被以被确认的相关传送封包传输速率接收的各 ACK(确认)的相对信号强度指针。若 ACK(确认)被接收，其相对信号强度指针被测量且其相对信号强度指针位准被决定，则该封包传输归属于所使用传输速率处的该相对信号强度指针位准。若无任何 ACK(确认)被接收，则传输错误系被假设。该例中，若相对信号强度指针处理不被用来选择传输速率，则该错误并不归属于任何特定相对信号强度指针位准。然而，若相对信号强度指针处理被用来选择传输速率，则被用来选择传输速率的该相对信号强度指针位准系被辨识，而该错误系归属于该相对信号强度指针位准及传输速率。运算被传送封包及传输错误总数系被维持各传输速率的各相对信号强度指针位准。各相对信号强度指针位准及传输速率的传输错误率系针对该相对信号强度指针位准及传输速率通过传输错误数除以封包传输数来计算。

图 5 为图 3 的全部速率适应处理 300 的相对信号强度指针训练处理 345 流程图。由于决定相对信号强度指针训练处理是否先被用来决定封包传输速率，所以相对信号强度指针训练处理系于封包被传送之后开始(步骤 505)。若否，则决定 ACK(确认)是否被接收以响应传送器封包(步骤 510)。若于步骤 510 决定无任何 ACK(确认)被接收，则无法归属该传输错误为特定相对信号强度指针位准，且相对信号强度指针训练处理 345 终止。若于步骤 510 决定 ACK(确认)被接收以响应该被传送封包，则 ACK(确认)的相对信号强度指针测量系被检索自无线传送/接收单元 100 中的内存 112，相对信号强度指针位准系通过处理器 108 决定，而相对信号强度指针位准总封包传输计数器 126 系针对该相对信号强度指针位准被增加(步骤 515)。

若于步骤 505 决定相对信号强度指针训练处理先被用来决定封包传输速率，则被该相对信号强度指针训练处理用来决定传输速率的相对信号强度指针位准系被辨识(步骤 520)。接着决定 ACK(确认)是否针对该被传送封包被接收(步骤 525)。若于步骤 525 决定 ACK(确认)不被接收，则相对信号强度指针位准总封包传输计数器 126 及相对信号强度指针位准封包传输错误计数器系针对该相对信号强度指针位准被增加(步骤 530)。若于步骤 525 决定 ACK(确认)被接收，则 ACK(确认)的相对信号强度指针测量系被检索自无线传送/接收单元 100 中的内存 112，ACK(确认)的相对信号强度指针位准系通过处理器 108 决定，而相对信号强度指针位准总封包传输计数器 126 系针对该 ACK(确认)的相对信号强度指针位准被增加(步骤 535)。

此信息系被用来针对所使用各传输速率计算各相对信号强度指针位准处的传输

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封包错误率(步骤 540)。此信息可被收集于如下表 3 的表中，其显示站用来传送封包例的各传输速率的传输封包错误率对相对信号强度指针统计值。

传输功率(dBm)(相对信号强度指针位准)	不同传输速率的传输封包错误率			
	速率 1 (如 1Mbps)	速率 2 (如 2Mbps)	…	速率 N (如 54Mbps)
-∞至-97	1.00	1.00	…	1.00
-97 至-94	0.64	0.92	…	1.00
-94 至-91	0.22	0.47	…	1.00
-91 至-88	0.07	0.18	…	1.00
-88 至-85	0.01	0.08	…	0.95
…	…	…	…	…
-70 至-67	0.00	0.00	…	0.15
-67 至-64	0.00	0.00	…	0.03
-64 至∞	0.00	0.00	…	0.00

表 3

如图 5 所示，给定相对信号强度指针位准及传输速率系于各新封包传输之后被更新(步骤 540)。若封包于第一次被传送及被再传送时被错误接收，则第二传输系被当作独特封包传输。成功传输事件中，数据库系使用 ACK(确认)帧的相对信号强度指针测量单独或结合被用来决定传输速率的相对信号强度指针来更新。若可获得复数有效相对信号强度指针测量，则最新者或统计值(如两个或更多最新测量平均)可被用来决定相对信号强度指针位准。然而，可有利地使用最后被接收 ACK(确认)的相对信号强度指针测量，因为其暂时接近该被传送封包。

相对信号强度指针为基础处理亦当作输入预期目标被传送封包错误率或最大允许封包错误率。目标被传送封包错误率对所有传输速率均相同，或其对不同速率有所不同。例如，表 3 中，最大允许封包错误率系被设定 0.10 给所有速率。因此，任何相对信号强度指针位准处的较佳传输速率系为具有不大于 0.10 的传输封包错误率的该位准处的最高传输速率。针对该有效传输封包错误率，必须存在充足测量数量来建立该封包错误率。

被接收用于相对信号强度指针位准建立有效传输封包错误率应为可配置数。例

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如，为了建立不大于 0.10 的传输封包错误率，至少 10 封包必须被接收。可替代是，传输封包错误率系较佳仅于被接收较佳封包数等于该传输封包错误率反向预期倍数之后才被视为稳定。例如，若该预期倍数为二且特定相对信号强度指针位准及传输速率的目标传输封包错误率值为 0.10，则为使传输封包错误率值被视为稳定，至少 2x(1/10)=20 封包必须被接收于该相对信号强度指针位准及传输速率。

表 3 中，粗字体值系标示各相对信号强度指针位准的较佳传输速率。例如，-88dBm 至-85dBm 的相对信号强度指针位准处，速率 1(1Mbps，具有 0.01 传输封包错误率)及速率 2(2Mbps，具有 0.08 传输封包错误率)均具有低于 0.10 最大可允许值的传输封包错误率。若次高速率(无图标)具有高于最大可允许(如 0.15)的封包错误率，则较佳传输速率系为速率 2，其为具有小于最大可允许的封包错误率的最高速率。相对信号强度指针很低(如表 3 中任何小于-91dBm 者)所以并无支持速率给予低于最大可允许封包错误率的传输封包错误率统计值例中，相对信号强度指针为基础处理应较佳使用一旗标来指示并无支持速率产生可接受传输封包错误率。该例中，因为传送封包较目标或最大可允许封包错误率所指示者可能产生错误，所以该封包不应被传送。可替代是，较佳传输速率可于传送封包之前被以最低支持速率设定。此信息可被归纳于下表，表 4。

传输功率(dBm)(相对信号强度指针位准)	较佳速率
-∞至-97	非旗标
-97 至-94	非旗标
-94 至-91	非旗标
-91 至-88	速率 1
-88 至-85	速率 2
…	…
-67 至-64	速率 N
-64 至∞	速率 N

表 4

如图 5 所示，传输封包错误率系针对相对信号强度指针位准及传输速率被计算，相对信号强度指针位准的较佳传输速率亦被决定如上(步骤 540)。获得传输速率对相对信号强度指针位准统计值并被决定对特定相对信号强度指针位准很稳定之后，相对信号强度指针为基础处理接着被用来调整传送器的传输速率。否则，传输封包错误率

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为基础处理被实施来决定传输速率。

图 6 为全部速率适应处理 300 的替代相对信号强度指针训练处理 345' 流程图，该例中其通常假设传送器功率及频道情况对实质等于最大持续期间的时间区间维持实质固定。

封包被传送之后，系决定 ACK(确认)是否针对该被传送封包被接收(步骤 605)。若是，则 ACK(确认)信号的相对信号强度指针测量系被检索自无线传送/接收单元 100 中的内存 112，其相对信号强度指针位准系被决定，而相对信号强度指针位准传输计数系被增加(步骤 610)。传输封包错误率接着针对该相对信号强度指针位准被更新，决定该传输封包错误率是否对该相对信号强度指针位准很稳定，若是，该相对信号强度指针位准的较佳封包传输速率系被更新(步骤 615)。

若于步骤 605 决定该被传输封包不接收 ACK(确认)，则决定最后最大持续期间内任何被接收自该第二站的封包是否可获得相对信号强度指针测量(步骤 620)。若否，则无法将传输错误归属于特定相对信号强度指针位准，且处理 345' 终止。然而，若于步骤 620 决定可获得一个或更多相对信号强度指针测量，则该测量的相对信号强度指针位准系被决定。若一个以上相对信号强度指针位准于步骤 625 被找出，则代表性相对信号强度指针位准系被决定，而相对信号强度指针位准总封包传输计数器 126 及相对信号强度指针位准封包传输错误计数器 128 系针对该相对信号强度指针位准系被增加。该相对信号强度指针位准的传输封包错误率接着被更新，且决定该传输封包错误率对该相对信号强度指针位准是否很稳定。若是，该相对信号强度指针位准的较佳封包传输速率系被更新(步骤 615)。

应注意，相对信号强度指针训练处理 345 及 345' 系为正在进行的处理。传输封包错误率系依据第 5 或 6 图以遵循每封包传输的进入封包，或替代于每 N 封包传输之后，甚至于相对信号强度指针位准被视为"受训"之后的相对信号强度指针位准处被更新。旧统计值可较佳地于显著时间区间消逝之后自内存 112 被删除，或通过维持于内存中仅最后测量较佳数量(如 100)来使用。可替代是，被储存于内存 112 中的相对信号强度指针统计值可被定期冲刷，藉此相对信号强度指针训练处理 345 及 345' 系从零重新开始。

依据图 7 所示本发明实施例中，传送至第二站的第一站系调整其传输速率以响应被接收自第二站的速率指令。此实施例系涉及于第二站测量，决定较佳速率，产生速率指令，传送速率指令至第一站，及于第一站实施较佳速率。可选择是，测量本身可被传送至第一站，其可决定较佳传输速率。被用来决定较佳速率的测量系可包含链接

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品质指针及/或其它测量，如被接收于第二站来自第一站的信号相对信号强度指针或信号噪声比。从第二站至第一站的速率指令系较佳被放置于被第二站传送至第一站的封包媒体存取控制标头中，但其亦可经由其它装置来传送，如帧的酬载或一个或更多专用封包中。

此实施系假设第二站已针对各被允许传输速率将达成预期服务品质(如封包错误率)所需敏感性(如信号噪声比)储存于内存中。此信息通过第二站获得的方法系可包含预先配置，训练或类似者，且超过本发明此实施范围。

针对第二站接收来自第一站的每封包(包含被寻址至非第二站的节点的封包)，第二站系测量及储存该封包的信号噪声比及其被接收的时间于内存中。此后，无论第二站何时需传送封包至第一站，其均需检查其内存来检视其是否已于最后最大持续期间内接收任何来自第一站的封包。若是，则第二站系从该信号噪声比测量产生统计值(如被接收于最大持续期间内的封包平均信号噪声比，或最新有效信号噪声比或类似者)，并将其与被储存于内存中的敏感性数字相比较。较佳速率系为该被产生信号噪声比统计值较达成预期服务品质所需信号噪声比为佳的最高速率。第二站接着编码该预期速率为传送至第一站的速率指令。

若第二站于最大持续期间中尚未接收来自第一站的封包，则第二站可设定较佳传输速率为预设速率；或为其成功接收封包的最后速率；或为被标示于其传送至第一站的最后速率指令中。可替代是，其可传送标示第二站并不提供第一站应使用的传输速率，因而留给第一站决定其传输速率的任务。第二站编码该预期速率或信号为速率指令，并将其传送至第一站。第一站接着储存最后速率指令及其被接收的时间于内存中，并于传送至第二站时实施它。

图 7 为传输速率指令被产生于第二站并传送至第一站的速率适应处理 700 流程图。当第一站具有一封包传送至第二站时(步骤 705)，其可检查其内存 112 来检视其是否已于最后最大持续期间内接收来自第二站的有效速率指令(步骤 710)。若是，第一站可依据被接收的最后速率指令来设定其传输速率。若不可获得有效速率指令，则第一站可如上述决定其自我传输速率(步骤 720)。封包接着被传送(步骤 725)。

虽然本发明的特性及组件被以特定组合说明于较佳实施例中，但各特性及组件系不需较佳实施例的其它特性及组件，或有或无本发明其它特性及组件的各种组合中被单独使用。

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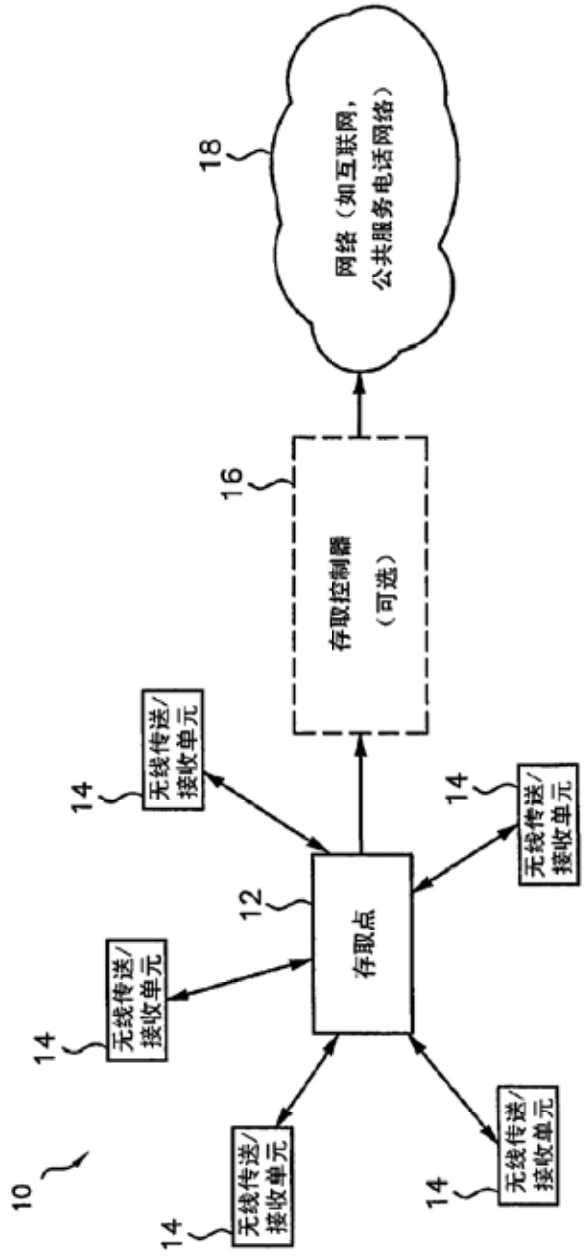


图 1

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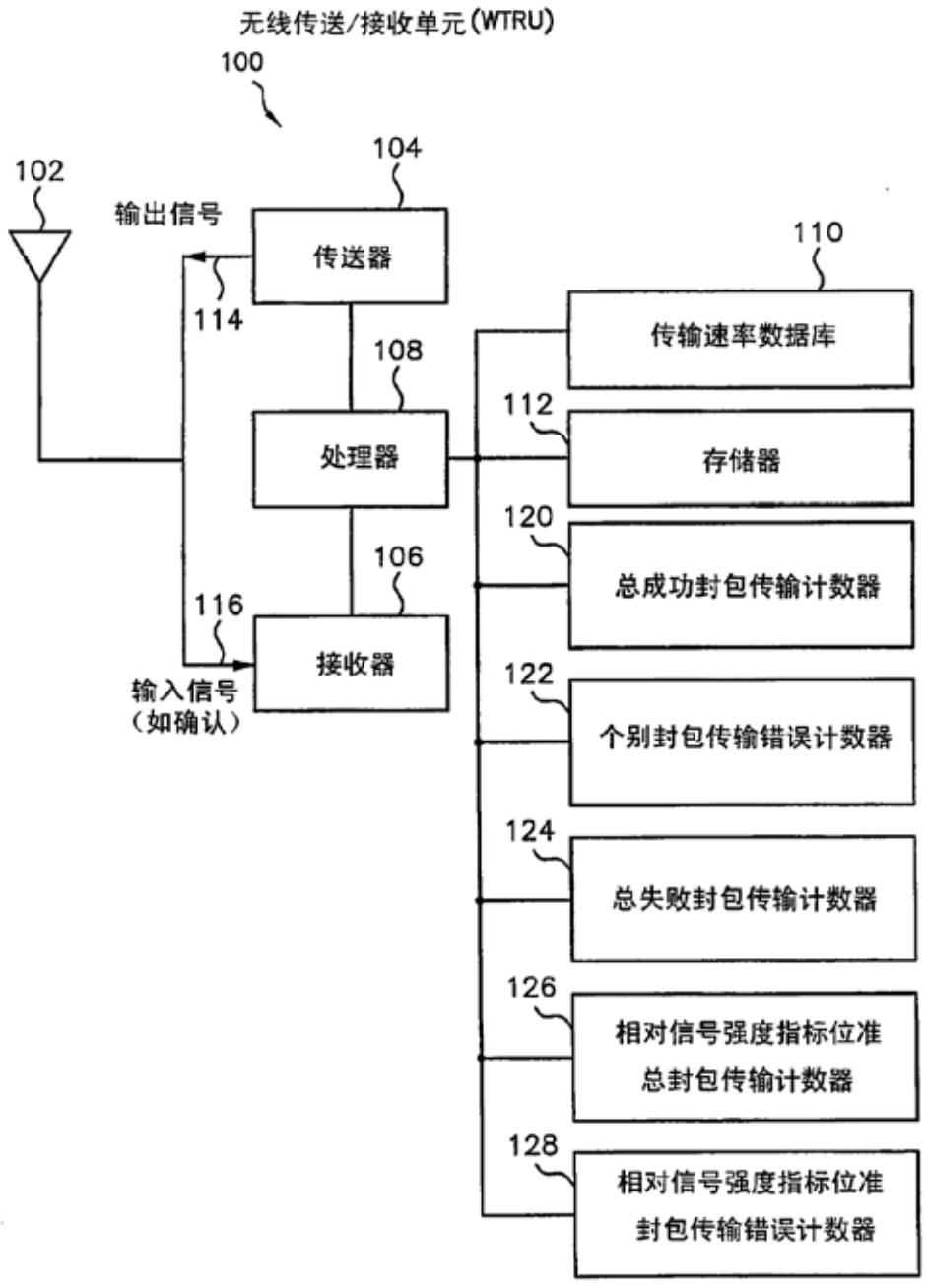


图 2

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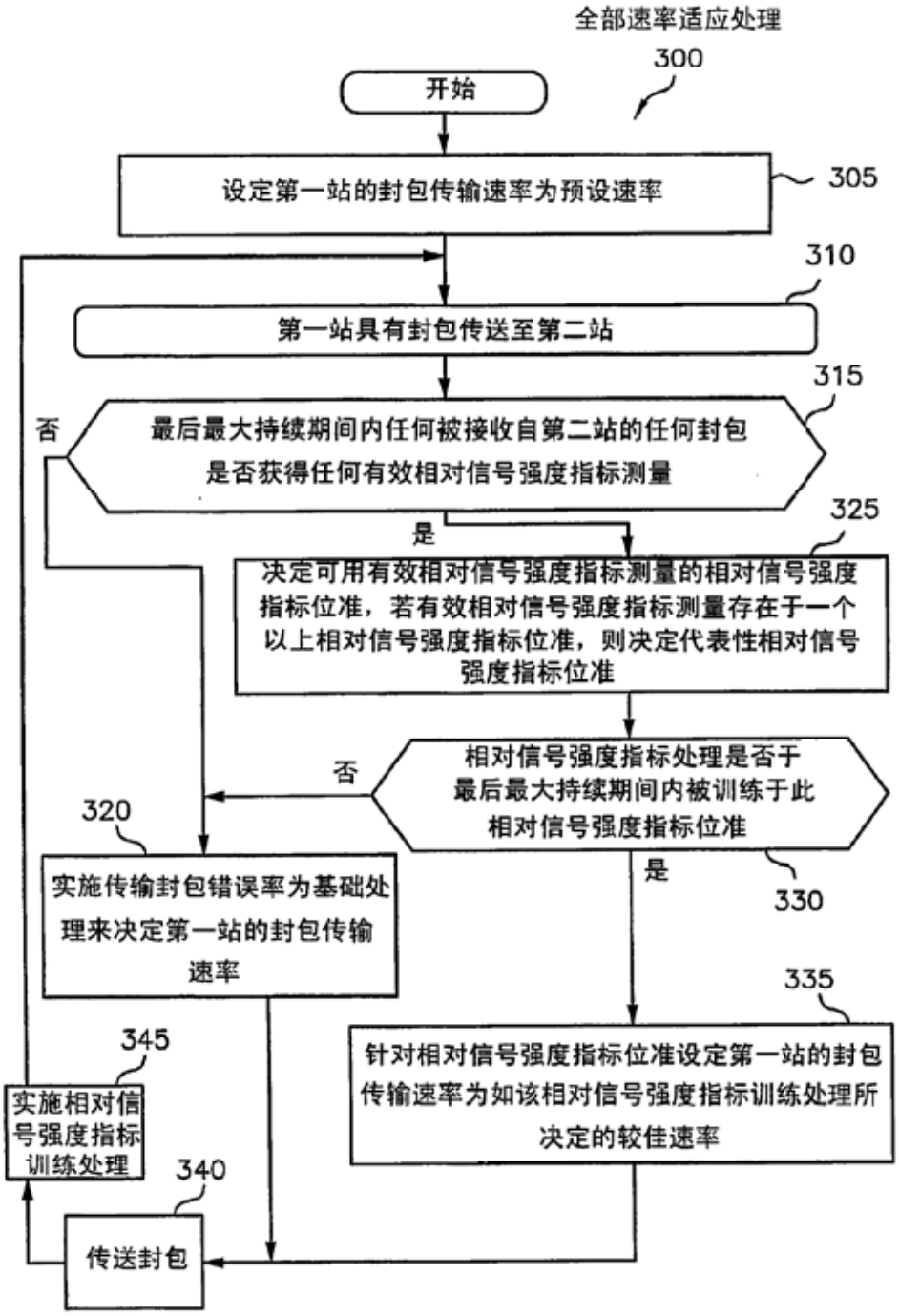


图 3

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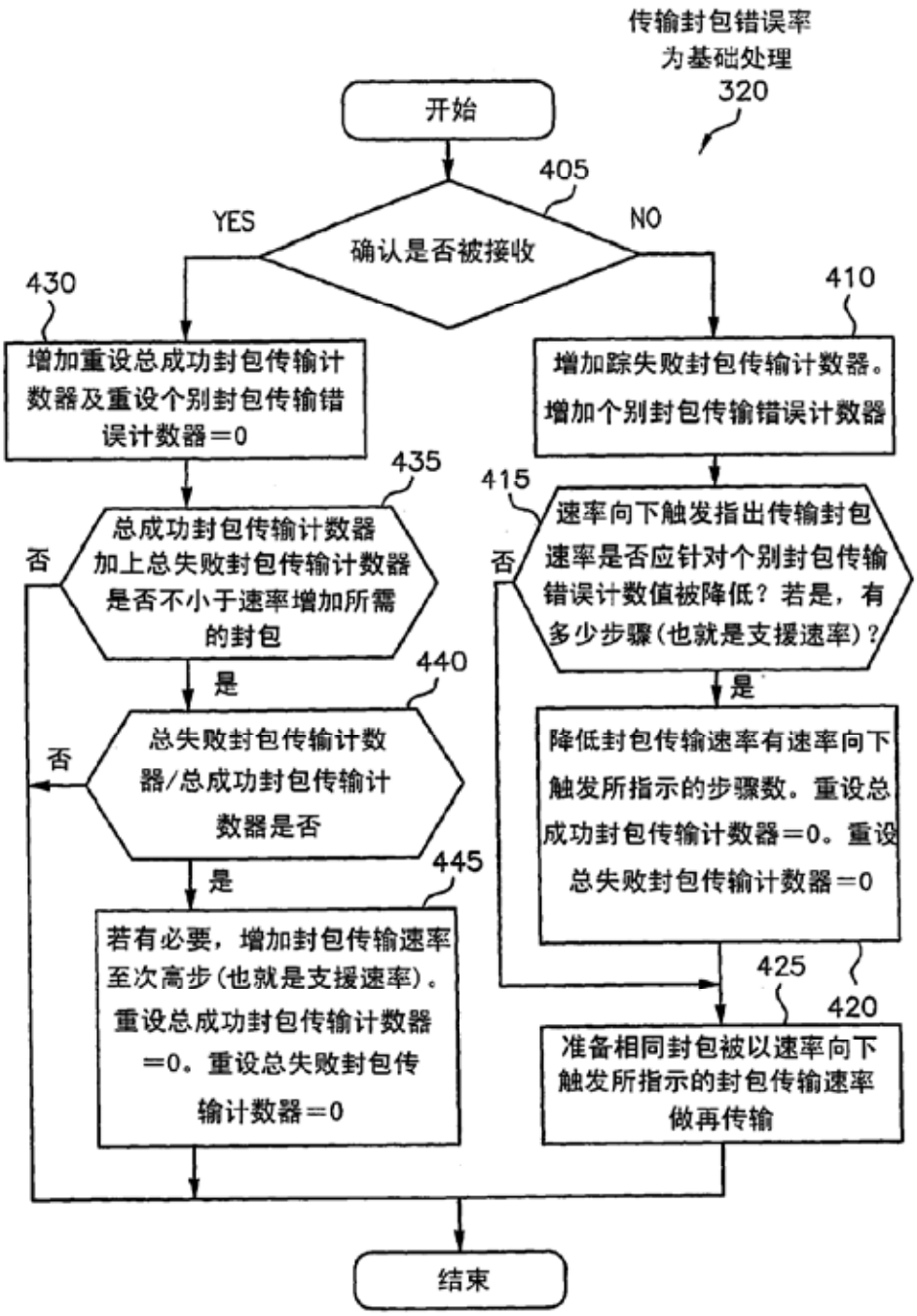


图 4

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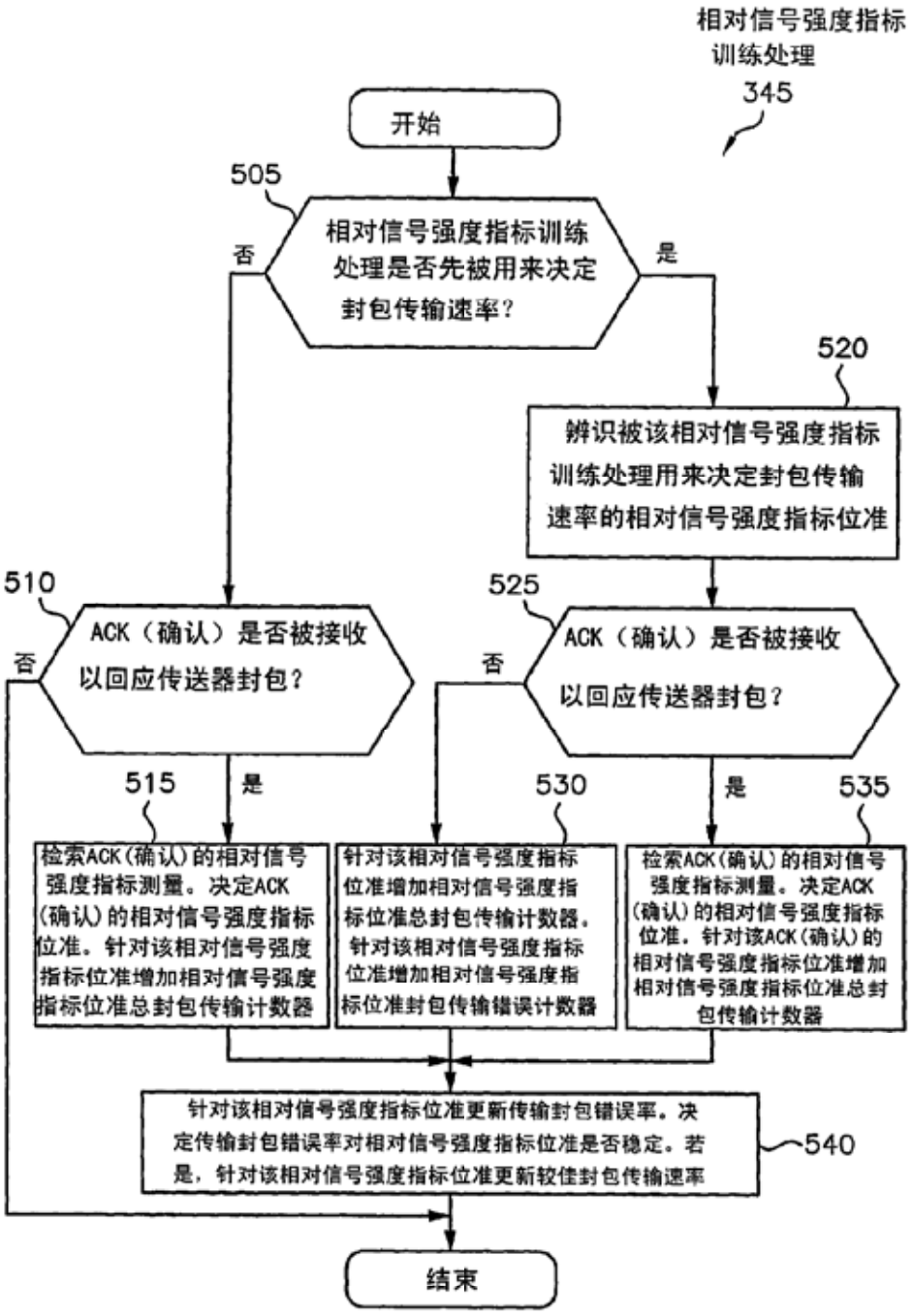


图 5

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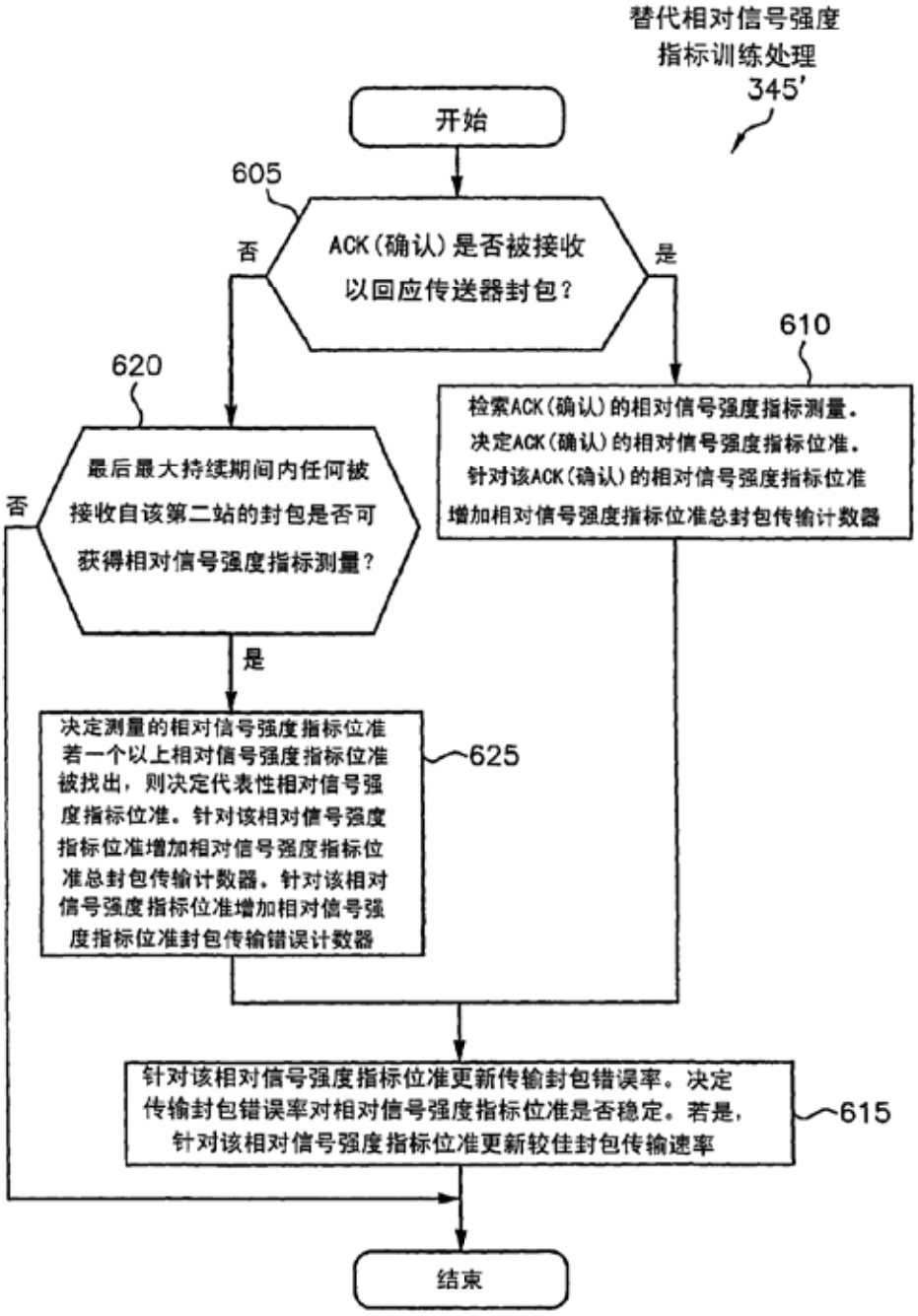


图 6

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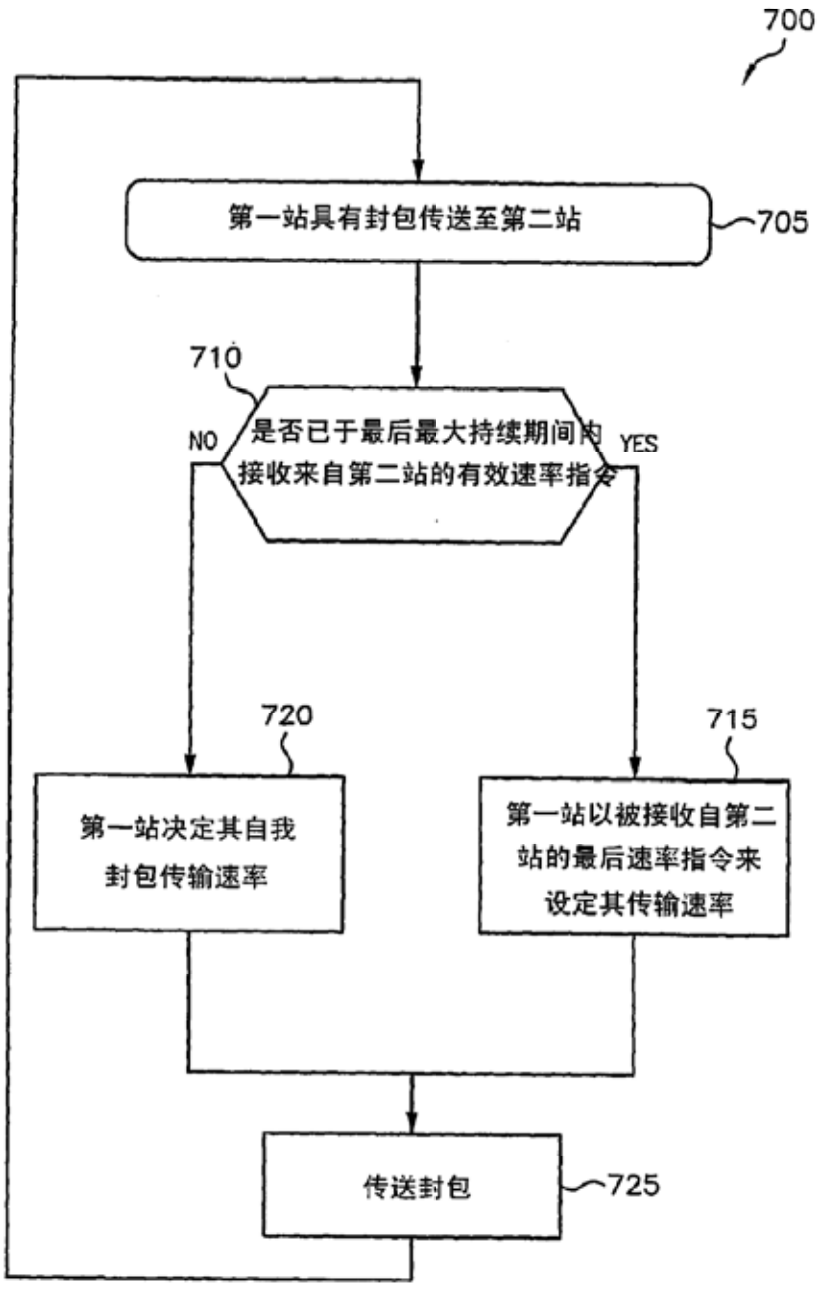


图 7

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PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION**	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
8241P055PCT		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/US2011/063326	05/12/2011	
Applicant		
ADAPTIVE SPECTRUM AND SIGNAL ALIGNMENT, INC.		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 4 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1 **Basis of the report**

a. With regard to the **language,** the international search was carried out on the basis of:

[X] the international application in the language in which it was filed

[ ] a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

b. [ ] This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).

c. [ ] With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.

2 [ ] **Certain claims were found unsearchable** (See Box No. II)

3. [ ] **Unity of invention is lacking** (see Box No III)

4. With regard to the **title,**

[X] the text is approved as submitted by the applicant

[ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

[X] the text is approved as submitted by the applicant

[ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority

6. With regard to the **drawings,**

a. the figure of the **drawings** to be published with the abstract is Figure No. 2A

[X] as suggested by the applicant

[ ] as selected by this Authority, because the applicant failed to suggest a figure

[ ] as selected by this Authority, because this figure better characterizes the invention

b. [ ] none of the figures is to be published with the abstract

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2011/063326

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04L12/56 H04L12/28
ADD.

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)
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)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2007/116411 A1 (LINK FUSION LTD [IL]; FERMON ISRAEL [IL]) 18 October 2007 (2007-10-18) the whole document	1-55
X	US 2011/110359 A1 (COOKE STEPHEN P [CA] ET AL) 12 May 2011 (2011-05-12) the whole document	1-55
X	EP 2 112 781 A1 (KONINKL KPN NV [NL]) 28 October 2009 (2009-10-28) the whole document	1,38,54, 55

-/--

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 February 2012	15/02/2012

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, Fax: (+31-70) 340-3016	Schneider, Gernot

Form PCT/ISA/210 (second sheet) (April 2005)

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2011/063326

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	BEES DUNCAN: "Flexible Bandwidth Services with DSL Bonding", INTERNET CITATION, 1 August 2002 (2002-08-01), pages 1-23, XP002495657, Retrieved from the Internet: URL:http://www.pmc-sierra.com/cgi-bin/document.pl?docnum=2021395 [retrieved on 2002-08-01] the whole document -----	1-55

1

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2011/063326

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2007116411 A1	18-10-2007	NONE	
US 2011110359 A1	12-05-2011	CA 2730020 A1	14-01-2010
		EP 2304893 A1	06-04-2011
		US 2011110359 A1	12-05-2011
		WO 2010003251 A1	14-01-2010
EP 2112781 A1	28-10-2009	NONE	

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PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2011/063326	05.12.2011	

International Patent Classification (IPC) or both national classification and IPC
INV. H04L12/56 H04L12/28

Applicant
ADAPTIVE SPECTRUM AND SIGNAL ALIGNMENT, INC.

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA:	Date of completion of this opinion	Authorized Officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Fax: +49 89 2399 - 4465	see form PCT/ISA/210	Schneider, Gernot Telephone No. +49 89 2399-7515

Form PCT/ISA/237 (Cover Sheet) (July 2009)

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed

   ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43bis.1(a))

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing filed or furnished:

   a. (means)

      ☐ on paper

      ☐ in electronic form

   b. (time)

      ☐ in the international application as filed

      ☐ together with the international application in electronic form

      ☐ subsequently to this Authority for the purposes of search

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	
	No:	Claims	1-55
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-55
Industrial applicability (IA)	Yes:	Claims	1-55
	No:	Claims	

2. Citations and explanations

see separate sheet

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Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 The wording ("wherein the second WAN ..comprises the second WAN") of claim 4 is unclear, thereby rendering the definition of the subject-matter of said claim unclear (Article 6 PCT).

2 The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claim 1 is not new in the sense of Article 33(2) PCT.

2.1 The document 1 discloses (the references in parentheses applying to this document):

A system comprising:
a first Local Area Network (LAN) access device to establish a first LAN;(cf fig 3 Home network)
a second LAN access device to establish a second LAN operationally distinct from the first LAN (cf fig 3 other home networks for the building);
a first Wide Area Network (WAN) backhaul connection to provide the first LAN access device with WAN connectivity;(cf fig 4 a n DSL lines)
a second WAN backhaul connection to provide the second LAN access device with WAN connectivity, wherein each of the first WAN backhaul and the second WAN backhaul are physically distinct; (cf fig 4 a n DSL lines)
a traffic aggregation unit to form a logically bonded WAN interface over the first WAN backhaul and the second WAN backhaul,(cf fig 3 box 10; cf p 25 l 3 "In addition, system 10 can be configured to support other possible Loop bonding techniques that are used to implement DSL bonding according to the G.998 series of ITU-T Recommendations, which simply increases the data rate in proportion to the number of bonded lines.")

2.2 This corresponds to the wording of the present claim 1. Therefore the subject matter of claim 1 is not new and hence said claim does not fulfill The requirements of Article 33(2) PCT.

3 Dependent claims 2-37,39-53 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step, the reasons being as follows:

claim 2,13: Bandwidth sharing p12, l 1

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claim 3,7,8,20,32,35,36: cf D1 fig 3

claim 4,30: triple play to ISP: cf D1 p 10 l 2

claim 5,9,12: different IP addresses: implictly given by DHCP (cf D1 fig 9)

claim 6: different service provider (cf fig 7a)

claim 10: address translation: obvious for the skilled person as it is included in every home router

claim 11: VLAN IPTV,VOIP: cf D1 p24 third paragraph

claim 16: layer 3 bonding: obvious for the skilled person

claim 14: indirect communication link:cf D2 fig 3 ring topology

claim 15:backup path cf D2 fig 3

claim 17,35: separate aggregation unit Cf D1 fig 3

claim 18,26: integrated aggregation unit: cf D1 cf fig 7a

claim 21-25,27,28:WLAN services: cf D1 fig 4C

claim 31:WAN connection choices:cf D1 p 14 third par.

claim 33,34:layer 2 connection (cf fig 8a)

claim 37: deaggregation unit(cf fig 7a)

4 Document D1 discloses:

A method comprising:
establishing a first Local Area Network (LAN) via a first access device (cf fig 3 Home network);
establishing a second LAN via a second access device, wherein the second LAN is operationally distinct from the first LAN;(cf fig 3 other home networks for the building);
providing the first LAN access device with WAN connectivity via a first Wide Area Network (WAN) backhaul connection;(cf fig 4 a n DSL lines)
providing the second LAN access device with WAN connectivity via a second WAN backhaul connection, wherein each of the first WAN backhaul and the second WAN backhaul are physically distinct; (cf fig 4 a n DSL lines)and
forming a logically bonded WAN interface over the first WAN backhaul and the second WAN backhaul.(cf fig 3 box 10; cf p 25 l 3 "In addition, system 10 can be configured to support other possible Loop bonding techniques that are

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used to implement DSL bonding according to the G.998 series of IT-T Recommendations, which simply increases the data rate in proportion to the number of bonded lines.")

4.1 The references correspond to the wording of claim 38. Therefore, Claim 38 does not fulfill the requirements of Article 33(2) PCT.

5 Furthermore, the objections expressed in the preceding paragraphs in relation to claim 1 are also valid for the independent claims 54 and 55, which contain the corresponding features merely in terms of apparatus claims. Thus the subject matter of claims 54 and 55 does not appear to involve an inventive step, Article 33(3) PCT .

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Possible steps after receipt of the international search report (ISR) and written opinion of the International Searching Authority (WO-ISA)

General information	For all international applications filed on or after 01/01/2004 the competent ISA will establish an ISR. It is accompanied by the WO-ISA. Unlike the former written opinion of the IPEA (Rule 66.2 PCT), the WO-ISA is not meant to be responded to, but to be taken into consideration for further procedural steps. This document explains about the possibilities.
Amending claims under Art. 19 PCT	Within 2 months after the date of mailing of the ISR and the WO-ISA the applicant may file amended claims under Art. 19 PCT directly with the International Bureau of WIPO. The PCT reform of 2004 did not change this procedure. For further information please see Rule 46 PCT as well as form PCT/ISA/220 and the corresponding Notes to form PCT/ISA/220.
Filing a demand for international preliminary examination	In principle, the WO-ISA will be considered as the written opinion of the IPEA. This should, in many cases, make it unnecessary to file a demand for international preliminary examination. If the applicant nevertheless wishes to file a demand this must be done before expiry of 3 months after the date of mailing of the ISR/ WO-ISA or 22 months after priority date, whichever expires later (Rule 54bis PCT). Amendments under Art. 34 PCT can be filed with the IPEA as before, normally at the same time as filing the demand (Rule 66.1 (b) PCT). If a demand for international preliminary examination is filed and no comments/amendments have been received the WO-ISA will be transformed by the IPEA into an IPRP (International Preliminary Report on Patentability) which would merely reflect the content of the WO-ISA. The demand can still be withdrawn (Art. 37 PCT).
Filing informal comments	After receipt of the ISR/WO-ISA the applicant may file informal comments on the WO-ISA directly with the International Bureau of WIPO. These will be communicated to the designated Offices together with the IPRP (International Preliminary Report on Patentability) at 30 months from the priority date. Please also refer to the next box.
End of the international phase	At the end of the international phase the International Bureau of WIPO will transform the WO-ISA or, if a demand was filed, the written opinion of the IPEA into the IPRP, which will then be transmitted together with possible informal comments to the designated Offices. The IPRP replaces the former IPER (international preliminary examination report).
Relevant PCT Rules and more information	Rule 43 PCT, Rule 43bis PCT, Rule 44 PCT, Rule 44bis PCT, PCT Newsletter 12/2003, OJ 11/2003, OJ 12/2003

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XS CPRTENFRDE

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION**	see Form PCT/ISA/220 as well as, where applicable, item 5 below.
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/US2011/060265	10/11/2011	
Applicant		
ASSIA, INC.		

This international search report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This international search report consists of a total of 4 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**
   a. With regard to the **language,** the international search was carried out on the basis of:
      [X] the international application in the language in which it was filed
      [ ] a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))
   b. [ ] This international search report has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43.6*bis*(a)).
   c. [ ] With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, see Box No. I.
2. [ ] **Certain claims were found unsearchable** (See Box No. II)
3. [ ] **Unity of invention is lacking** (see Box No III)
4. With regard to the **title,**
   [X] the text is approved as submitted by the applicant
   [ ] the text has been established by this Authority to read as follows:
5. With regard to the **abstract,**
   [X] the text is approved as submitted by the applicant
   [ ] the text has been established, according to Rule 38.2, by this Authority as it appears in Box No. IV. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority
6. With regard to the **drawings,**
   a. the figure of the **drawings** to be published with the abstract is Figure No. 4
      [X] as suggested by the applicant
      [ ] as selected by this Authority, because the applicant failed to suggest a figure
      [ ] as selected by this Authority, because this figure better characterizes the invention
   b. [ ] none of the figures is to be published with the abstract

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2011/060265

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04L1/00 H04L1/20
ADD.

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)
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 practicable, search terms used)
EPO-Internal, WPI Data, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2007/136337 A2 (ERICSSON TELEFON AB L M [SE]) 29 November 2007 (2007-11-29) page 2, lines 7-9,19-24 page 4, lines 27-35 page 5, lines 7-18,23-25 page 5, line 32 - page 6, line 2 page 6, lines 17-22 page 7, lines 9-12,28-30 page 8, lines 17-37 page 12, lines 1-5 page 16, lines 21-28 claim 39 figure 1 -/--	1-5, 7-14, 16-21, 23-25, 27, 29-39, 41-48, 50-52

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 June 2012	21/06/2012

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, Fax: (+31-70) 340-3016	Meister, Mark

1

Form PCT/ISA/210 (second sheet) (April 2005)

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2011/060265

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.

X	US 7 840 220 B1 (MITCHELL JAMES P [US]) 23 November 2010 (2010-11-23)	1-5, 7-14, 16-21, 23-27, 29-39, 41-48, 50-52
	column 5, lines 13-31 column 5, line 62 - column 6, line 47 column 6, line 54 - column 7, line 6 column 7, line 19 - column 8, line 11 figures 2,3	

A	WO 2011/079612 A1 (ZTE CORP [CN]; ZHANG QINGHONG [CN]; LI HANG [CN]) 7 July 2011 (2011-07-07) the whole document	1-52
L	-& EP 2 426 983 A1 (ZTE CORP [CN]) 7 March 2012 (2012-03-07) paragraphs [0004] - [0010] paragraphs [0012], [0013] paragraphs [0020] - [0024] paragraph [0026] paragraphs [0034] - [0036] figure 1	1-52

1

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Page #1332

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2011/060265

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2007136337 A2	29-11-2007	CN 101449503 A	03-06-2009
		EP 2020111 A2	04-02-2009
		JP 2009538559 A	05-11-2009
		TW 200805931 A	16-01-2008
		US 2007275665 A1	29-11-2007
		US 2010183064 A1	22-07-2010
		US 2011105046 A1	05-05-2011
		WO 2007136337 A2	29-11-2007
US 7840220 B1	23-11-2010	NONE	
WO 2011079612 A1	07-07-2011	AU 2010338867 A1	22-12-2011
		CN 101765161 A	30-06-2010
		EP 2426983 A1	07-03-2012
		WO 2011079612 A1	07-07-2011
EP 2426983 A1	07-03-2012	AU 2010338867 A1	22-12-2011
		CN 101765161 A	30-06-2010
		EP 2426983 A1	07-03-2012
		WO 2011079612 A1	07-07-2011

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PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2011/060265	10.11.2011	

International Patent Classification (IPC) or both national classification and IPC
INV. H04L1/00 H04L1/20

Applicant
ASSIA, INC.

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notifed the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA:	Date of completion of this opinion	Authorized Officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Fax: +49 89 2399 - 4465	see form PCT/ISA/210	Meister, Mark Telephone No. +49 89 2399-0

Form PCT/ISA/237 (Cover Sheet) (July 2009)

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☑ the international application in the language in which it was filed

   ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43bis.1(a))

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing filed or furnished:

   a. (means)

      ☐ on paper

      ☐ in electronic form

   b. (time)

      ☐ in the international application as filed

      ☐ together with the international application in electronic form

      ☐ subsequently to this Authority for the purposes of search

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	6, 7, 15, 22-24, 28, 40, 41, 49, 50
	No:	Claims	1-5, 8-14, 16-21, 25-27, 29-39, 42-48, 51, 52
Inventive step (IS)	Yes:	Claims	6, 15, 22, 28, 40, 49
	No:	Claims	1-5, 7-14, 16-21, 23-27, 29-39, 41-48, 50-52
Industrial applicability (IA)	Yes:	Claims	1-52
	No:	Claims	

2. Citations and explanations

see separate sheet

Charter Communications, Inc.
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Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

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Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following documents:

D1 WO 2007/136337 A2 (ERICSSON TELEFON AB L M [SE]) 29 November 2007 (2007-11-29)

D2 US 7 840 220 B1 (MITCHELL JAMES P [US]) 23 November 2010 (2010-11-23)

2 The present application does not meet the criteria of Article 33(2) PCT, because the subject-matter of the independent claims is not new. Reasons follow.

2.1 D1 discloses (the references in parenthesis applying to this document):

A method for optimizing performance (page 2, lines 7-9 and 19-24: according to the method of D1, CQI for link adaptation is generated as a function of long-term propagation channel conditions when short-term propagation channel estimates are not reliable. This way the performance of the communication unit(s) is optimized) of one or more communication units (page 5, lines 7-18, page 7, lines 9-12, page 16, lines 26-28, figure 1, reference sign 12) by a remote server (page 5, lines 23-25, page 7, lines 9-12, figure 1, reference sign 10: the base station 10 can be seen as a remote server), the method comprising:
collecting data from the one or more communication units (according to D1, different types of data concerning the wireless communication devices can be collected by the base station: information on fast/slow fading, page 4, lines 31-35, page 16, lines 21-23, claim 39, relative motion with respect to the base station, page 6, lines 17-21, identification number of the devices, page 7, lines 28-30, location of the devices, page 6, lines 20-22);
generating a policy, for each of the one or more communication units (page 16, lines 26-28), based on the collected data (page 1, lines 27-35, page 5, line 32, page 6, line 2, page 8, lines 17-37, page 12, lines 1-5, page 16, lines 21-28: the

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first policy corresponds to a link adaptation mode in which the channel quality information is generated as a function of long-term propagation channel characteristics, e.g. NACK rate, while the second policy corresponds to a link adaptation mode in which the channel quality information is generated as a function of short-term channel estimates); and

sending the policy to each of the one or more communication units, wherein the policy comprises conditions for operation of the one or more communication units, wherein the one or more communication units implement the policy (page 7, lines 9-12, "a base station 10 in the wireless communication network can instruct one or more devices in a plurality of wireless communication devices 12 to feed back information that is compatible with the preferred operating mode") according to time-varying data (link adaptation is inherently performed according to time-varying data).

As all the features of claim 1 are disclosed in the same combination in D1, the subject-matter of claim 1 is not new (Article 33(2) PCT).

2.2 D2 discloses (the references in parenthesis applying to this document):

A method for optimizing performance of one or more communication units (figure 2, reference sign 12a: the communication unit is the DTV station 12a. There can be more than one DTV stations 12a, see column 8, line 6, "Some DTV stations 12a...") by a remote server (column 5, lines 13-31, figure 2, reference sign 13: the remote server is the EOC 13, which is connected to the DTV station(s) 12a via the WAN 18), the method comprising:

collecting data from the one or more communication units (column 7, line 19 - column 8, line 11: data, i.e. RF statistics over a geographic region, is collected by the EOC 13 during a field survey. The data can be collected from the mobile clients 16 but also from DTV stations 12a, see column 8, lines 6-9, "This data may be used for the field survey data...");

generating a policy, for each of the one or more communication units, based

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on the collected data (column 5, line 62 - column 6, line 47: a FEC policy is generated at the EOC 13 for the DTV station (s) on the basis of the data collected during the field survey); and
sending the policy to each of the one or more communication units (column 6, lines 39-41, "An assigned FEC method and strength is used with a data payload for broadcast over the DTV broadcast network 12 to the mobile client 16"), wherein the policy comprises conditions for operation of the one or more communication units, wherein the one or more communication units implement the policy (column 6, line 54 - column 7, line 6: the conditions for operation comprise link adaptation strategies) according to time-varying data (column 6, line 54 - column 7, line 6: the time-varying data correspond to the GPS position and speed of the mobile clients 16 and to time information).

As all the features of claim 1 are disclosed in the same combination in D2, the subject-matter of claim 1 is not new (Article 33(2) PCT).

2.3 The same applies to the corresponding independent claims 10, 27, 34 and 44, the subject-matter of which is thus also not new (Article 33(2) PCT).

2.4 D1 discloses (the references in parenthesis applying to this document):

A method for optimizing performance (page 2, lines 7-9 and 19-24: according to the method of D1, CQI for link adaptation is generated as a function of long-term propagation channel conditions when short-term propagation channel estimates are not reliable. This way the performance of the communication unit(s) is optimized) of one or more communication units (page 5, lines 7-18, page 7, lines 9-12, page 16, lines 26-28, figure 1, reference sign 12), the method comprising:
sending data from one or more communication units to a remote server (according to D1, different types of data concerning the wireless communication devices can be sent to the base station, which can be seen as a remote server: information on fast/slow fading, page 4, lines 31-35, page 16, lines 21-23, claim 39, relative motion with respect to the base station, page 6, lines 17-21,

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identification number of the devices, page 7, lines 28-30, location of the devices, page 6, lines 20-22):
receiving a policy from the remote server (page 7, lines 9-12, "a base station 10 in the wireless communication network can instruct one or more devices in a plurality of wireless communication devices 12 to feed back information that is compatible with the preferred operating mode"), wherein the policy comprises conditions for operation of the one or more communication units (page 1, lines 27-35, page 5, line 32, page 6, line 2, page 8, lines 17-37, page 12, lines 1-5, page 16, lines 21-28: the first policy corresponds to a link adaptation mode in which the channel quality information to be computed by the wireless communication devices is generated as a function of long-term propagation channel characteristics, e.g. NACK rate, while the second policy corresponds to a link adaptation mode in which the channel quality information is generated as a function of short-term channel estimates); and
executing the policy (implicit) by implementing one of first and second algorithms (the two algorithms correspond to the above mentioned two link adaptation modes corresponding to fast-fading and slow-fading) based on the conditions and time-varying data (link adaptation is inherently performed according to time-varying data).

As all the features of claim 17 are disclosed in the same combination in D1, the subject-matter of claim 17 is not new (Article 33(2) PCT).

2.5 D2 discloses (the references in parenthesis applying to this document):

A method for optimizing performance of one or more communication units (figure 2, reference sign 12a: the communication unit is the DTV station 12a. There can be more than one DTV stations 12a, see column 8, line 6, "Some DTV stations 12a..."), the method comprising:
sending data from one or more communication units to a remote server (column 5, lines 13-31, figure 2, reference sign 13: the remote server is the EOC 13, which is connected to the DTV station(s) 12a via the WAN 18. Column 7, line 19 -

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column 8, line 11: data, i.e. RF statistics over a geographic region, is collected by the EOC 13 during a field survey. The data can be collected from the mobile clients 16 but also from DTV stations 12a, see column 8, lines 6-9, "This data may be used for the field survey data...");
receiving a policy from the remote server (column 6, lines 39-41, "An assigned FEC method and strength is used with a data payload for broadcast over the DTV broadcast network 12 to the mobile client 16"), wherein the policy comprises conditions for operation of the one or more communication units (column 6, line 54 - column 7, line 6: the conditions for operation comprise link adaptation strategies); and
executing the policy by implementing one of first and second algorithms (column 6, line 54 - column 7, line 6, figure 3: the link adaptation strategies corresponding to Zones 1 and 2 can be seen as first and second algorithms) based on the conditions and time-varying data (column 6, line 54 - column 7, line 6: the time-varying data corresponds to the GPS position and speed of the mobile clients 16 and to time information).

2.6 As all the features of claim 17 are disclosed in the same combination in D2, the subject-matter of claim 17 is not new (Article 33(2) PCT).

2.7 The same applies to the corresponding independent claim 27, the subject-matter of which is thus also not new (Article 33(2) PCT).

3 Dependent claims 2-5, 7-9, 11-14, 16, 18-21, 23-26, 29-33, 35-39, 41-43, 45-48, 50-52 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty (Article 33(2) PCT) and/or inventive step (Article 33(3) PCT), see the documents and the corresponding passages cited in the international search report.

4 The combination of the features of dependent claims 6, 15, 22, 28, 40 and 49 is neither known from, nor rendered obvious by, the available prior art. The reasons are as follows: the fact of generating the (software) code for an adaptation algorithm at the server and of sending the code to the communication unit(s) for being executed on the communication unit(s) allows to increase the flexibility and adaptability of the link adaptation policies to be used in the system (e.g. with respect to sending only link adaptation

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parameters as in D2). In other words, the link adaptation algorithms to be executed at the communication unit(s) can be better dynamically updated and adapted to the specific situations of the network and of each of the communication units. The generation of the (software) code for an adaptation algorithm at the server is neither disclosed nor suggested by the available documents of the prior art.

Re Item VIII

Certain observations on the international application

5 The expression "pseudo-code" used in claims 6, 15, 22, 28, 40 and 49 renders the subject-matter of these claims unclear (Article 6 PCT) for the following reasons:

5.1 Wikipedia (http://en.wikipedia.org/wiki/Pseudocode) gives the following definition of pseudo-code: "In computer science and numerical computation, pseudocode is an informal high-level description of the operating principle of a computer program or other algorithm. It uses the structural conventions of a programming language, but **is intended for human reading rather than machine reading**. Pseudocode typically omits details that are not essential for human understanding of the algorithm, such as variable declarations, system-specific code and some subroutines. The programming language is augmented with natural language description details, where convenient, or with compact mathematical notation. The purpose of using pseudocode is that it is easier for people to understand than conventional programming language code, and that it is an efficient and environment-independent description of the key principles of an algorithm. It is commonly used in textbooks and scientific publications that are documenting various algorithms, and also in planning of computer program development, for sketching out the structure of the program before the actual coding takes place. No standard for pseudocode syntax exists, as **a program in pseudocode is not an executable program**."

5.2 The following statements are in the description: "The pseudo-code may be coded in any software coding language that is executable by the communication unit" and "when the WiFi communication system 200 has the capability to decode and execute a pre-defined pseudo-code" (§ 0030, 0058, 0064). These statements clearly contradict the well-known, common meaning of "pseudo-code", as shown above. A pseudo-code is not executable by a processor. For this reason, the intended limitations for claims 6, 15, 22, 28, 40 and 49 are not clear, contrary to the requirements of Article 6 PCT.

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The expression "pseudo-code or code" used in claims 6, 15, 22, 28, 40 and 49 should have been changed into "software code" in order to meet the requirements of Article 6 PCT.

6 Claims 10, 12, 13, 14 refers to method steps to be implemented by the communication unit(s), even though claims 10, 12, 13, 14 refer to a machine-readable storage medium having computer executable instructions to be executed by the remote server. The intended limitations for claims 10, 12, 13, 14 are therefore not clear, contrary to the requirements of Article 6 PCT.

7 Claims 34, 36, 37, 38, 39 refers to apparatus features of the communication unit(s), even though claims 34, 36, 37, 38, 39 refer to the server apparatus. The intended limitations for claims 34, 36, 37, 38, 39 are therefore not clear, contrary to the requirements of Article 6 PCT.

8 Although claims 34 and 44 have been drafted as separate independent claims, they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought and/or in respect of the terminology used for the features of that subject-matter. The aforementioned claims therefore lack conciseness and as such do not meet the requirements of Article 6 PCT.

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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter I of the Patent Cooperation Treaty)

(PCT Rule 44*bis*)

Applicant's or agent's file reference 8241P054PCT	**FOR FURTHER ACTION**	See item 4 below
International application No. PCT/US2011/060265	International filing date *(day/month/year)* 10 November 2011 (10.11.2011)	Priority date *(day/month/year)*
International Patent Classification (8th edition unless older edition indicated) See relevant information in Form PCT/ISA/237		
Applicant ADAPTIVE SPECTRUM AND SIGNAL ALIGNMENT, INC.		

1. This international preliminary report on patentability (Chapter I) is issued by the International Bureau on behalf of the International Searching Authority under Rule 44 *bis*.1(a).

2. This REPORT consists of a total of 11 sheets, including this cover sheet.

   In the attached sheets, any reference to the written opinion of the International Searching Authority should be read as a reference to the international preliminary report on patentability (Chapter I) instead.

3. This report contains indications relating to the following items:

☒	Box No. I	Basis of the report
☐	Box No. II	Priority
☐	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
☐	Box No. IV	Lack of unity of invention
☒	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
☐	Box No. VI	Certain documents cited
☐	Box No. VII	Certain defects in the international application
☒	Box No. VIII	Certain observations on the international application

4. The International Bureau will communicate this report to designated Offices in accordance with Rules 44*bis*.3(c) and 93*bis*.1 but not, except where the applicant makes an express request under Article 23(2), before the expiration of 30 months from the priority date (Rule 44*bis* .2).

	Date of issuance of this report 13 May 2014 (13.05.2014)
The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No. +41 22 338 82 70	Authorized officer Simin Baharlou e-mail: pt09.pct@wipo.int

Form PCT/IB/373 (January 2004)

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PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2011/060265	10.11.2011	

International Patent Classification (IPC) or both national classification and IPC
INV. H04L1/00 H04L1/20

Applicant
ASSIA, INC.

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notifed the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA:	Date of completion of this opinion	Authorized Officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Fax: +49 89 2399 - 4465	see form PCT/ISA/210	Meister, Mark Telephone No. +49 89 2399-0

Form PCT/ISA/237 (Cover Sheet) (July 2009)

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☑ the international application in the language in which it was filed

   ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43bis.1(a))

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing filed or furnished:

   a. (means)

      ☐ on paper

      ☐ in electronic form

   b. (time)

      ☐ in the international application as filed

      ☐ together with the international application in electronic form

      ☐ subsequently to this Authority for the purposes of search

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	6, 7, 15, 22-24, 28, 40, 41, 49, 50
	No:	Claims	1-5, 8-14, 16-21, 25-27, 29-39, 42-48, 51, 52
Inventive step (IS)	Yes:	Claims	6, 15, 22, 28, 40, 49
	No:	Claims	1-5, 7-14, 16-21, 23-27, 29-39, 41-48, 50-52
Industrial applicability (IA)	Yes:	Claims	1-52
	No:	Claims	

2. Citations and explanations

see separate sheet

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Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

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Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following documents:

D1 WO 2007/136337 A2 (ERICSSON TELEFON AB L M [SE]) 29 November 2007 (2007-11-29)

D2 US 7 840 220 B1 (MITCHELL JAMES P [US]) 23 November 2010 (2010-11-23)

2 The present application does not meet the criteria of Article 33(2) PCT, because the subject-matter of the independent claims is not new. Reasons follow.

2.1 D1 discloses (the references in parenthesis applying to this document):

A method for optimizing performance (page 2, lines 7-9 and 19-24: according to the method of D1, CQI for link adaptation is generated as a function of long-term propagation channel conditions when short-term propagation channel estimates are not reliable. This way the performance of the communication unit(s) is optimized) of one or more communication units (page 5, lines 7-18, page 7, lines 9-12, page 16, lines 26-28, figure 1, reference sign 12) by a remote server (page 5, lines 23-25, page 7, lines 9-12, figure 1, reference sign 10: the base station 10 can be seen as a remote server), the method comprising:
collecting data from the one or more communication units (according to D1, different types of data concerning the wireless communication devices can be collected by the base station: information on fast/slow fading, page 4, lines 31-35, page 16, lines 21-23, claim 39, relative motion with respect to the base station, page 6, lines 17-21, identification number of the devices, page 7, lines 28-30, location of the devices, page 6, lines 20-22);
generating a policy, for each of the one or more communication units (page 16, lines 26-28), based on the collected data (page 1, lines 27-35, page 5, line 32, page 6, line 2, page 8, lines 17-37, page 12, lines 1-5, page 16, lines 21-28: the

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first policy corresponds to a link adaptation mode in which the channel quality information is generated as a function of long-term propagation channel characteristics, e.g. NACK rate, while the second policy corresponds to a link adaptation mode in which the channel quality information is generated as a function of short-term channel estimates); and
sending the policy to each of the one or more communication units, wherein the policy comprises conditions for operation of the one or more communication units, wherein the one or more communication units implement the policy (page 7, lines 9-12, "a base station 10 in the wireless communication network can instruct one or more devices in a plurality of wireless communication devices 12 to feed back information that is compatible with the preferred operating mode") according to time-varying data (link adaptation is inherently performed according to time-varying data).

As all the features of claim 1 are disclosed in the same combination in D1, the subject-matter of claim 1 is not new (Article 33(2) PCT).

2.2 D2 discloses (the references in parenthesis applying to this document):

A method for optimizing performance of one or more communication units (figure 2, reference sign 12a: the communication unit is the DTV station 12a. There can be more than one DTV stations 12a, see column 8, line 6, "Some DTV stations 12a...") by a remote server (column 5, lines 13-31, figure 2, reference sign 13: the remote server is the EOC 13, which is connected to the DTV station(s) 12a via the WAN 18), the method comprising:
collecting data from the one or more communication units (column 7, line 19 - column 8, line 11: data, i.e. RF statistics over a geographic region, is collected by the EOC 13 during a field survey. The data can be collected from the mobile clients 16 but also from DTV stations 12a, see column 8, lines 6-9, "This data may be used for the field survey data...");
generating a policy, for each of the one or more communication units, based

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on the collected data (column 5, line 62 - column 6, line 47: a FEC policy is generated at the EOC 13 for the DTV station (s) on the basis of the data collected during the field survey); and
sending the policy to each of the one or more communication units (column 6, lines 39-41, "An assigned FEC method and strength is used with a data payload for broadcast over the DTV broadcast network 12 to the mobile client 16"), wherein the policy comprises conditions for operation of the one or more communication units, wherein the one or more communication units implement the policy (column 6, line 54 - column 7, line 6: the conditions for operation comprise link adaptation strategies) according to time-varying data (column 6, line 54 - column 7, line 6: the time-varying data correspond to the GPS position and speed of the mobile clients 16 and to time information).

As all the features of claim 1 are disclosed in the same combination in D2, the subject-matter of claim 1 is not new (Article 33(2) PCT).

2.3 The same applies to the corresponding independent claims 10, 27, 34 and 44, the subject-matter of which is thus also not new (Article 33(2) PCT).

2.4 D1 discloses (the references in parenthesis applying to this document):

A method for optimizing performance (page 2, lines 7-9 and 19-24: according to the method of D1, CQI for link adaptation is generated as a function of long-term propagation channel conditions when short-term propagation channel estimates are not reliable. This way the performance of the communication unit(s) is optimized) of one or more communication units (page 5, lines 7-18, page 7, lines 9-12, page 16, lines 26-28, figure 1, reference sign 12), the method comprising:
sending data from one or more communication units to a remote server (according to D1, different types of data concerning the wireless communication devices can be sent to the base station, which can be seen as a remote server: information on fast/slow fading, page 4, lines 31-35, page 16, lines 21-23, claim 39, relative motion with respect to the base station, page 6, lines 17-21,

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identification number of the devices, page 7, lines 28-30, location of the devices, page 6, lines 20-22):
receiving a policy from the remote server (page 7, lines 9-12, "a base station 10 in the wireless communication network can instruct one or more devices in a plurality of wireless communication devices 12 to feed back information that is compatible with the preferred operating mode"), wherein the policy comprises conditions for operation of the one or more communication units (page 1, lines 27-35, page 5, line 32, page 6, line 2, page 8, lines 17-37, page 12, lines 1-5, page 16, lines 21-28: the first policy corresponds to a link adaptation mode in which the channel quality information to be computed by the wireless communication devices is generated as a function of long-term propagation channel characteristics, e.g. NACK rate, while the second policy corresponds to a link adaptation mode in which the channel quality information is generated as a function of short-term channel estimates); and
executing the policy (implicit) by implementing one of first and second algorithms (the two algorithms correspond to the above mentioned two link adaptation modes corresponding to fast-fading and slow-fading) based on the conditions and time-varying data (link adaptation is inherently performed according to time-varying data).

As all the features of claim 17 are disclosed in the same combination in D1, the subject-matter of claim 17 is not new (Article 33(2) PCT).

2.5 D2 discloses (the references in parenthesis applying to this document):

A method for optimizing performance of one or more communication units (figure 2, reference sign 12a: the communication unit is the DTV station 12a. There can be more than one DTV stations 12a, see column 8, line 6, "Some DTV stations 12a..."), the method comprising:
sending data from one or more communication units to a remote server (column 5, lines 13-31, figure 2, reference sign 13: the remote server is the EOC 13, which is connected to the DTV station(s) 12a via the WAN 18. Column 7, line 19 -

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column 8, line 11: data, i.e. RF statistics over a geographic region, is collected by the EOC 13 during a field survey. The data can be collected from the mobile clients 16 but also from DTV stations 12a, see column 8, lines 6-9, "This data may be used for the field survey data...");

receiving a policy from the remote server (column 6, lines 39-41, "An assigned FEC method and strength is used with a data payload for broadcast over the DTV broadcast network 12 to the mobile client 16"), wherein the policy comprises conditions for operation of the one or more communication units (column 6, line 54 - column 7, line 6: the conditions for operation comprise link adaptation strategies); and

executing the policy by implementing one of first and second algorithms (column 6, line 54 - column 7, line 6, figure 3: the link adaptation strategies corresponding to Zones 1 and 2 can be seen as first and second algorithms) based on the conditions and time-varying data (column 6, line 54 - column 7, line 6: the time-varying data corresponds to the GPS position and speed of the mobile clients 16 and to time information).

2.6 As all the features of claim 17 are disclosed in the same combination in D2, the subject-matter of claim 17 is not new (Article 33(2) PCT).

2.7 The same applies to the corresponding independent claim 27, the subject-matter of which is thus also not new (Article 33(2) PCT).

3 Dependent claims 2-5, 7-9, 11-14, 16, 18-21, 23-26, 29-33, 35-39, 41-43, 45-48, 50-52 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty (Article 33(2) PCT) and/or inventive step (Article 33(3) PCT), see the documents and the corresponding passages cited in the international search report.

4 The combination of the features of dependent claims 6, 15, 22, 28, 40 and 49 is neither known from, nor rendered obvious by, the available prior art. The reasons are as follows: the fact of generating the (software) code for an adaptation algorithm at the server and of sending the code to the communication unit(s) for being executed on the communication unit(s) allows to increase the flexibility and adaptability of the link adaptation policies to be used in the system (e.g. with respect to sending only link adaptation

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parameters as in D2). In other words, the link adaptation algorithms to be executed at the communication unit(s) can be better dynamically updated and adapted to the specific situations of the network and of each of the communication units. The generation of the (software) code for an adaptation algorithm at the server is neither disclosed nor suggested by the available documents of the prior art.

Re Item VIII

Certain observations on the international application

5 The expression "pseudo-code" used in claims 6, 15, 22, 28, 40 and 49 renders the subject-matter of these claims unclear (Article 6 PCT) for the following reasons:

5.1 Wikipedia (http://en.wikipedia.org/wiki/Pseudocode) gives the following definition of pseudo-code: "In computer science and numerical computation, pseudocode is an informal high-level description of the operating principle of a computer program or other algorithm. It uses the structural conventions of a programming language, but **is intended for human reading rather than machine reading**. Pseudocode typically omits details that are not essential for human understanding of the algorithm, such as variable declarations, system-specific code and some subroutines. The programming language is augmented with natural language description details, where convenient, or with compact mathematical notation. The purpose of using pseudocode is that it is easier for people to understand than conventional programming language code, and that it is an efficient and environment-independent description of the key principles of an algorithm. It is commonly used in textbooks and scientific publications that are documenting various algorithms, and also in planning of computer program development, for sketching out the structure of the program before the actual coding takes place. No standard for pseudocode syntax exists, as **a program in pseudocode is not an executable program**."

5.2 The following statements are in the description: "The pseudo-code may be coded in any software coding language that is executable by the communication unit" and "when the WiFi communication system 200 has the capability to decode and execute a pre-defined pseudo-code" (§ 0030, 0058, 0064). These statements clearly contradict the well-known, common meaning of "pseudo-code", as shown above. A pseudo-code is not executable by a processor. For this reason, the intended limitations for claims 6, 15, 22, 28, 40 and 49 are not clear, contrary to the requirements of Article 6 PCT.

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