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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/257,621	01/13/2015	8934359	AFD111101442-US	1450

95957 7590 12/23/2014

Ling Wu
1107 Bettstrail Way
Potomac, MD 20854

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

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

The Patent Term Adjustment is 474 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

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

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

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

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

Dezhi Zhang, Shenzhen City, CHINA;
Marek Hajduczenia, Fiaes, PORTUGAL;
Liquan Yuan, Shenzhen City, CHINA;
Weiliang Zhang, Shenzhen City, CHINA;

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Nokia of America Corporation *et al.*
Exhibit 1002
IPR2024-00900, USPN 8,934,359
1 of 441

Receipt date: 04/02/2012 13257621 - GAU: 2463

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	13257621
Filing Date	2011-09-20
First Named Inventor	Dezhi ZHANG et al.
Art Unit	
Examiner Name	Unknown
Attorney Docket Number	AFD111101442-US

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					

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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
Change(s) applied to document, /M.C.E./ 12/10/2014	1	20020051455	A1	2002-05-02	KOREA ELECTRONICS&TELECOM RES INST Lee, et al.	

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

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	101346958	CN	A	2009-01-14	NTT DOCOMO INC		☐
	2	1677898	CN	A	2005-10-05	HITACHI INTERNAT ELECTRIC K K		☐

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Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13257621	ZHANG ET AL.
	Examiner	**Art Unit**
	PETER SOLINSKY	2463

CPC						
Symbol					**Type**	**Version**
H04L		12	/	2861	F	2013-01-01
H04B		10	/	0793	I	2013-01-01
H04L		12	/	2885	I	2013-01-01
H04L		12	/	5695	I	2013-01-01
H04Q		11	/	0066	A	2013-01-01
H04Q		11	/	0067	I	2013-01-01
H04Q		2011	/	0064	A	2013-01-01
H04Q		2011	/	0084	A	2013-01-01
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CPC Combination Sets							
Symbol				**Type**	**Set**	**Ranking**	**Version**
			/				
			/				

/PETER SOLINSKY/ Examiner.Art Unit 2463	10/17/2014	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	15	
/MELVIN MARCELO/ Primary Examiner.Art Unit 2463	10/17/2014	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	3

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13257621	ZHANG ET AL.
	Examiner	**Art Unit**
	PETER SOLINSKY	2463

US ORIGINAL CLASSIFICATION		INTERNATIONAL CLASSIFICATION										
CLASS	SUBCLASS	CLAIMED					NON-CLAIMED					
370	252	H	0	4	L	12 / 44 (2006.01)						

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

/PETER SOLINSKY/ Examiner.Art Unit 2463	10/17/2014	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	15	
/MELVIN MARCELO/ Primary Examiner.Art Unit 2463	10/17/2014	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	3

Exhibit 1002
IPR2024-00900, USPN 8,934,359
4 of 441

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13257621	ZHANG ET AL.
	Examiner	**Art Unit**
	PETER SOLINSKY	2463

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

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	9	17												
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11	16														

/PETER SOLINSKY/ Examiner.Art Unit 2463	10/17/2014	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	15	
/MELVIN MARCELO/ Primary Examiner.Art Unit 2463	10/17/2014	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	3

PTO/SB/08a (01-10)
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(Not for submission under 37 CFR 1.99)

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Filing Date	2011-09-20
First Named Inventor	Dezhi ZHANG et al.
Art Unit	
Examiner Name	Unknown
Attorney Docket Number	AFD111101442-US

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					

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U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20020051455	A1	2002-05-02	KOREA ELECTRONICS&TELECOM RES INST	

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

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	101346958	CN	A	2009-01-14	NTT DOCOMO INC		☐
	2	1677898	CN	A	2005-10-05	HITACHI INTERNAT ELECTRIC K K		☐

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EFS Web 2.1.17 ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /P.S./

Receipt date: 04/02/2012	Application Number	13257621 13257621 - GAU: 2463
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Filing Date	2011-09-20
	First Named Inventor	Dezhi ZHANG et al.
	Art Unit	
	Examiner Name	Unknown
	Attorney Docket Number	AFD111101442-US

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 for PCT/CN2010/073773 dated August 24, 2010	☐

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

EXAMINER SIGNATURE

Examiner Signature	/Peter Solinsky/	Date Considered	12/08/2014

*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.

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

Receipt date: 04/02/2012	Application Number	13257621 13257621 - GAU: 2463
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Filing Date	2011-09-20
	First Named Inventor	Dezhi ZHANG et al.
	Art Unit	
	Examiner Name	Unknown
	Attorney Docket Number	AFD111101442-US

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	/Ling Wu/	Date (YYYY-MM-DD)	2012-04-01
Name/Print	Ling Wu	Registration Number	66304

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.**

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

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.

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

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13257621	ZHANG ET AL.
	Examiner	Art Unit
	PETER SOLINSKY	2463

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

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

CLAIM		DATE								
Final	Original	10/17/2014								
1	1	=								
-	2	-								
2	3	=								
3	4	=								
4	5	=								
5	6	=								
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13	11	=								
14	12	=								
-	13	-								
15	14	=								
8	15	=								
11	16	=								
9	17	=								
10	18	=								

PART B - FEE(S) TRANSMITTAL

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

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

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

05957 7590 10/21/2014
Ling Wu
1107 Bettstrail Way
Potomac, MD 20854

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

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

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

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/257,621	04/02/2012	Dezhi Zhang	AFD111101442-US	1459

TITLE OF INVENTION: Method and Passive Optical Network System for Managing Uplink Burst Overhead Parameters

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$960	$0	$0	$960	01/21/2015

EXAMINER	ART UNIT	CLASS-SUBCLASS
SOLINSKY, PETER G	2463	370-252000

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

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

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)
PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.
(A) NAME OF ASSIGNEE: ZTE CORPORATION
(B) RESIDENCE: (CITY and STATE OR COUNTRY): Shenzhen City, Guangdong Province P.R. China
Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☑ Corporation or other private group entity ☐ Government

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

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
☐ A check is enclosed.
☐ Payment by credit card. Form PTO-2038 is attached.
☑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number 50-4848 (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
☐ Applicant certifying micro entity status. See 37 CFR 1.29
NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
☐ Applicant asserting small entity status. See 37 CFR 1.27
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status
☐ Applicant changing to regular undiscounted fee status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature Ling Wu Date 12/4/2014
Typed or printed name Ling Wu Registration No. 66304

PTOL-85 Part B (10-13) Approved for use through 10/31/2013 OMB 0651-0033 U.S. Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

Exhibit 1002
IPR2024-00900, USPN 8,934,359
11 of 441

Electronic Patent Application Fee Transmittal

Application Number:	13257621
Filing Date:	02-Apr-2012
Title of Invention:	Method and Passive Optical Network System for Managing Uplink Burst Overhead Parameters
First Named Inventor/Applicant Name:	Dezhi Zhang
Filer:	Ling Wu
Attorney Docket Number:	AFD111101442-US

Filed as Large Entity

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

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Utility Appl Issue Fee	1501	1	960	960
Publ. Fee- Early, Voluntary, or Normal	1504	1	0	0

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

Electronic Acknowledgement Receipt

EFS ID:	20862558
Application Number:	13257621
International Application Number:	
Confirmation Number:	1450
Title of Invention:	Method and Passive Optical Network System for Managing Uplink Burst Overhead Parameters
First Named Inventor/Applicant Name:	Dezhi Zhang
Customer Number:	95957
Filer:	Ling Wu
Filer Authorized By:	
Attorney Docket Number:	AFD111101442-US
Receipt Date:	04-DEC-2014
Filing Date:	02-APR-2012
Time Stamp:	11:16:50
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	$960
RAM confirmation Number	10675
Deposit Account	505648
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)

1	Issue Fee Payment (PTO-85B)	PartB_Fees_Transmittal_AFD11 1101442-US.pdf	598865 35506d62eeb1416f471e409c38ae93116450743a	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	32150 bec7ca28262abf038e357e15b79ee85ba347a411	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	631015	

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

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

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

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

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

95957 7590 10/21/2014

Ling Wu
1107 Bettstrail Way
Potomac, MD 20854

EXAMINER
SOLINSKY, PETER G

ART UNIT	PAPER NUMBER
2463	

DATE MAILED: 10/21/2014

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/257,621	04/02/2012	Dezhi Zhang	AFD111101442-US	1450

TITLE OF INVENTION: Method and Passive Optical Network System for Managing Uplink Burst Overhead Parameters

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$960	$0	$0	$960	01/21/2015

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

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

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

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

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

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

PART B - FEE(S) TRANSMITTAL

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

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

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

95957 7590 10/21/2014

Ling Wu
1107 Bettstrail Way
Potomac, MD 20854

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

Certificate of Mailing or Transmission

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

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

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/257,621	04/02/2012	Dezhi Zhang	AFD111101442-US	1450

TITLE OF INVENTION: Method and Passive Optical Network System for Managing Uplink Burst Overhead Parameters

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$960	$0	$0	$960	01/21/2015

EXAMINER	ART UNIT	CLASS-SUBCLASS
SOLINSKY, PETER G	2463	370-252000

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

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

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

2. For printing on the patent front page, list

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

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

1 _____

2 _____

3 _____

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

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

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

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

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

❑ Issue Fee

❑ Publication Fee (No small entity discount permitted)

❑ Advance Order - # of Copies _____

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

❑ A check is enclosed.

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

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

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

❑ Applicant certifying micro entity status. See 37 CFR 1.29

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

❑ Applicant asserting small entity status. See 37 CFR 1.27

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

❑ Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

PTOL-85 Part B (10-13) Approved for use through 10/31/2013. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
13/257,621	04/02/2012	Dezhi Zhang	AFD111101442-US	1450

95957 7590 10/21/2014

Ling Wu
1107 Bettstrail Way
Potomac, MD 20854

EXAMINER	
SOLINSKY, PETER G	
ART UNIT	PAPER NUMBER
2463	

DATE MAILED: 10/21/2014

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

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

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

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

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

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

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

Notice of Allowability	Application No. 13/257,621	Applicant(s) ZHANG ET AL.	
	Examiner PETER SOLINSKY JR	Art Unit 2463	AIA (First Inventor to File) Status No

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

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

1. ☒ This communication is responsive to *Filing of 04/02/2012*.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on_____.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are *1,3-9,11,12 and 14-18*. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov .
4. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   Certified copies:
   a) ☒ All b) ☐ Some *c) ☐ None of the:
   1. ☒ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

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

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

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

Attachment(s)

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

/PETER SOLINSKY JR/ Examiner, Art Unit 2463	/Melvin Marcelo/ Primary Examiner, Art Unit 2463

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DETAILED ACTION

Notice of Pre-AIA or AIA Status

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

EXAMINER'S AMENDMENT

2. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Ling Wu on October 14, 2012.

The application has been amended as follows:

What is claimed is:

1. (Currently Amended) A method for managing upstream burst overhead parameters, comprising:

an optical line terminal or an optical network unit detecting transmission quality of a downlink between the optical line terminal and the optical network unit;

the optical line terminal or the optical network unit determining the upstream burst overhead parameters suitable for the optical network unit according to the transmission quality; and

the optical network unit starting to use the upstream burst overhead parameters suitable for the optical network unit after switching time determined by the optical network unit itself or indicated by the optical line terminal~~.~~;

wherein, before the step of the optical line terminal or the optical network unit detecting the transmission quality of the downlink between the optical line terminal and the optical network unit, the method further comprises:

the optical line terminal determining and identifying N kinds of upstream burst overhead parameter sets according to different levels of link quality, wherein N is an integer and is larger than zero; and

the optical line terminal sending a parameter value or an identification of one default upstream burst overhead parameter set to the optical network unit; and the optical network unit receiving the parameter value or the identification of the upstream burst overhead parameter set in a waiting state and using the upstream burst overhead parameter set; or,

the optical line terminal sending parameter values or identifications of more than one upstream burst overhead parameter set to the optical network unit; and the optical network unit receiving the parameter values or the identifications of the upstream burst overhead parameter sets in a waiting state and using one of the received upstream burst overhead parameter sets.

2. (Canceled)

3. (Currently amended) The method of claim ~~2~~ 1, wherein:

after the step of the optical network unit receiving the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s), the method further comprises: the optical network unit entering into a serial number state;

the step of the optical line terminal detecting the transmission quality of the downlink between the optical line terminal and the optical network unit comprises: in the serial number state of the optical network unit, the optical line terminal detecting the downlink between the optical network unit and the optical line terminal to acquire quality

information of the downlink;

the step of the optical line terminal determining the upstream burst overhead parameters suitable for the optical network unit according to the transmission quality comprises: the optical line terminal determining the upstream burst overhead parameter set suitable for the optical network unit according to the quality information of the downlink, and notifying the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) suitable for the optical network unit to the optical network unit via a unicast message or a broadcast message.

4. (Currently amended) The method of claim ~~2~~ 1, wherein:

after the step of the optical network unit receiving the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s), the method further comprises: the optical network unit entering into a serial number state;

the step of the optical network unit detecting the transmission quality of the downlink between the optical line terminal and the optical network unit comprises: in the serial number state of the optical network unit, the optical network unit detecting the downlink between the optical network unit and the optical line terminal to acquire quality information of the downlink;

after the step of acquiring the quality information of the downlink, the method further comprises: the optical network unit notifying the quality information of the downlink to the optical line terminal;

the step of the optical line terminal determining the upstream burst overhead parameters suitable for the optical network unit according to the transmission quality comprises: the optical line terminal determining the upstream burst overhead parameter set suitable for the optical network unit according to the quality information of the downlink, and notifying the parameter value(s) or the identification(s) of the upstream

burst overhead parameter set(s) suitable for the optical network unit to the optical network unit via a unicast message or a broadcast message.

5. (Currently amended) The method of claim ~~2~~ 1, wherein:

after the step of the optical network unit receiving the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s), the method further comprises: the optical network unit entering into a serial number state;

the step of the optical network unit detecting the transmission quality of the downlink between the optical line terminal and the optical network unit comprises: in the serial number state of the optical network unit, the optical network unit detecting the downlink between the optical network unit and the optical line terminal to acquire quality information of the downlink;

The step of the optical network unit determining the upstream burst overhead parameters suitable for the optical network unit according to the transmission quality comprises: the optical network unit determining the upstream burst overhead parameter set suitable for the optical network unit according to the quality information of the downlink, and notifying the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) suitable for the optical network unit to the optical line terminal via a unicast message or a broadcast message.

6. (Previously presented) The method of claim 3, wherein:

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical line terminal setting a switching index value of the upstream burst overhead parameters in a tag field assigned

for a bandwidth of the optical network unit, and sending the switching index value to the optical network unit via a downstream frame; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal comprises: after the optical network unit receives the switching index value, the optical network unit using the upstream burst overhead parameters suitable for the optical network unit in a next frame; or,

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical line terminal notifying a hyper frame number to the optical network unit; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal comprises: after the optical network unit receives the hyper frame number and after a frame indicated by the hyper frame number arrives, the optical network unit starting to use the upstream burst overhead parameters suitable for the optical network unit; or,

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical network unit notifying a hyper frame number to the optical line terminal; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time determined by the optical network unit itself comprises: after a frame indicated by the hyper frame number arrives, the optical network unit starting to use the upstream burst

overhead parameters suitable for the optical network unit.

7. (Previously presented) The method of claim 3, wherein:

the upstream burst overhead parameter set comprises: state of forward error correction, delimiter, preamble and guard band.

8. (Currently amended) The method of claim ~~2~~ 1, wherein:

in the step of the optical line terminal sending the parameter values or the identifications of more than one upstream burst overhead parameter set to the optical network unit, the optical line terminal sends the parameter values or the identifications of one or more upstream burst overhead parameter sets to all optical network units or one or more optical network units which communicate with the optical line terminal.

9. (Currently amended) An optical network unit for managing upstream burst overhead parameters, comprising a first parameter acquisition module, ~~and~~ a switching module and a burst overhead parameter set receiving module; wherein:

the first parameter acquisition module is configured to:

detect transmission quality of a downlink between an optical line terminal and the optical network unit or receive transmission quality of a downlink detected and sent by the optical line terminal, determine upstream burst overhead parameters suitable for the optical network unit according to the transmission quality, and send the upstream burst overhead parameters suitable for the optical network unit to the optical line terminal; or,

detect transmission quality of a downlink between an optical line terminal and the optical network unit, send the transmission quality to the optical line terminal, and receive, from the optical line terminal, upstream burst overhead parameters suitable for the optical network unit determined according to the transmission quality; or,

directly receive, from an optical line terminal, upstream burst overhead parameters suitable for the optical network unit determined by the optical line terminal; and,

while or after notifying the upstream burst overhead parameters suitable for the optical network unit to the optical line terminal, or while or after receiving the upstream burst overhead parameters suitable for the optical network unit sent by the optical line terminal, indicate the switching module;

the switching module is configured to:

while or after receiving an indication from the first parameter acquisition module, determine switching time or receive switching time indicated by the optical line terminal, and start to use the upstream burst overhead parameters suitable for the optical network unit after the switching time determined by itself or indicated by the optical line terminal.;

a burst overhead parameter set receiving module, configured to:

receive, in a waiting state, a parameter value or an identification of one default upstream burst overhead parameter set sent by the optical line terminal to the optical network unit after the optical line terminal determines and identifies N kinds of upstream burst overhead parameter sets according to different levels of link quality, and use the upstream burst overhead parameter set; or,

receive, in a waiting state, parameter values or identifications of more than one upstream burst overhead parameter set sent by the optical line terminal to the optical network unit after the optical line terminal determines and identifies N kinds of upstream burst overhead parameter sets according to different levels of link quality, and use one of the upstream burst overhead parameter sets;

wherein, N is an integer and is larger than zero.

10. (Canceled)

11. (Original) The optical network unit of claim 9, wherein:

the switching module is further configured to: while or after receiving the indication

from the first parameter acquisition module, receive a switching index value of the upstream burst overhead parameters which is sent from the optical line terminal to the optical network unit via a downstream frame and are set in a tag field assigned for a bandwidth of the optical network unit by the optical line terminal; and, the switching module is configured to start to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal according to the following manner: after receiving the switching index value, using the upstream burst overhead parameters in a next frame; or

the switching module is further configured to: while or after receiving the indication from the first parameter acquisition module, receive a hyper frame number notified by the optical line terminal to the optical network unit; and, the switching module is configured to start to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal according to the following manner: after a frame indicated by the hyper frame number arrives, starting to use the upstream burst overhead parameters; or

the switching module is further configured to: while or after receiving the indication from the first parameter acquisition module, notify a hyper frame number to the optical line terminal; and, the optical network unit is configured to start to use the upstream burst overhead parameters after the switching time determined by the optical network unit itself according to the following method: after a frame indicated by the hyper frame number arrives, start to use the upstream burst overhead parameters.

12. (Currently amended) An optical line terminal for managing upstream burst overhead parameters, comprising: a second parameter acquisition module, ~~and~~ a switching time transceiving module and a upstream burst overhead parameter set acquisition module, wherein:

the second parameter acquisition module is configured to:

detect transmission quality of a downlink between the optical line terminal and an optical network unit, send the transmission quality to the optical network unit, and receive upstream burst overhead parameters suitable for the optical network unit determined by the optical network unit according to the transmission quality sent by the optical line terminal; or,

detect transmission quality of a downlink between the optical line terminal and an optical network unit, determine upstream burst overhead parameters suitable for the optical network unit according to the transmission quality, and notify the determined upstream burst overhead parameters suitable for the optical network unit to the optical network unit; or,

receive transmission quality of a downlink detected and sent by an optical network unit, determine the upstream burst overhead parameters suitable for the optical network unit according to the transmission quality, and notify the determined upstream burst overhead parameters suitable for the optical network unit to the optical network unit; or,

receive upstream burst overhead parameters suitable for an optical network unit which are sent and determined by the optical network unit according to transmission quality of a downlink detected and acquired by the optical network unit itself; and

while or after notifying the determined upstream burst overhead parameters suitable for the optical network unit to the optical network unit, or while or after receiving the upstream burst overhead parameters suitable for the optical network unit sent by the optical network unit, indicate switching time transceiving module;

the switching time transceiving module is configured to:

while or after receiving an indication from the second parameter acquisition module, indicate the switching time to the optical network unit or receive the switching time sent by the optical network unit, so that the optical network unit start to use the

upstream burst overhead parameters after the switching time.;

a upstream burst overhead parameter set acquisition module, configured to: determine and identify N kinds of upstream burst overhead parameter sets according to different levels of link quality; wherein N is an integer and is larger than zero; and send a parameter value or an identification of one default upstream burst overhead parameter set to the optical network unit, or, send parameter values or identifications of more than one upstream burst overhead parameter set to the optical network unit,

so that the optical network unit receives the parameter value or the identification of the one upstream burst overhead parameter set in a waiting state and uses the upstream burst overhead parameter set; or, the optical network unit receives the parameter values or the identifications of more than one upstream burst overhead parameter set in a waiting state and uses one of the upstream burst overhead parameter sets.

13. (Canceled)

14. (Previously presented) The optical line terminal of claim 12, wherein:

the switching time transceiving module is configured to indicate the switching time to the optical network unit according to the following manner: setting a switching index value of the upstream burst overhead parameters in a tag field assigned for a bandwidth of the optical network unit, and sending the switching index value to the optical network unit via a downstream frame, so that after the optical network unit receives the switching index value, the optical network unit uses the upstream burst overhead parameters in a next frame; or,

the switching time transceiving module is configured to indicate the switching time to the optical network unit according to the following manner: notifying a hyper frame number to the optical network unit, so that the optical network unit starts to use the

upstream burst overhead parameters after a frame indicated by the hyper frame number from the optical line terminal arrives; or,

the switching time transceiving module is configured to receive the switching time sent by the optical network unit according to the following method: receiving a hyper frame number notified by the optical network unit, so that the optical network unit starts to use the upstream burst overhead parameters after a frame indicated by the hyper frame number arrives.

15. (Previously presented) The method of claim 4, wherein:

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical line terminal setting a switching index value of the upstream burst overhead parameters in a tag field assigned for a bandwidth of the optical network unit, and sending the switching index value to the optical network unit via a downstream frame; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal comprises: after the optical network unit receives the switching index value, the optical network unit using the upstream burst overhead parameters suitable for the optical network unit in a next frame; or,

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical line terminal notifying a hyper frame number to the optical network unit; the step of the optical network unit

starting to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal comprises: after the optical network unit receives the hyper frame number and after a frame indicated by the hyper frame number arrives, the optical network unit starting to use the upstream burst overhead parameters suitable for the optical network unit; or,

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical network unit notifying a hyper frame number to the optical line terminal; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time determined by the optical network unit itself comprises: after a frame indicated by the hyper frame number arrives, the optical network unit starting to use the upstream burst overhead parameters suitable for the optical network unit.

16. (Previously presented) The method of claim 5, wherein:

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical line terminal setting a switching index value of the upstream burst overhead parameters in a tag field assigned for a bandwidth of the optical network unit, and sending the switching index value to the optical network unit via a downstream frame; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal comprises: after the optical network unit receives the switching

index value, the optical network unit using the upstream burst overhead parameters suitable for the optical network unit in a next frame; or,

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical line terminal notifying a hyper frame number to the optical network unit; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal comprises: after the optical network unit receives the hyper frame number and after a frame indicated by the hyper frame number arrives, the optical network unit starting to use the upstream burst overhead parameters suitable for the optical network unit; or,

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical network unit notifying a hyper frame number to the optical line terminal; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time determined by the optical network unit itself comprises: after a frame indicated by the hyper frame number arrives, the optical network unit starting to use the upstream burst overhead parameters suitable for the optical network unit.

17. (Previously presented) The method of claim 4, wherein:

the upstream burst overhead parameter set comprises: state of forward error correction, delimiter, preamble and guard band.

18. (Previously presented) The method of claim 5, wherein:

the upstream burst overhead parameter set comprises: state of forward error correction, delimiter, preamble and guard band.

Allowable Subject Matter

3. Claims 1, 3 - 9, 11, 12, 14 - 18 allowed.

4. The following is an examiner's statement of reasons for allowance: The ITU standard ITU-T G.984.2 teaches the necessary signaling for a Gigabit-Passive Optical Network. The uplink data is transmitted in burst cycles. The standard states that uplink parameters stay the same as long as the optical network is operational. The invention is for setting up multiple sets of parameters to use in the uplink burst cycle in order to better use bandwidth based on the quality of the transmission channel.

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

Any inquiry concerning this communication or earlier communications from the examiner should be directed to PETER SOLINSKY JR whose telephone number is (571)270-7216. The examiner can normally be reached on Monday through Thursday 6:30 am to 5:00 pm.

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

number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/PETER SOLINSKY JR/
Examiner, Art Unit 2463

/MELVIN MARCELO/
Primary Examiner, Art Unit 2463

Examiner-Initiated Interview Summary	Application No.	Applicant(s)	
	13/257,621	ZHANG ET AL.	
	Examiner	Art Unit	
	PETER SOLINSKY JR	2463	

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

(1) *PETER SOLINSKY JR*. (3)_____.

(2) *Ling Wu, applicant's representative*. (4)_____.

Date of Interview: *14 October 2014*.

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

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

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

Claim(s) discussed: *1 and 2*.

Identification of prior art discussed: _____.

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

Explained that allowable subject matter existed in claim 2, 10, and 13 and claims could be allowable if independent claims were amended to include above claim language..

Applicant recordation instructions: It is not necessary for applicant to provide a separate record of the substance of interview.

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

☐ Attachment

/PETER SOLINSKY JR/ Examiner, Art Unit 2463	

Exhibit 1002
IPR2024-00900, USPN 8,934,359
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Notice of References Cited	Application/Control No. 13/257,621	Applicant(s)/Patent Under Reexamination ZHANG ET AL.	
	Examiner PETER SOLINSKY JR	Art Unit 2463	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-7,600,171 B2	10-2009	Lee et al.	714/751
*	B	US-2010/0208747 A1	08-2010	Gordon et al.	370/468
*	C	US-8,041,216 B2	10-2011	de Lind van Wijngaarden, Adriaan J.	398/71
*	D	US-8,195,050 B2	06-2012	Matsuyama et al.	398/102
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

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

NON-PATENT DOCUMENTS

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

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

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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: **Dezhi ZHANG et al.**	)	Customer No.: **95957**
Serial No.: **13/257,621**	)	Confirmation No.: **1450**
Filed: **09/20/2011**	)	Art Unit: **Unknown**
For: **Method and Passive Optical Network System for Managing Uplink Burst Overhead Parameters**	)	Examiner: **Unknown**

SUPPLEMENTAL PRELIMINARY AMENDMENTS

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

Dear Sir or Madam:

Please amend the application as set forth herein.

Amendments to the Claims begin on page 2 of this paper.

Respectfully submitted,

By: _____

Ling Wu
Patent Agent for Applicant
Registration No. 66,304

Date: October 14, 2014
Ling Wu
1107 Bettstrail Way
Potomac, MD 20854
(301) 637-2202 (tel)
(301) 251-0237 (fax)

Replace the Claims with the following amended Claims.

What is claimed is:

1. (Currently Amended) A method for managing upstream burst overhead parameters, comprising:

an optical line terminal or an optical network unit detecting transmission quality of a downlink between the optical line terminal and the optical network unit;

the optical line terminal or the optical network unit determining the upstream burst overhead parameters suitable for the optical network unit according to the transmission quality; and

the optical network unit starting to use the upstream burst overhead parameters suitable for the optical network unit after switching time determined by the optical network unit itself or indicated by the optical line terminal~~.~~;

wherein, before the step of the optical line terminal or the optical network unit detecting the transmission quality of the downlink between the optical line terminal and the optical network unit, the method further comprises:

the optical line terminal determining and identifying N kinds of upstream burst overhead parameter sets according to different levels of link quality, wherein N is an integer and is larger than zero; and

the optical line terminal sending a parameter value or an identification of one default upstream burst overhead parameter set to the optical network unit; and the optical network unit receiving the parameter value or the identification of the upstream burst overhead parameter set in a waiting state and using the upstream burst overhead parameter set; or,

the optical line terminal sending parameter values or identifications of more than one upstream burst overhead parameter set to the optical network unit; and the optical network unit receiving the parameter values or the identifications of the upstream burst overhead parameter sets in a waiting state and using one of the received upstream burst overhead parameter sets.

2. (Canceled) ~~The method of claim 1, wherein, before the step of the optical line terminal or the optical network unit detecting the transmission quality of the downlink between the optical line terminal and the optical network unit, the method further comprises:~~

~~the optical line terminal determining and identifying N kinds of upstream burst overhead parameter sets according to different levels of link quality, wherein N is an integer and is larger than zero; and~~

~~the optical line terminal sending a parameter value or an identification of one default upstream burst overhead parameter set to the optical network unit; and the optical network unit receiving the parameter value or the identification of the upstream burst overhead parameter set in a waiting state and using the upstream burst overhead parameter set; or,~~

~~the optical line terminal sending parameter values or identifications of more than one upstream burst overhead parameter set to the optical network unit; and the optical network unit receiving the parameter values or the identifications of the upstream burst overhead parameter sets in a waiting state and using one of the received upstream burst overhead parameter sets.~~

3. (Currently amended) The method of claim ~~2~~ 1, wherein:

after the step of the optical network unit receiving the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s), the method further comprises: the optical network unit entering into a serial number state;

the step of the optical line terminal detecting the transmission quality of the downlink between the optical line terminal and the optical network unit comprises: in the serial number state of the optical network unit, the optical line terminal detecting the downlink between the optical network unit and the optical line terminal to acquire quality information of the downlink;

the step of the optical line terminal determining the upstream burst overhead parameters suitable for the optical network unit according to the transmission quality comprises: the optical line terminal determining the upstream burst overhead parameter set suitable for the optical network unit according to the quality information of the downlink, and notifying the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) suitable for the optical network unit to the optical network unit via a unicast message or a broadcast message.

4. (Currently amended) The method of claim ~~2~~ 1, wherein:

after the step of the optical network unit receiving the parameter value(s) or the

identification(s) of the upstream burst overhead parameter set(s), the method further comprises: the optical network unit entering into a serial number state;

the step of the optical network unit detecting the transmission quality of the downlink between the optical line terminal and the optical network unit comprises: in the serial number state of the optical network unit, the optical network unit detecting the downlink between the optical network unit and the optical line terminal to acquire quality information of the downlink;

after the step of acquiring the quality information of the downlink, the method further comprises: the optical network unit notifying the quality information of the downlink to the optical line terminal;

the step of the optical line terminal determining the upstream burst overhead parameters suitable for the optical network unit according to the transmission quality comprises: the optical line terminal determining the upstream burst overhead parameter set suitable for the optical network unit according to the quality information of the downlink, and notifying the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) suitable for the optical network unit to the optical network unit via a unicast message or a broadcast message.

5. (Currently amended) The method of claim ~~2~~ 1, wherein:

after the step of the optical network unit receiving the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s), the method further comprises: the optical network unit entering into a serial number state;

the step of the optical network unit detecting the transmission quality of the downlink between the optical line terminal and the optical network unit comprises: in the serial number state of the optical network unit, the optical network unit detecting the downlink between the optical network unit and the optical line terminal to acquire quality information of the downlink;

The step of the optical network unit determining the upstream burst overhead parameters suitable for the optical network unit according to the transmission quality comprises: the optical network unit determining the upstream burst overhead parameter set suitable for the optical network unit according to the quality information of the downlink, and notifying the parameter

value(s) or the identification(s) of the upstream burst overhead parameter set(s) suitable for the optical network unit to the optical line terminal via a unicast message or a broadcast message.

6. (Previously presented) The method of claim 3, wherein:

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical line terminal setting a switching index value of the upstream burst overhead parameters in a tag field assigned for a bandwidth of the optical network unit, and sending the switching index value to the optical network unit via a downstream frame; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal comprises: after the optical network unit receives the switching index value, the optical network unit using the upstream burst overhead parameters suitable for the optical network unit in a next frame; or,

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical line terminal notifying a hyper frame number to the optical network unit; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal comprises: after the optical network unit receives the hyper frame number and after a frame indicated by the hyper frame number arrives, the optical network unit starting to use the upstream burst overhead parameters suitable for the optical network unit; or,

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical network unit notifying a hyper frame number to the

optical line terminal; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time determined by the optical network unit itself comprises: after a frame indicated by the hyper frame number arrives, the optical network unit starting to use the upstream burst overhead parameters suitable for the optical network unit.

7. (Previously presented) The method of claim 3, wherein:

the upstream burst overhead parameter set comprises: state of forward error correction, delimiter, preamble and guard band.

8. (Currently amended) The method of claim ~~2~~ 1, wherein:

in the step of the optical line terminal sending the parameter values or the identifications of more than one upstream burst overhead parameter set to the optical network unit, the optical line terminal sends the parameter values or the identifications of one or more upstream burst overhead parameter sets to all optical network units or one or more optical network units which communicate with the optical line terminal.

9. (Currently amended) An optical network unit for managing upstream burst overhead parameters, comprising a first parameter acquisition module, ~~and~~ a switching module and a burst overhead parameter set receiving module; wherein:

the first parameter acquisition module is configured to:

detect transmission quality of a downlink between an optical line terminal and the optical network unit or receive transmission quality of a downlink detected and sent by the optical line terminal, determine upstream burst overhead parameters suitable for the optical network unit according to the transmission quality, and send the upstream burst overhead parameters suitable for the optical network unit to the optical line terminal; or,

detect transmission quality of a downlink between an optical line terminal and the optical network unit, send the transmission quality to the optical line terminal, and receive, from the optical line terminal, upstream burst overhead parameters suitable for the optical network unit determined according to the transmission quality; or,

directly receive, from an optical line terminal, upstream burst overhead parameters suitable for the optical network unit determined by the optical line terminal; and,

while or after notifying the upstream burst overhead parameters suitable for the optical network unit to the optical line terminal, or while or after receiving the upstream burst overhead parameters suitable for the optical network unit sent by the optical line terminal, indicate the switching module;

the switching module is configured to:

while or after receiving an indication from the first parameter acquisition module, determine switching time or receive switching time indicated by the optical line terminal, and start to use the upstream burst overhead parameters suitable for the optical network unit after the switching time determined by itself or indicated by the optical line terminal~~.~~;

a burst overhead parameter set receiving module, configured to:

receive, in a waiting state, a parameter value or an identification of one default upstream burst overhead parameter set sent by the optical line terminal to the optical network unit after the optical line terminal determines and identifies N kinds of upstream burst overhead parameter sets according to different levels of link quality, and use the upstream burst overhead parameter set; or,

receive, in a waiting state, parameter values or identifications of more than one upstream burst overhead parameter set sent by the optical line terminal to the optical network unit after the optical line terminal determines and identifies N kinds of upstream burst overhead parameter sets according to different levels of link quality, and use one of the upstream burst overhead parameter sets;

wherein, N is an integer and is larger than zero.

10. (Canceled) ~~The optical network unit of claim 9, further comprising:~~

~~a burst overhead parameter set receiving module, configured to:~~

~~receive, in a waiting state, a parameter value or an identification of one default upstream burst overhead parameter set sent by the optical line terminal to the optical network unit after the optical line terminal determines and identifies N kinds of upstream burst overhead parameter sets according to different levels of link quality, and use the upstream burst overhead parameter set; or,~~

~~receive, in a waiting state, parameter values or identifications of more than one upstream burst overhead parameter set sent by the optical line terminal to the optical network unit after the optical line terminal determines and identifies N kinds of upstream burst overhead parameter sets according to different levels of link quality, and use one of the upstream burst overhead parameter sets;~~

~~wherein, N is an integer and is larger than zero.~~

11. (Original) The optical network unit of claim 9, wherein:

the switching module is further configured to: while or after receiving the indication from the first parameter acquisition module, receive a switching index value of the upstream burst overhead parameters which is sent from the optical line terminal to the optical network unit via a downstream frame and are set in a tag field assigned for a bandwidth of the optical network unit by the optical line terminal; and, the switching module is configured to start to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal according to the following manner: after receiving the switching index value, using the upstream burst overhead parameters in a next frame; or

the switching module is further configured to: while or after receiving the indication from the first parameter acquisition module, receive a hyper frame number notified by the optical line terminal to the optical network unit; and, the switching module is configured to start to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal according to the following manner: after a frame indicated by the hyper frame number arrives, starting to use the upstream burst overhead parameters; or

the switching module is further configured to: while or after receiving the indication from the first parameter acquisition module, notify a hyper frame number to the optical line terminal; and, the optical network unit is configured to start to use the upstream burst overhead parameters after the switching time determined by the optical network unit itself according to the following method: after a frame indicated by the hyper frame number arrives, start to use the upstream burst overhead parameters.

12. (Currently amended) An optical line terminal for managing upstream burst overhead parameters, comprising: a second parameter acquisition module, ~~and~~ a switching time

transceiving module and a upstream burst overhead parameter set acquisition module, wherein:

the second parameter acquisition module is configured to:

detect transmission quality of a downlink between the optical line terminal and an optical network unit, send the transmission quality to the optical network unit, and receive upstream burst overhead parameters suitable for the optical network unit determined by the optical network unit according to the transmission quality sent by the optical line terminal; or,

detect transmission quality of a downlink between the optical line terminal and an optical network unit, determine upstream burst overhead parameters suitable for the optical network unit according to the transmission quality, and notify the determined upstream burst overhead parameters suitable for the optical network unit to the optical network unit; or,

receive transmission quality of a downlink detected and sent by an optical network unit, determine the upstream burst overhead parameters suitable for the optical network unit according to the transmission quality, and notify the determined upstream burst overhead parameters suitable for the optical network unit to the optical network unit; or,

receive upstream burst overhead parameters suitable for an optical network unit which are sent and determined by the optical network unit according to transmission quality of a downlink detected and acquired by the optical network unit itself; and

while or after notifying the determined upstream burst overhead parameters suitable for the optical network unit to the optical network unit, or while or after receiving the upstream burst overhead parameters suitable for the optical network unit sent by the optical network unit, indicate switching time transceiving module;

the switching time transceiving module is configured to:

while or after receiving an indication from the second parameter acquisition module, indicate the switching time to the optical network unit or receive the switching time sent by the optical network unit, so that the optical network unit start to use the upstream burst overhead parameters after the switching time.;

a upstream burst overhead parameter set acquisition module, configured to: determine and identify N kinds of upstream burst overhead parameter sets according to different levels of link

quality; wherein N is an integer and is larger than zero; and send a parameter value or an identification of one default upstream burst overhead parameter set to the optical network unit, or, send parameter values or identifications of more than one upstream burst overhead parameter set to the optical network unit,

so that the optical network unit receives the parameter value or the identification of the one upstream burst overhead parameter set in a waiting state and uses the upstream burst overhead parameter set; or, the optical network unit receives the parameter values or the identifications of more than one upstream burst overhead parameter set in a waiting state and uses one of the upstream burst overhead parameter sets.

13. (Canceled) ~~The optical line terminal of claim 12, further comprising:~~

~~a upstream burst overhead parameter set acquisition module, configured to: determine and identify N kinds of upstream burst overhead parameter sets according to different levels of link quality; wherein N is an integer and is larger than zero; and send a parameter value or an identification of one default upstream burst overhead parameter set to the optical network unit, or, send parameter values or identifications of more than one upstream burst overhead parameter set to the optical network unit,~~

~~so that the optical network unit receives the parameter value or the identification of the one upstream burst overhead parameter set in a waiting state and uses the upstream burst overhead parameter set; or, the optical network unit receives the parameter values or the identifications of more than one upstream burst overhead parameter set in a waiting state and uses one of the upstream burst overhead parameter sets.~~

14. (Previously presented) The optical line terminal of claim 12, wherein:

the switching time transceiving module is configured to indicate the switching time to the optical network unit according to the following manner: setting a switching index value of the upstream burst overhead parameters in a tag field assigned for a bandwidth of the optical network unit, and sending the switching index value to the optical network unit via a downstream frame, so that after the optical network unit receives the switching index value, the optical network unit uses the upstream burst overhead parameters in a next frame; or,

the switching time transceiving module is configured to indicate the switching time to the

optical network unit according to the following manner: notifying a hyper frame number to the optical network unit, so that the optical network unit starts to use the upstream burst overhead parameters after a frame indicated by the hyper frame number from the optical line terminal arrives; or,

the switching time transceiving module is configured to receive the switching time sent by the optical network unit according to the following method: receiving a hyper frame number notified by the optical network unit, so that the optical network unit starts to use the upstream burst overhead parameters after a frame indicated by the hyper frame number arrives.

15. (Previously presented) The method of claim 4, wherein:

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical line terminal setting a switching index value of the upstream burst overhead parameters in a tag field assigned for a bandwidth of the optical network unit, and sending the switching index value to the optical network unit via a downstream frame; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal comprises: after the optical network unit receives the switching index value, the optical network unit using the upstream burst overhead parameters suitable for the optical network unit in a next frame; or,

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical line terminal notifying a hyper frame number to the optical network unit; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal comprises: after the optical network unit receives the hyper frame number and after a frame indicated by the hyper frame number arrives, the optical network unit starting to use the upstream burst

overhead parameters suitable for the optical network unit; or,

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical network unit notifying a hyper frame number to the optical line terminal; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time determined by the optical network unit itself comprises: after a frame indicated by the hyper frame number arrives, the optical network unit starting to use the upstream burst overhead parameters suitable for the optical network unit.

16. (Previously presented) The method of claim 5, wherein:

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical line terminal setting a switching index value of the upstream burst overhead parameters in a tag field assigned for a bandwidth of the optical network unit, and sending the switching index value to the optical network unit via a downstream frame; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal comprises: after the optical network unit receives the switching index value, the optical network unit using the upstream burst overhead parameters suitable for the optical network unit in a next frame; or,

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical line terminal notifying a hyper frame number to the optical network unit; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal comprises:

after the optical network unit receives the hyper frame number and after a frame indicated by the hyper frame number arrives, the optical network unit starting to use the upstream burst overhead parameters suitable for the optical network unit; or,

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical network unit notifying a hyper frame number to the optical line terminal; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time determined by the optical network unit itself comprises: after a frame indicated by the hyper frame number arrives, the optical network unit starting to use the upstream burst overhead parameters suitable for the optical network unit.

17. (Previously presented) The method of claim 4, wherein:

the upstream burst overhead parameter set comprises: state of forward error correction, delimiter, preamble and guard band.

18. (Previously presented) The method of claim 5, wherein:

the upstream burst overhead parameter set comprises: state of forward error correction, delimiter, preamble and guard band.

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13257621	ZHANG ET AL.
	Examiner	Art Unit
	PETER SOLINSKY	2463

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

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

CLAIM		DATE								
Final	Original	10/17/2014								
1	1	=								
-	2	-								
3	3	=								
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5	5	=								
6	6	=								
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15	12	=								
-	13	-								
16	14	=								
9	15	=								
12	16	=								
10	17	=								
11	18	=								

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13257621	ZHANG ET AL.
	Examiner	Art Unit
	PETER SOLINSKY	2463

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
370	252	10/14/2014	p.s.

SEARCH NOTES		
Search Notes	Date	Examiner
Submitted PLUS search	10/14/2014	p.s.
Conducted EAST search	10/14/2014	p.s.
Conducted Inventor search	10/17/2014	p.s.
Consulted primary examiner Melvin Marcelo	10/13/2014	p.s.

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner
370	252	10/17/2014	p.s.

/PETER SOLINSKY/ Examiner.Art Unit 2463	

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	13257621
	Filing Date	2012-04-02
	First Named Inventor	Dezhi Zhang et al.
	Art Unit	
	Examiner Name	Unknown
	Attorney Docket Number	AFD111101442-US

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Receipt date: 07/01/2014	Application Number	13257621 13257621 - GAU: 2463
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Filing Date	2012-04-02
	First Named Inventor	Dezhi Zhang et al.
	Art Unit	
	Examiner Name	Unknown
	Attorney Docket Number	AFD111101442-US

/P.S./	1	"Gigabit-capable Passive Optical Networks (G-PON): Transmission convergence layer specification"; Recommendation ITU-T G.984.3; 03/2008; SERIES G: TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSYTEMS AND NETWORKS; Digital sections and digital line system - Optical line systems for local and access networks; XP17588388A; the whole document	☐

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Examiner Signature	/Peter Solinsky/	Date Considered	10/17/2014

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Receipt date: 07/01/2014	Application Number	13257621	13257621 - GAU: 2463
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Filing Date	2012-04-02	
	First Named Inventor	Dezhi Zhang et al.	
	Art Unit		
	Examiner Name	Unknown	
	Attorney Docket Number	AFD111101442-US	

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☐ See attached certification statement.

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☐ A certification statement is not submitted herewith.

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Signature	/Ling Wu/	Date (YYYY-MM-DD)	2014-07-01
Name/Print	Ling Wu	Registration Number	66304

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

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

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	13257621
	Filing Date	2012-04-02
	First Named Inventor	Dezhi Zhang et al.
	Art Unit	
	Examiner Name	Unknown
	Attorney Docket Number	AFD111101442-US

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/P.S./	1	2000278281	JP	A	2000-10-06	NEC CORP		☐

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Receipt date: 03/17/2014	Application Number	13257621 13257621 - GAU: 2463
INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Filing Date	2012-04-02
	First Named Inventor	Dezhi Zhang et al.
	Art Unit	
(Not for submission under 37 CFR 1.99)	Examiner Name	Unknown
	Attorney Docket Number	AFD111101442-US

/P.S./	1	"Reliable Multicast with ARQ and FEC for strcaming HDTV"; Shuichi AOKI et al.; NHK Science and Technical Research Laboratories; 1-10-11 kinuta Setagaya-ku, Tokyo 157-8510 Japan; E-mail: aoki.s-ha@nhk.or.jp; see pages 2-9/E	☐

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Receipt date: 03/17/2014	Application Number	13257621 13257621 - GAU: 2463
INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Filing Date	2012-04-02
	First Named Inventor	Dezhi Zhang et al.
	Art Unit	
	Examiner Name	Unknown
	Attorney Docket Number	AFD111101442-US

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☐ 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

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Signature	/Ling Wu/	Date (YYYY-MM-DD)	2014-03-17
Name/Print	Ling Wu	Registration Number	66304

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CONFIRMATION NO. 1450

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
13/257,621	04/02/2012 RULE	370	2463	AFD111101442-US

APPLICANTS

INVENTORS

Dezhi Zhang, Shenzhen City, CHINA;
Marek Hajduczenia, Fiaes, PORTUGAL;
Liquan Yuan, Shenzhen City, CHINA;
Weiliang Zhang, Shenzhen City, CHINA;

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

This application is a 371 of PCT/CN2010/073773 06/10/2010

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

CHINA 200910212093.3 11/04/2009

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

05/14/2012

Foreign Priority claimed ☑ Yes ☐ No 35 USC 119(a-d) conditions met ☑ Yes ☐ No Verified and Acknowledged /PETER G SOLINSKY/ Examiner's Signature	☐ Met after Allowance Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
		CHINA	8	~~14~~ 15	3

ADDRESS

Ling Wu
1107 Bettstrail Way
Potomac, MD 20854
UNITED STATES

TITLE

Method and Passive Optical Network System for Managing Uplink Burst Overhead Parameters

FILING FEE RECEIVED	FEES: Authority has been given in Paper	☐ All Fees
980	No._____ to charge/credit DEPOSIT ACCOUNT	☐ 1.16 Fees (Filing)
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Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13257621	ZHANG ET AL.
	Examiner	**Art Unit**
	PETER SOLINSKY	2463

CPC						
Symbol					**Type**	**Version**
H04L		12	/	2861	F	2013-01-01
H04B		10	/	0793	I	2013-01-01
H04L		12	/	2885	I	2013-01-01
H04L		12	/	5695	I	2013-01-01
H04Q		11	/	0067	I	2013-01-01
H04Q		11	/	0066	A	2013-01-01
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H04Q		2011	/	0084	A	2013-01-01
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CPC Combination Sets							
Symbol				**Type**	**Set**	**Ranking**	**Version**
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			/				

/PETER SOLINSKY/ Examiner.Art Unit 2463	10/17/2014	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	15	
/MELVIN MARCELO/ Primary Examiner.Art Unit 2463	10/17/2014	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	3

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	13257621	ZHANG ET AL.
	Examiner	**Art Unit**
	PETER SOLINSKY	2463

US ORIGINAL CLASSIFICATION		INTERNATIONAL CLASSIFICATION										
CLASS	SUBCLASS	CLAIMED					NON-CLAIMED					
370	252	H	0	4	L	12 / 44 (2006.01)						
CROSS REFERENCE(S)												
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)											

/PETER SOLINSKY/ Examiner.Art Unit 2463	10/17/2014	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	15	
/MELVIN MARCELO/ Primary Examiner.Art Unit 2463	10/17/2014	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	3

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
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☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
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12	16														

/PETER SOLINSKY/ Examiner.Art Unit 2463	10/17/2014	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	15	
/MELVIN MARCELO/ Primary Examiner.Art Unit 2463	10/17/2014	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	3

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L2	359	(dezhi near3 zhang).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/10/17 13:23
L3	80	(marek near3 hajduczenia).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/10/17 13:23
L4	175	(liquan near3 yuan).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/10/17 13:24
L5	374	(weiliang near3 zhang).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/10/17 13:24
L6	5	2 and 3 and 4 and 5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/10/17 13:24
S1	1	(13/257621).APP.	US-PGPUB; USPAT; USOCR	OR	OFF	2014/10/13 09:06
S2	1	("20120213509").PN.	DERWENT	OR	OFF	2014/10/13 09:06
S3	16817	(370/252).CCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2014/10/13 09:08
S4	73694	(optical adj line adj terminal) "OLT" (optical adj network adj unit) "ONU"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/10/13 09:22
S5	21	(S4 near3 (detecting measure detect measuring find identify notice observe recognize see)) with (quality condition attribute) with (link connection transmission)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/10/13 09:28
S6	1	("7600171").PN.	USPAT; USOCR	OR	OFF	2014/10/13 09:31
S7	6	(S4 near3 (determine calculate find use utilize assign)) with (burst near3 parameter)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/10/13 09:33

S8	15	S4 with (burst near3 parameter)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/10/13 09:38
S9	146	uplink near3 burst near3 (parameter variable specification)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/10/13 09:58
S10	7	S9 and S4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/10/13 09:58

10/17/2014 1:25:08 PM
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CONFIRMATION NO. 1450

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
13/257,621	04/02/2012 RULE	370	2463	AFD111101442-US

APPLICANTS

INVENTORS

Dezhi Zhang, Shenzhen City, CHINA;
Marek Hajduczenia, Fiaes, PORTUGAL;
Liquan Yuan, Shenzhen City, CHINA;
Weiliang Zhang, Shenzhen City, CHINA;

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

This application is a 371 of PCT/CN2010/073773 06/10/2010

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

CHINA 200910212093.3 11/04/2009

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

05/14/2012

Foreign Priority claimed ☑ Yes ☐ No 35 USC 119(a-d) conditions met ☑ Yes ☐ No Verified and Acknowledged /PETER G SOLINSKY/ Examiner's Signature	☐ Met after Allowance Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
		CHINA	8	14	3

ADDRESS

Ling Wu
1107 Bettstrail Way
Potomac, MD 20854
UNITED STATES

TITLE

Method and Passive Optical Network System for Managing Uplink Burst Overhead Parameters

FILING FEE RECEIVED	FEES: Authority has been given in Paper	☐ All Fees
980	No._____ to charge/credit DEPOSIT ACCOUNT	☐ 1.16 Fees (Filing)
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PLUS Search Results for S/N 13257621, Searched Thu Oct 09 10:06:44 EDT 2014

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20120213509 99
7606490 70
7477845 84
8315520 84
8406636 84
8428034 84
8548328 84
8712240 84
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PLUS Search Results for S/N 13257621, Searched Thu Oct 09 10:06:48 EDT 2014

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6778781 99
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8712240 99
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6049550 75
6061328 75
6078596 75

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	13257621
	Filing Date	2012-04-02
	First Named Inventor	Dezhi Zhang et al.
	Art Unit	
	Examiner Name	Unknown
	Attorney Docket Number	AFD111101442-US

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	Art Unit	
	Examiner Name	Unknown
	Attorney Docket Number	AFD111101442-US

	1	"Gigabit-capable Passive Optical Networks (G-PON): Transmission convergence layer specification"; Recommendation ITU-T G.984.3; 03/2008; SERIES G: TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSYTEMS AND NETWORKS; Digital sections and digital line system - Optical line systems for local and access networks; XP17588388A; the whole document	☐

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	Filing Date	2012-04-02
	First Named Inventor	Dezhi Zhang et al.
	Art Unit	
	Examiner Name	Unknown
	Attorney Docket Number	AFD111101442-US

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Signature	/Ling Wu/	Date (YYYY-MM-DD)	2014-07-01
Name/Print	Ling Wu	Registration Number	66304

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EFS ID:	19461560
Application Number:	13257621
International Application Number:	
Confirmation Number:	1450
Title of Invention:	Method and Passive Optical Network System for Managing Uplink Burst Overhead Parameters
First Named Inventor/Applicant Name:	Dezhi Zhang
Customer Number:	95957
Filer:	Ling Wu
Filer Authorized By:	
Attorney Docket Number:	AFD111101442-US
Receipt Date:	01-JUL-2014
Filing Date:	02-APR-2012
Time Stamp:	13:18:46
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	Supplemental_IDS_AFD111101442-US.pdf	612394 99b2365958b79b07ff642ff5754fb44634ceb2da	no	4

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	Application Number	13257621
	Filing Date	2012-04-02
	First Named Inventor	Dezhi Zhang et al.
	Art Unit	
	Examiner Name	Unknown
	Attorney Docket Number	AFD111101442-US

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	1	2000278281	JP	A	2000-10-06	NEC CORP		☐
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	Art Unit	
	Examiner Name	Unknown
	Attorney Docket Number	AFD111101442-US

	1	"Reliable Multicast with ARQ and FEC for strcaming HDTV"; Shuichi AOKI et al.; NHK Science and Technical Research Laboratories; 1-10-11 kinuta Setagaya-ku, Tokyo 157-8510 Japan; E-mail: aoki.s-ha@nhk.or.jp; see pages 2-9/E	☐

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Signature	/Ling Wu/	Date (YYYY-MM-DD)	2014-03-17
Name/Print	Ling Wu	Registration Number	66304

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信学技報
IEICE Technical Report
CQ2007-102(2007-8)

ARQ と FEC を用いた ハイビジョンマルチキャスト配信の品質確保方式とその評価

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あらまし　光ファイバーなどのブロードバンド IP 接続サービスでは、IP マルチキャスト技術を用いることで多数の端末に同時に映像コンテンツを配信する IP 放送が行われている。IP ネットワークで高品質な映像配信サービスを提供する場合には、パケットロスが発生するネットワーク品質低下時にもサービス品質を一定に保つ必要がある。一般に、パケットロスで失われた情報の回復に FEC が利用されている。FEC では一定数の検査パケットを常に伝送するが、パケットロスが発生しない場合それらの検査パケットは利用されず無駄となる。このためパケットロスの発生が少ない品質の良い IP ネットワークを用いる場合、検査パケットを常に伝送することによる伝送効率低下が大きい。そこで、常時伝送される FEC の検査パケットを削減するため、検査パケットの常時伝送と ARQ を用いた個別伝送を導入することで、受信品質が低下した端末だけが検査パケットを追加受信する方式を考案した。商用ネットワークを用いたハイビジョンストリームの配信実験により考案方式による伝送効率の改善効果を確認した。
キーワード　リライアブルマルチキャスト，FEC，ARQ，ストリーミング

Reliable Multicast with ARQ and FEC for streaming HDTV

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Abstract　IP multicast enables delivery of video and audio to numerous users at the same time. The quality of video and audio at a receiver is subject to a significant degradation as the result of packet loss. In order to overcome the influence of packet loss, an application-layer FEC technique is often used in streaming applications. In FEC, parity packets are invariably received. These parity packets are never used if all packets are correctly received. This causes inefficiency using FEC on networks where packets are not often lost. To reduce the traffic of unnecessary parity packets, a new application-layer error correction mechanism based on layered multicast and ARQ has developed. In this paper, we propose a protocol. In proposed protocol, parity packets are partitioned into fundamental and supplementary parity packets and are sent as separate multicast sessions. They are used in combination with ARQ. By the use of this mechanism, supplementary parity packets are only received by receivers suffering from severe packet loss. The effectiveness of proposed reliable multicast protocol is examined by the experiment of streaming HDTV over a commercial IP network. The results of this experiment show that the proposed protocol effectively recovers lost packets.
Keyword　reliable multicast, FEC, ARQ, streaming

1. はじめに

IP ネットワークでは、マルチキャスト通信を用いることで、同一の情報を多数の受信端末に同時に届ける放送型のサービスを提供することができる。IP ネットワークの高速化が進んだことで、ハイビジョン映像のマルチキャストストリーミング配信も可能となりつつある。

既に IP ネットワークを用いた通信はベストエフォート型の通信であるため、パケットロスの発生やパケットの到着遅延ジッタの増加などの伝送品質低下が観測されることがある。こうした伝送品質の低下は、映像のストリーミング配信において映像品質の低下を引き起こす。このため一定の品質の映像配信サービスを提供するためには、伝送品質低下が発生した場合にもアプリケーション層で対策を行うことで映像や音声の視聴品質への影響を抑える必要がある。

従来、ストリーミング配信における伝送品質確保を目的として FEC(Forward Error Correction:誤り訂正技

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術)が用いられた[1]。FEC では、一定数の検査パケットを常に伝送する。しかし、パケットロスがない場合、受信した検査パケットは利用されないため、パケットロスの発生が少ない品質の良い IP ネットワークを用いる場合、検査パケットを常に一定数伝送することは無駄が大きく、伝送効率が低下する。そこで、常に受信される FEC の検査パケットを削減するため、検査パケットを２つの階層に分割し、品質の良い時には一部の検査パケットのみを受信することとする。受信品質が低下した端末だけがすべての検査パケットを受信することで、伝送品質を効率よく確保する。さらに ARQ(Automatic Repeat Request:再送要求)を補助的に用いる。このような方式を提案し、商用のマルチキャスト配信ネットワークを用いたハイビジョン映像の配信実験を行いその評価を行った。

本稿では、2.で伝送の品質を確保する FEC と ARQ について概観し、マルチキャスト配信に用いる際の問題点を指摘する。3.で提案する伝送方式について述べる。4.で商用のネットワークを用いた提案方式の評価を行い 5.でまとめる。

2. 伝送の品質を確保する FEC と ARQ

トランスポート層に TCP を用いるユニキャスト通信では通信の信頼性が確保されているが、一般にマルチキャスト通信では UDP が用いられるため、信頼性は確保されない。一定のサービス品質を提供するためにはマルチキャスト通信においても信頼性を確保する必要があり、こうしたマルチキャスト通信はリライアブルマルチキャストとして知られている。伝送品質低下のうち、パケットの到着遅延や遅延ジッタの増加は、受信端末が備える受信バッファにおいて吸収され、吸収できない程度に増加した場合、パケットロスとなる。このためリライアブルマルチキャストでは、パケットロスの対策をアプリケーション層で確保することが重要となり、アプリケーション層で誤り訂正符号を用いて、伝送途中でロスした情報を受信端末が回復する FEC、ロスした情報について送信側に再度送信することを要求する ARQ の技術等が用いられている [2]~[4]。

2.1. FEC による信頼性確保の特徴と問題

FEC は、誤り訂正符号による検査情報をデータから生成し、それらを検査パケットとしてデータパケットと共に送信する[5]。誤り訂正符号の復号により失われたデータを回復することができる。こうした仕組みのため、

- 片方向だけの通信で信頼性を確保
- 送信側負荷が受信端末数に依存せず一定のため、端末数のスケーラビリティを確保

などの特徴がある一方、

- あらかじめ回復能力を設計し、送信する検査パケットの量を決定する必要がある
- 発生するパケットロスが少ない時は、常に受信する検査パケットが無駄になる

などの問題がある。

2.2. ARQ による信頼性確保の特徴と問題

ARQ を用いる場合、受信端末がデータパケットのロスを検出した時、喪失データパケットを再度送信するよう送信側に要求し受信し直すことで、失われたデータを回復する[6]。こうした仕組みのため、

- あらかじめ回復能力を設計する必要がなく、損失より多くのデータパケットがロストしても回復可能
- パケットロスが少ない時には、再送要求がほとんど行われないため帯域を浪費せず効率的に信頼性を確保

などの特徴がある一方、

- 再送要求に応答する送信側及びネットワークの負荷が変動するため、端末数のスケーラビリティ確保が困難
- パケットロスが多い時には、再送するパケットが多く信頼性確保の効率が低下

などの問題がある。

3. 提案する伝送方式[7][8]

受信品質の良い受信端末に対する FEC による冗長な検査パケットの伝送を削減し伝送効率の向上を図るため、検査パケットを２つに分け階層化伝送を行うとともに、階層的に発生するパケットロスに対して ARQ を用いる伝送方式を提案する。本方式によれば、多数の受信端末のそれぞれに効率よく伝送の品質を確保可

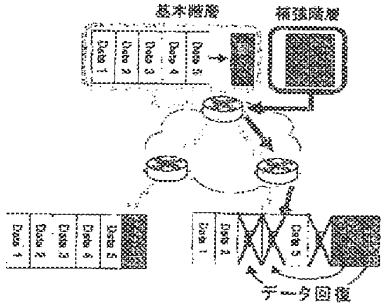


図１ 検査パケットの階層化による
受信領域の拡張と品質確保の両立

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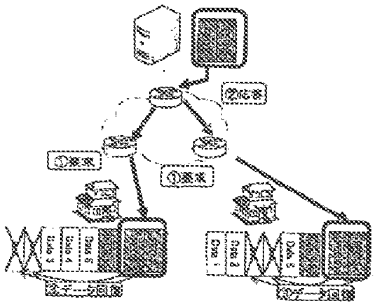


図２ ARQとその応答

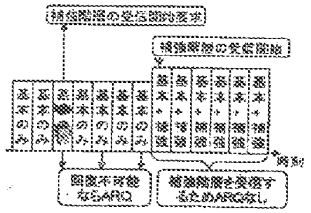


図３ 補強階層の受信開始要求とARQ

後となる。

送信側は、送信するデータパケットから誤り訂正符号による検査パケットを生成し、生成した検査パケットのうち一定数をデータパケットと共に基本階層としてマルチキャストにより送信し、残りの検査パケットを補強階層として基本階層とは別にマルチキャストにより送信する(図１)。

受信端末は、それぞれの受信品質に応じて(1)～(3)の動作を行う。

(1) 受信品質が良好で、ロスパケットが少数の時は、基本階層のみ受信し補強階層を受信しない。補強階層を受信しないことで受信帯域を削減し伝送効率を高める(図１：左端)。

(2) 基本階層のみ受信時は、補強階層を受信した場合と比べ受信する検査パケットが少なくロスパケットの回復能力が低い。そのため、回復できないパケットが発生した時は、ARQによりロストしたパケットの再送を試みる。ARQにより送信側に要求する際は、ロストしたデータパケットそのものを要求せず、補強階層の検査パケットの再送を要求する。FECブロック内の複数のデータパケットがロストした場合にも、ARQはFECブロックごとに１回だけ行うことで(図２)、要求回数を抑える。

(3) ロスパケットが増した時には、２つのマルチキャストストリームを受信し、基本階層に加え補強階層の検査パケットを受信することでロストパケットの回復能力を高く維持する。(図１：A.E.)。

一般にマルチキャストストリームの受信は、受信端末が受信開始要求を行ってから、実際に受信するまでに時間を要する。このため補強階層が必要となり要求した後、補強階層の検査パケットが受信されパケットの回復能力があるまでの間にARQによる回復を試みる。補強階層の検査パケットが受信されたらARQを停止することで、再送要求回数の増加あるいは応答待ちの増加といったARQの問題を抑えながら回復能力を向上する(図３)。

送信側は、データパケット、基本階層、補強階層のパケットを送信する他、ARQに対する次の応答を行う。

(a) ARQを受けた場合、要求されたFECブロックの補強階層の検査パケットを再度送信する。補強階層の検査パケットのみを一律に送信することで、従来のデータパケットを再送する場合と比較し応答負荷を抑える。

(b) 同一ブロックのARQを複数の受信端末から受けた場合、個別に応答することはせず要求を集約し、複数の受信端末が受信できるよう、基本階層、補強階層と従来の、再送要求に対する応答パケットを送信するマルチキャストセッションにより送信することでさらに応答負荷を抑える(図２)。

4. 商用ネットワークによる評価

受案伝送方式の伝送品質改善の効果、伝送効率改善効果の確認を目的として商用ネットワークでのマルチキャスト配信サービスを用いた実証実験を行った。配信サービスは、東日本地域に最大１００Mbpsの帯域のマルチキャスト通信を提供するもので、実験では世田谷区に配信拠点を設置し、４箇所の受信地点(世田谷区、渋谷区、長野市、東京市)に設置した受信端末に向けてハイビジョンストリームのマルチキャスト配信を行った。この実験システムを用いて表１に示す２つの実験を行った。実験のパラメタを以下に示す。

- 配信信号
  ハイビジョン映像をあらかじめ MPEG-2 Video MP@HL1440 でエンコードした 17.5Mbps の MPEG-2Transport Stream
- IPパケットの構成
  ７個の MPEG-2 TS パケットを RFC2250 に従い

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表１　２つの実験とその目的

実験①	提案方式の基本的な動作を検証するために、ハイビジョンマルチキャスト配信を行い、補強階層の選択受信及び ARQ により伝送品質が維持されること、さらに受信領域の拡張による伝送効率を確認する。
実験②	受信品質が悪い場合の動作を検証するために、ハイビジョンマルチキャスト配信と同時にファイルのダウンロードによりトラフィックを増加させて、補強階層の選択受信及び ARQ により伝送品質が維持されることを確認する。

ペイロードに格納し、RFC3550 に規定される RTP(Realtime Transport Protocol)のパケットフォーマットとし、IPv6 のヘッダを付加することでデータパケットを構成した。

- FEC ブロックの構成
  データパケット１９０個を１ブロックに含め、検査パケットをリードソロモン符号(214,190)により生成した。リードソロモン符号化の際の１シンボルは、１データパケットから抜き出すこととし、１９０個のデータパケットから２４個の検査パケットを生成した(図４)。この２４個の検査パケットを６個及び１８個の２つに分け、６個を基本階層に、残りを補強階層に割りあてた。基本階層のマルチキャストストリームでは、ブロックごとに１９０個のデータパケット、６個の検査パケットの順に送信した。FEC ブロックを超えてパケットの送信順序を入れ換えるインタリーブは行わなかった。
- マルチキャストの制御プロトコル
  MLDv2(Multicast Listener Discovery Version 2 、RFC3810)を用い、PIM-SSM によるマルチキャスト通信を行った。
- 補強階層の受信制御
  １つの FEC ブロック内でデータパケットのロスが４個以上発生した時に補強階層の受信開始要求を行い、データパケットのロスが発生しない FEC ブロックが１０ブロック連続した時に補強階層の受信停止要求を行った。
- ARQ 後の処理
  ロスパケットの回復のため ARQ を行った受信端末は、検査パケットの到着に関わらず要求してから 200ms 経過した後、あらかじめパケット

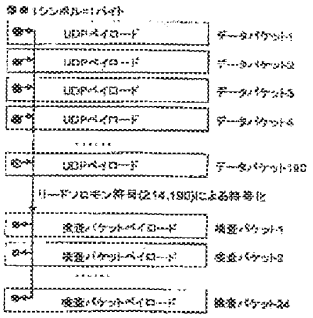


図４　データパケットから検査パケットの生成

ロスを確認し、応答パケットが正常に受信され、可能であれば回復処理を行った。なお ARQ 処理によるデータパケットの前方タイミングのジッタを回避するため、ARQ を行わない FEC ブロックについても、ARQ を行った場合と同様に FEC ブロックの受信後 200ms の遅延をさせた。

提案方式と比較のため、ロスパケットの回復能力が異なる２種類の、FEC のみを用いて ARQ を用いない方式についても評価実験を行った。

- 最大長単純 FEC 方式
  データパケットからリードソロモン符号(214、190)による検査パケット生成し、常に受信する。提案方式で、基本階層と補強階層の両方の検査パケットを用いる場合に相当する。
- 最大長単純 FEC 方式
  データパケットからリードソロモン符号(196、190)による検査パケット生成し、常に受信する。提案方式で、基本階層の前方パケットだけを用いる場合に相当する。

4.1. 評価結果(実験①)

実験①における各受信端末におけるデータパケットのロス率と、１つの FEC ブロック内のパケットのロス数の最大値を表２に示す。表２中、「最大」の列が FEC ブロック内において検出されたロス数の最大値を、「受信時」の列は FEC 及び ARQ による回復処理を行う以前のデータパケットのロス率を示す。「処理後」の列は、

表２　実験①におけるパケットのロス状況

	世田谷			新宿			昌野			和光		
	最大	受信時	処理後	最大	受信時	処理後	最大	受信時	処理後	最大	受信時	処理後
提案方式	1	1.9e-7	0.0	7	2.6e-5	0.0	6	2.9e-5	0.0	3	1.7e-5	0.0
固定長単純 FEC	1	1.9e-7	0.0	5	2.2e-5	0.0	6	2.7e-5	0.0	3	1.2e-5	0.0
固定長単純 FEC	1	1.4e-7	0.0	5	2.1e-5	0.0	6	2.6e-5	0.0	3	1.4e-5	0.0

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表3　補強階層を受信した割合(%)

世田谷	渋谷	長野	札幌
0.0	0.20	0.02	0.0

表4　各方式の平均冗長度(%)

提案	高冗長	低冗長
3.2	13.6	3.2

表5　パケットのロスが発生したFECブロック数

ロス数	1	2	3	4	5	6	7	合計
ブロック数	5	7	13	44	19	3	1	92

FEC及びARQによる回復処理を行った後のデータパケットのロス率を示す。ロス率については、ストリーミング受信を行った３５時間の平均値とした。

表2に示す通り、提案方式、高冗長単純FEC方式、低冗長単純FEC方式のいずれも、ロスしたパケットを回復処理により全て回復した。

表5から、発生したパケットロス数が４地点で異なることが分かるが、FECブロック内における最大のロス数は、提案方式の評価を行った実験で観測された７個であった。このことから、FECブロックあたり最大２４個のパケットロスを回復できる高冗長単純FEC方式は、実際には使われない冗長パケットが多く過剰であったことが分かる。低冗長単純FEC方式は、FECブロックあたり６個までのパケットのロスを回復できる。この点は、低冗長単純FEC方式の評価を行った実験で観測されたFECブロック内のロス数が最大５個であったことから、必要十分な値であったことが分かる。

提案方式の伝送効率を確認するため、提案方式において補強階層を受信したFECブロックの割合を表３に示す。実験①ではパケットロスが少数しか発生せず、大きな回復能力が必要とされなかったため、補強階層は平表となり、多くのFECブロックで補強階層を受信しなかったことが確認できる。データパケット数に対する受信した検査パケット数の割合から計算した冗長度を表４に示す。提案方式は、低冗長単純FEC方式と同等の冗長度となっており、補強階層の選択受信により効率的に伝送品質を確保したことが確認できた。

補強階層の受信を要求後、実際に補強階層の検査パケットを受信するまで概ね１秒程度を要した。この間にパケットのロスが発生したFECブロック数やブロック内のパケットのロス数ごとに表５に示す。合計９２個のFECブロックでパケットロスが観測された。これらのパケットロスを回復するためARQが一度発生したが、再送後の回復処理により全てのロスパケットを回復した。ARQの発生頻度は、受信端末あたり約１４時間に一度と充分少なく、補強階層を受信する以前に発生するパケットロスをARQにより回復できることが確認されることから、補強階層の受信に遅延を要しても提案方式が有効と言える。

4.2. 評価結果(実験②)

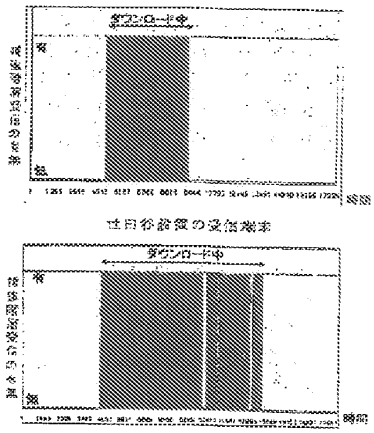
受信品質が悪い場合の提案方式の動作を検証するため、世田谷及び札幌駅の受信端末で、ストリーミング受信中に650MBのファイルをダウンロードした場合のデータパケットのロス率を表６に示す。ダウンロードによるトラフィックの増加のため、確率的にパケットロスが観測され、実験①と比較し大きな受信時ロス率となった。

表６から、提案方式は高冗長単純FEC方式と同程度にロスパケットの回復能力を持つことが分かる。実験①では、低冗長単純FEC方式と高冗長単純FEC方式とで回復後ロス率に差がなかったが、実験②では低冗長単純FEC方式は、提案方式、高冗長単純FEC方式

表6　受信端末におけるパケットロス率

	世田谷	
	受信時	処理後
提案方式	5.2e-3	9.3e-5
高冗長単純FEC方式	5.6e-3	1.3e-4
低冗長単純FEC方式	5.4e-3	1.8e-3

	札幌	
	受信時	処理後
提案方式	4.0e-3	1.9e-4
高冗長単純FEC方式	4.0e-3	1.6e-4
低冗長単純FEC方式	3.9e-3	1.3e-3



世田谷駅前の受信端末

札幌駅周の受信端末

図５　補強階層受信の有無

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表７　再送要求を行った回数

多田谷	3回
札幌	17回

と比較し処理遅延ロスが多く、十分なロスパケットの回復ができていない。

図５に多田谷及び札幌における提案方式でのダウンロード前後の補強階層の受信状態を示す。図５から、いずれの場合もダウンロード中に殆ど継続して補強階層を受信したことが分かる。ダウンロード中に補強階層を受信したFECブロックの割合は、多田谷設置の受信端末で97.2%、札幌設置の受信端末で88.8%と高く、実験①の場合と異なり多くのブロックで補強階層を利用して多くの検査パケットを受信したことが分かる。トラフィックが増加し、パケットロスが多くなったため補強階層を受信することで回復能力を高めたことが確認できる。

提案方式におけるダウンロード期間中のARQの発生回数を表７に示す。平均して約７８秒に一度のARQの発生頻度であり、発生頻度は多くない。ARQにより１８FECブロックの合計２０１個のパケットを回復した。また、ARQに対する応答のうち３回について集約の効果が確認された。

ARQは、補強階層が受信される以前に発生したパケットロスが回復不可能な時のみ行われるため、確認的に受信品質が低下した状況でも発生頻度は少なく、かつ補強階層を受信する以前のパケットロスに対する回復能力を向上したと言える。

応答の集約は絶対数が少ないものの、世田谷に設置した受信端末が発した ARQ を全て集約したことから効果があると考えられる。特にマルチキャスト通信では送信側にあるネットワーク上側でパケットがロスした場合、その影響は多数の受信端末に及ぶ。そのため多数の受信端末から同一 FEC ブロックについてのARQ が発生する状況も想定され、ARQ の応答回数に上限を設けるためにも集約の仕組みは必要と考えられる。

4.3. 評価結果のまとめ

実験①、実験②から、以下のことが分かる。

実験①のように受信品質が良好な状態が継続する場合、低冗長単純 FEC 方式でも伝送の品質を確保できるが、低冗長単純 FEC 方式では実験②のように受信品質が低下すると品質を確保できない。

実験②のように受信品質が低下する場合を考慮すると伝送品質確保のためには高冗長単純 FEC 方式が望ましいが、実験①のように受信品質が良好な場合には、有効に利用される検査パケットが少なく伝送効率が低下する。

提案方式は、実験①のように受信品質が良好な場合には、基本階層のみを受信することで伝送効率を高く保ち、散発的に発生するパケットロスに対して ARQ により伝送品質を維持する。一方、実験②のように受信品質が低下する場合には、補強階層を受信することで伝送品質を確保する。このため、良好に受信できる時間が多いが、それに受信品質が低下するネットワークに対する配信方式として有効である。

5. まとめ

検査パケットを階層化し、受信状態が良好な時には補強階層の受信を停止し受信階層を削減し、散発的に発生するパケットロスに対して ARQ を用いて伝送品質を確保し、受信状態が継続的に低下した時には補強階層を受信することで、効率よく伝送の品質を確保する伝送方式を提案した。商用のマルチキャスト配信ネットワークを用いたハイビジョンストリーム配信実験を行い、提案方式の効果を確認した。

今後、再送要求の集約方法、応答方法を改善すると共に、より多数の受信端末での評価を行う予定である。

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METHOD AND DEVICE FOR MEASURING TRANSMISSION QUALITY IN ATM OPTICAL ACCESS NETWORK

Inventor(s): MITSUYAMA TOMOAKI ± (MITSUYAMA TOMOAKI)

Applicant(s): NEC CORP ± (NEC CORP)

Classification: - **international:** ***H04B10/08; H04B17/00; H04L12/24; H04L12/26; H04L12/28; H04L12/56;*** (IPC1-7): H04B10/08; H04B17/00; H04L12/24; H04L12/26; H04L12/28

- **cooperative:**

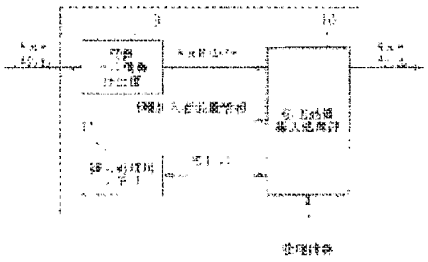
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Abstract of JP2000278281 (A)

PROBLEM TO BE SOLVED: To reduce a hardware scale for testing transmission quality of a station side device and a subscriber side device. SOLUTION: Under the condition that a system supports only a transmission quality test relating to a total frequency band of a connection supported between a station side device 4 and a subscriber side device, the connection for the transmission quality test executed by the station side device includes (N*M) kinds of connections and it is equivalent to execute the transmission quality test in the unit of subscriber devices (M kinds) and connections for the transmission quality test executed by subscriber devices are N kinds and it is equivalent to execute the transmission quality test for all input connections in a lot. Thus, the station side device 4 executes the transmission quality test for each connection outputted to the subscriber devices and each subscriber device executes the transmission quality test to all input cells.



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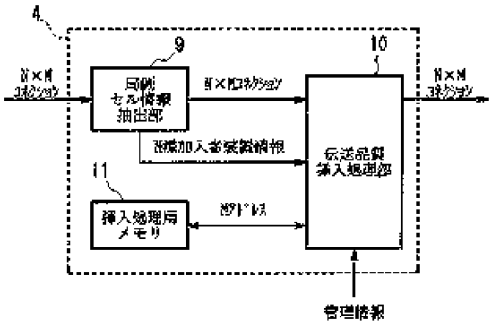
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最終頁に続く

(54)【発明の名称】　ＡＴＭ光アクセスネットワークにおける伝送品質測定方法ならびに装置

(57)【要約】
【課題】　局側装置の伝送品質試験のハードウェア規模と加入者側装置の伝送品質試験のハードウェア規模の削減をはかる。
【解決手段】　局側装置４と加入者側装置５間でサポートしているコネクションの総帯域に関する伝送品質試験のみをサポートするシステムを条件とした場合，局側装置にて実施される伝送品質試験のコネクションは（Ｎ×Ｍ）種のコネクションであるが，加入者装置単位（Ｍ種）に伝送品質試験を実施することと等価であること，ならびに，加入者装置で実施される伝送品質試験のコネクションはＮ種であるが，入力コネクションをひとまとめに伝送品質試験を実施することと等価であることから，局側装置４で加入者側装置５に出力されるコネクション毎，加入者装置で入力セル全てに対し伝送品質試験を実施するようにした。



1

【特許請求の範囲】

【請求項１】　ＡＴＭセルを用いた帯域割り当て制御により局と複数の加入者間を光伝送路を介してポイント・ツー・マルチポイントでアクセスするＡＴＭ光アクセスネットワークにおいて、前記局側装置と加入者側装置間でサポートしているコネクションの総帯域に関する伝送品質試験のみを条件とし、前記局側装置で加入者側装置に出力されるコネクション毎、前記加入者側装置で入力セルの全てに対し、それぞれ伝送品質試験を行うことを特徴とするＡＴＭ光アクセスネットワークにおける伝送品質測定方法。

【請求項２】　前記局側装置で行なわれる伝送品質試験は、セルを受信し、該受信セルに基づいて加入者側装置情報を引き出し、引き出した加入者情報に基づいて内蔵するメモリから伝送品質試験情報を読み出し、該伝送品質試験情報をもとに前記受信セルの伝送品質試験を行うことを特徴とする請求項１に記載のＡＴＭ光アクセスネットワークにおける伝送品質測定方法。

【請求項３】　前記加入者側装置で行なわれる伝送品質試験は、セルを受信し、受信セルに基づいて伝送品質試験情報を内蔵するメモリから読み出し、前記受信セルの伝送品質試験を行うことを特徴とする請求項１に記載のＡＴＭ光アクセスネットワークにおける伝送品質測定方法。

【請求項４】　局と複数の加入者間を光伝送路を介して接続し、１加入者装置あたりのサポートコネクションがＮ種、光分岐する数がＭ種であるＡＴＭ光アクセスネットワークにおいて、前記局側装置にあって、伝送品質の試験を行う試験装置は、Ｎ×Ｍのコネクションのセルを入力として受信し、Ｍ種の加入者情報のうちの一つを抽出してＮ×Ｍコネクションのセルを出力するセル情報抽出部と、該セル情報抽出部から得られる加入者装置情報をもとに挿入処理用メモリから伝送品質情報を読み出し、該セルに対して伝送品質試験処理を行う伝送品質挿入処理部から成り、前記加入者側装置にあって伝送品質の試験を行う試験装置は、Ｎコネクションのセルを入力として受信し、伝送品質試験をおこなうための情報を内蔵する抽出処理用メモリから読み出し、該セルに対し、伝送品質試験を行いＮコネクションのセルを出力する伝送品質抽出処理部から成ることを特徴とするＡＴＭ光アクセスネットワークにおける伝送品質測定装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、ＡＴＭ光アクセスネットワーク（ＰＯＮ）における伝送品質測定方法ならびに装置に関する。

【０００２】

【従来の技術】光アクセスネットワークの一形態にＰＯＮ（Passive Optical Network）方式がある。このＰＯＮ方式は、局側にあるＯＬＴ（Optical Line Terminal）と加入者側にあるＯＮＵ（Optical Network Unit）の間に光カップラ等の光受動素子のみでアクセス網を構築することからパッシブ・オプティカル・ネットワークと呼ばれる。このＰＯＮ方式は、ＰＤＳ（Passive Double Star）方式と基本構成は同じであるが、局と複数の加入者間をポイントツーマルチポイントにアクセスすることが可能なことから、局側装置のコスト低減に寄与する加入者多重を実現する。図５に、局側装置５１に光伝送路５３を介して加入者装置５２が分岐接続され、フレームを構成するセルをＡＴＭ（非同期転送モード）で伝送する、ＡＴＭ－ＰＯＮ通信系が示されている。このＡＴＭ－ＰＯＮ通信系では、局側装置５１と複数（ＭＡＸ３２分岐）の加入者側装置５２間の伝送品質を測定する伝送品質試験が存在する。ここでいう伝送品質試験とは、局側装置５１と加入者側装置間５２でサポートする全てのコネクションに対し実施される試験である。図６に示すように、ＡＴＭ－ＰＯＮ通信系では、加入者装置５２を複数接続することから、一加入者装置あたりのサポートコネクションをＮ種、光分岐する数をＭ種（Ｍ≦３２、Ｎ＞Ｍ）とすれば、局側装置５１が持つ試験装置５４では、（Ｎ×Ｍ）種のコネクションに対する伝送品質試験を実施し、加入者側装置５２が持つ試験装置５５では、Ｎ種のコネクションに対し伝送品質試験を実施することになる。この伝送品質試験において、コネクションに対するＯＡＭ（Operation Administration and Maintenance）機能は、ユーザセル（試験対象ユーザセル５６、試験対象外ユーザセル５８）のそれぞれに対しオーバヘッド情報（ＯＡＭセル５７）を付加することで実現される。

【０００３】

【発明が解決しようとする課題】ところで、上述した従来例によれば、サポートコネクションが一つ増えると、それに伴ない、局側装置５１と加入者側装置５２の伝送品質試験のために使用されるメモリ規模が増え、更に周辺ハードウェア規模も増大するという欠点があった。一方、局側装置５１と加入者装置５２間でサポートしているコネクションの総帯域に関する伝送品質試験のみをサポートすることを条件とした場合、局側装置５１で実施される伝送品質試験のコネクションは（Ｎ×Ｍ）種のコネクションであるが、加入者装置単位（Ｍ種）に伝送品質試験を実施することと等価である。また、加入者側装置で実施される伝送品質試験のコネクションはＮ種であるが、入力コネクションをひとまとめ（１種）に伝送品質試験を実施することと等価である。本発明は上記事情に鑑みてなされたものであり、ＡＴＭ－ＰＯＮ通信系において、局側装置と加入者側装置間でサポートしているコネクションの総帯域に関する伝送品質試験のみをサポートすることを条件とし、局側装置では加入者側装置に出力されるコネクション毎に、加入者側装置では入力セル全てに対し伝送品質試験を実施することにより、局側

装置の伝送品質試験のハードウェア規模と加入者側装置の伝送品質試験のハードウェア規模の削減をはかることのできる、ＡＴＭ光アクセスネットワークにおける伝送品質測定方法ならびに装置を提供することを目的とする。

【０００４】

【課題を解決するための手段】上述した課題を解決するために請求項１に記載のＡＴＭ光アクセスネットワークにおける伝送品質測定方法は、ＡＴＭセルを用いた帯域割り当て制御により局と複数の加入者間を光伝送路を介してポイント・ツー・マルチポイントでアクセスするＡＴＭ光アクセスネットワークにおいて、前記局側装置と加入者側装置間でサポートしているコネクションの総帯域に関する伝送品質試験のみを条件とし、前記局側装置で加入者側装置に出力されるコネクション毎、前記加入者側装置で入力セルの全てに対し、それぞれ伝送品質試験を行うことを特徴とする。また、請求項２に記載のＡＴＭ光アクセスネットワークにおける伝送品質測定方法は、請求項１に記載の伝送品質測定方法において、局側装置で行なわれる伝送品質試験は、セルを受信し、該受信セルに基づいて加入者装置情報を引き出し、引き出した加入者情報に基づいて内蔵するメモリから伝送品質試験情報を読み出し、該伝送品質試験情報をもとに前記受信セルの伝送品質試験を行うことを特徴とする。更に請求項３に記載のＡＴＭ光アクセスネットワークにおける伝送品質測定方法は、請求項１に記載の伝送品質測定方法において、加入者側装置で行なわれる伝送品質試験は、セルを受信し、受信セルに基づいて伝送品質試験情報を内蔵するメモリから読み出し、前記受信セルの伝送品質試験を行うことを特徴とする。

【０００５】請求項４に記載のＡＴＭ光アクセスネットワークにおける伝送品質測定装置は、局と複数の加入者間を光伝送路を介して接続し、１加入者装置あたりのサポートコネクションがＮ種、光分岐する数がＭ種であるＡＴＭ光アクセスネットワークにおいて、前記局側装置にあって、伝送品質の試験を行う試験装置は、Ｎ×Ｍのコネクションのセルを入力として受信し、Ｍ種の加入者情報のうちの一つを抽出してＮ×Ｍコネクションのセルを出力するセル情報抽出部と、該セル情報抽出部から得られる加入者装置情報をもとに挿入処理用メモリから伝送品質情報を読み出し、該セルに対して伝送品質試験処理を行う伝送品質挿入処理部から成り、前記加入者側装置にあって伝送品質の試験を行う試験装置は、Ｎコネクションのセルを入力として受信し、伝送品質試験をおこなうための情報を内蔵する抽出処理用メモリから読み出し、該セルに対し、伝送品質試験を行いＮコネクションのセルを出力する伝送品質抽出処理部から成ることを特徴とする。

【０００６】本発明は、局側装置と加入者側装置間でサポートしているコネクションの総帯域に関する伝送品質試験のみをサポートするシステムを条件とした場合、局試験装置で実施される伝送品質試験のコネクションは（Ｎ×Ｍ）種のコネクションであるが、加入者装置単位（Ｍ種）に伝送品質試験を実施することと等価であること、また、加入者試験装置で実施される伝送品質試験のコネクションはＮ種であるが、入力コネクションをひとまとめ（１種）に伝送品質試験を実施することと等価であることに着目し、局側装置においてＭ種の加入者装置単位に伝送品質の試験を実施し、加入者側装置においてＮ種の入力コネクションをひとまとめに伝送品質試験を実施することで、それぞれ、メモリに格納すべきデータの種類を（Ｎ×Ｍ）種からＭに、Ｎ種必要であったメモリ格納情報を１種に削減でき、また、周辺ハードウェアの削減も可能とするものである。

【０００７】

【発明の実施の形態】図１、図２は本発明の実施形態を示すブロック図であり、それぞれ、局側装置が持つ試験装置（以下、局試験装置４と称す）、加入者側装置が持つ試験装置（以下、加入者試験装置５と称す）の内部構成を示す。図１において、局試験装置４は、局側セル情報抽出部９、伝送品質挿入処理部１０、挿入処理用メモリ１１を含む。図２において、加入者試験装置５は、伝送品質抽出処理部１２、抽出処理用メモリ１３を含む。

【０００８】局側セル情報抽出部９は、（Ｎ×Ｍ）コネクションのセルが入力され、Ｍ種のうちの一つの加入者装置情報を抽出し、（Ｎ×Ｍ）コネクションのセルを出力する。伝送品質挿入処理部１０は、前記局側セル情報抽出部９から出力されるＭ種の加入者装置情報をもとに、挿入処理用メモリ１１から伝送品質試験情報を読み出し、管理情報に基づき前記セルに対して伝送品質試験処理を行い、（Ｎ×Ｍ）コネクションのセルを出力する。伝送品質抽出処理部１２は、Ｎコネクションのセルが入力され、伝送品質試験を実施するための情報を抽出処理用メモリ１３から読み出し、管理情報に基づいて入力セルに対して伝送品質試験処理を行う。

【０００９】図３、図４は本発明実施形態の動作を説明するために引用した図であり、それぞれ、局試験装置４、加入者試験装置５でセルを受信した以降の伝送品質試験処理の手順がフローチャートで示されている。動作説明に先立ち、局側装置と加入者装置間でサポートしているコネクションの総帯域に関する伝送品質試験のみをサポートするシステムを条件とした場合、局試験装置４で実施される伝送品質試験のコネクションは（Ｎ×Ｍ）種のコネクションであるが、加入者装置単位（Ｍ種）に伝送品質試験を実施することと等価であること、また、加入者試験装置５で実施される伝送品質試験のコネクションはＮ種であるが、入力コネクションをひとまとめ（１種）に伝送品質試験を実施することと等価であることは上述したとおりである。

【００１０】本発明はこのことを利用したものであり、

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以下．図１、図２に示す本発明実施形態の動作につき、図３．図４に示すフローチャートを参照しながら説明する。まず、局試験装置４が持つ局側セル情報抽出部９でセルを受信した場合（ステップＡ１）．受信セルから加入者装置情報を引き出し（ステップＡ２）、引き出した情報を伝送品質挿入処理部１０へ入力セルと同時に出力する（ステップＡ３）。伝送品質挿入処理部１０は、加入者装置情報をもとに挿入処理用メモリ１１から伝送品質試験情報を読み出し（ステップＡ４）、該セルに対し伝送品質処理を実施し、セルを出力する（ステップＡ５）。

【００１１】加入者試験装置５が持つ伝送品質抽出処理部１２がセルを受信した場合（ステップＢ１）．抽出処理用メモリ１３から伝送品質試験情報を抽出する（ステップＢ２）。伝送品質抽出処理部１２は、抽出した伝送品質試験情報を元に、該セルに対し伝送品質試験処理を実施し、セルを出力する（ステップＢ３）。尚．伝送品質挿入処理部１０と伝送品質抽出処理部１２による伝送品質試験処理そのものは．従来の伝送品質試験処理と等価の動作である。

【００１２】以上説明のように本発明は、局側装置と加入者側装置間でサポートしているコネクションの総帯域に関する伝送品質試験のみをサポートすることを条件に．局側装置では加入者装置に出力されるコネクション毎．加入者装置では入力セル全てに対し伝送品質試験を実施することにより、局側装置の伝送品質試験のハードウェア規模と加入者装置の伝送品質試験のハードウェア規模の削減をはかるものである。

【００１３】

【発明の効果】以上説明のように本発明によれば．メモリを縮小でき周辺ハードウェア規模の削減がはかれる。すなわち、局側装置においてはＭ種の加入者装置単位に伝送品質試験を実施することで、メモリに格納すべきデータの種類を（Ｎ×Ｍ）種からＭ種に削減でき．加入者側装置においてはＮ種の入力コネクションをひとまとめに伝送品質試験を実施することで、Ｎ種必要であったメモリ格納情報を１種に減らすことができる。また．サポートコネクションが増えた場合のメモリ容量の増加も抑制できる。それは、局側装置において加入者装置単位に伝送品質試験を実施しているため、サポートコネクションが増加してもメモリとは無縁になるためであり．また．加入者側装置においては、コネクションが増えても増えたコネクションも一緒にひとまとめにして伝送品質試験を実施するためである。

【図面の簡単な説明】

【図１】　本発明の実施形態を示すブロック図である。

【図２】　本発明の実施形態を示すブロック図である。

【図３】　図１に示す実施形態の動作を説明するために引用したフローチャートである。

【図４】　図２に示す実施形態の動作を説明するために引用したフローチャートである。

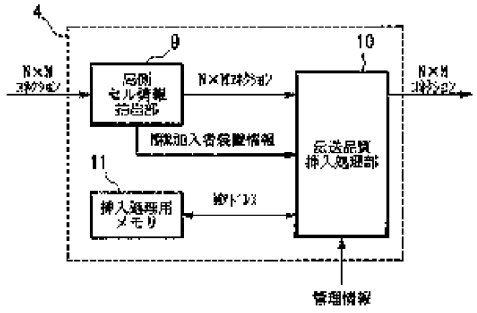
【図５】　ＡＴＭ－ＰＯＮ通信系の接続構成を示すブロック図である。

【図６】　従来の伝送品質測定における動作概念を示す図である。

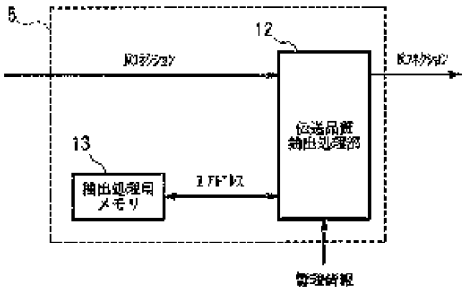
【符号の説明】

４…局試験装置．５…加入者側装置．９…局側セル情報抽出部．１０…伝送品質挿入処理部．１１…挿入処理用メモリ、１２…伝送品質抽出処理部．１３…抽出処理用メモリ

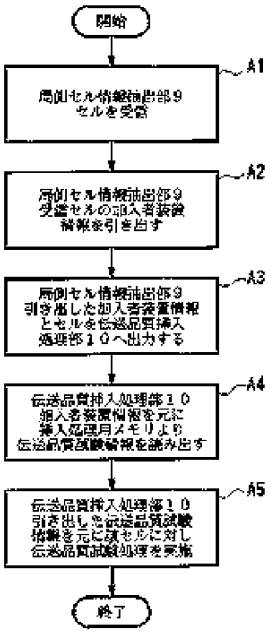
【図１】



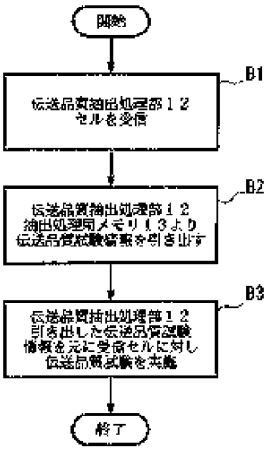
【図２】



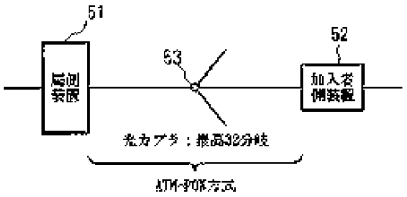
【図３】



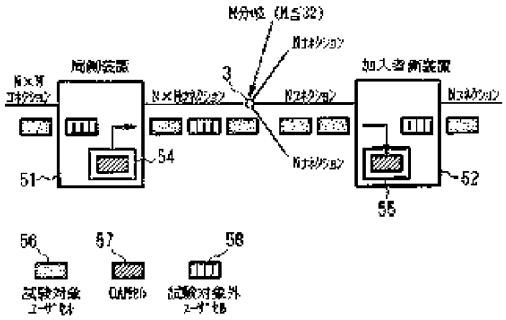
【図４】



【図５】



【図６】



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Ｆターム(参考) 5K002 AA05 BA04 DA12 EA05 FA01
GA03
5K030 GA05 HA10 HB29 JL03 LC09
MB04 MC08
5K042 AA02 AA04 CA10 CA13 CA16
DA11 EA01 FA15 GA17 JA01
LA13 LA15
9A001 CC07 LL08

Electronic Acknowledgement Receipt

EFS ID:	18488468
Application Number:	13257621
International Application Number:	
Confirmation Number:	1450
Title of Invention:	Method and Passive Optical Network System for Managing Uplink Burst Overhead Parameters
First Named Inventor/Applicant Name:	Dezhi Zhang
Customer Number:	95957
Filer:	Ling Wu
Filer Authorized By:	
Attorney Docket Number:	AFD111101442-US
Receipt Date:	17-MAR-2014
Filing Date:	02-APR-2012
Time Stamp:	14:55:03
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	Supplemental_IDS_AFD111101442-US.pdf	612201 21842bae42d21f58282927e9ec6b6d077d96168c	no	4

Warnings:	
Information:	

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

2	Foreign Reference	Reliable_Multicast_with_ARQ_and_FEC_for_strcaming_HDTV.pdf	640056 03827ea13f036629804e0bb45a3e7bf0e8deb249	no	8

Warnings:

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Information:

3	Foreign Reference	JP2000278281A.pdf	208354 7156675e432ddf33da274ba0b484b4bc68b71aa4	no	6

Warnings:

Information:

Total Files Size (in bytes):	1460611

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.

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

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

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

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
13/257,621	04/02/2012	Dezhi Zhang	AFD111101442-US

CONFIRMATION NO. 1450

95957
Ling Wu
1107 Bettstrail Way
Potomac, MD 20854

PUBLICATION NOTICE

OC000000056135293

Title: Method and Passive Optical Network System for Managing Uplink Burst Overhead Parameters

Publication No.US-2012-0213509-A1
Publication Date:08/23/2012

NOTICE OF PUBLICATION OF APPLICATION

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

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

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

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

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

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
13/257,621	04/02/2012		980	AFD111101442-US	14	3

CONFIRMATION NO. 1450

95957
Ling Wu
1107 Bettstrail Way
Potomac, MD 20854

FILING RECEIPT

OC000000054270535

Date Mailed: 05/15/2012

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

Applicant(s)

Dezhi Zhang, Shenzhen City, CHINA;
Marek Hajduczenia, Fiaes, PORTUGAL;
Liquan Yuan, Shenzhen City, CHINA;
Weiliang Zhang, Shenzhen City, CHINA;

Assignment For Published Patent Application

ZTE CORPORATION, Shenzhen City, Guangdong Province, CN

Power of Attorney: The patent practitioners associated with Customer Number 95957

Domestic Priority data as claimed by applicant

This application is a 371 of PCT/CN2010/073773 06/10/2010

Foreign Applications (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.)
CHINA 200910212093.3 11/04/2009

If Required, Foreign Filing License Granted: 05/14/2012

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 13/257,621**

Projected Publication Date: 08/23/2012

Non-Publication Request: No

Early Publication Request: No

Title

Method and Passive Optical Network System for Managing Uplink Burst Overhead Parameters

Preliminary Class

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

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

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

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

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

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

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Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

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U.S. APPLICATION NUMBER NO.	FIRST NAMED APPLICANT	ATTY. DOCKET NO.
13/257,621	Dezhi Zhang	AFD111101442-US

95957
Ling Wu
1107 Bettstrail Way
Potomac, MD 20854

INTERNATIONAL APPLICATION NO.	
PCT/CN2010/073773	
I.A. FILING DATE	PRIORITY DATE
06/10/2010	11/04/2009

CONFIRMATION NO. 1450
371 ACCEPTANCE LETTER

OC000000054270536

Date Mailed: 05/15/2012

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

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

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

04/02/2012	05/04/2012
DATE OF RECEIPT OF 35 U.S.C. 371(c)(1), (c)(2) and (c)(4) REQUIREMENTS	DATE OF COMPLETION OF ALL 35 U.S.C. 371 REQUIREMENTS

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

The following items have been received:

- Copy of the International Application filed on 09/20/2011
- English Translation of the IA filed on 09/20/2011
- Copy of the International Search Report filed on 09/20/2011
- Copy of IPE Report filed on 05/14/2012
- Preliminary Amendments filed on 04/02/2012
- Information Disclosure Statements filed on 04/02/2011
- Oath or Declaration filed on 04/02/2012
- U.S. Basic National Fees filed on 09/20/2011

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

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

CHARITTA A SHELTON

Telephone: (571) 272-3926

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

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 13/257,621

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	380
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	490
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	250
TOTAL CLAIMS (37 CFR 1.16(i))	14 minus 20 =	*			OR	x 60 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	*				x 250 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1120

APPLICATION AS AMENDED - PART II

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

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

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

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

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

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

MULTIPLE DEPENDENT CLAIM FEE CALCULATION SHEET

Substitute for Form PTO-1360
(For use with Form PTO/SB/06)

Application Number	Filing Date
13257621	

Applicant(s) Dezhi ZHANG

* May be used for additional claims or amendments

CLAIMS	AS FILED		AFTER FIRST AMENDMENT		AFTER SECOND AMENDMENT	
	Indep	Depend	Indep	Depend	Indep	Depend
1	1		1			
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Total Indep	3		3		0	
Total Depend	15	↵	11	↵	0	↵
Total Claims	18		14		0	

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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: **Dezhi ZHANG et al.**	)	Customer No.: **95957**
Serial No.: **13/257,621**	)	Confirmation No.: **1450**
Filed: **09/20/2011**	)	Art Unit: **Unknown**
For: **Method and Passive Optical Network System for Managing Uplink Burst Overhead Parameters**	)	Examiner: **Unknown**

PRELIMINARY AMENDMENTS

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

Dear Sir or Madam:

Please amend the application as set forth herein.

Amendments to the Specification begin on page 2 of this paper.

Amendments to the Claims begin on page 36 of this paper.

Remarks begin on page 47 of this paper.

Exhibit 1002
IPR2024-00900, USPN 8,934,359
104 of 441

Replace the Specification with the following amended Specification.

Method and Passive Optical Network System for Managing Uplink Burst Overhead Parameters

Technical Field

The present invention relates to the field of optical communication technology, and more particularly, to a method for assigning and managing upstream burst overhead parameters used between an optical line terminal (OLT) and an Optical Network Unit (ONU) in a passive optical network (PON) system and the passive optical network system.

Background of the Related Art

In the PON technology, it needs consistent upstream burst overhead parameters (i.e., parameters of upstream burst overhead) in the OLT and the ONU: the ONU sends upstream frames according to the determined upstream burst overhead parameters; the OLT correctly receives the upstream frames also according to the determined upstream burst overhead parameters. Based on this premise, the PON can work properly. Generally, the upstream burst overhead parameters include:

(1) State (on or off) of Forward Error Correction (FEC);

(2) Delimiter, which has a variable length and can be suitable to different optical fiber link quality;

(3) Preamble, which typically is a constant, but also may be several constants for selecting, and relates to different optical fiber link quality and performance of the optical module; and

(4) Guard band (Guard time), which is the number of bits of the guard band, and generally has a constant length.

In the existing ITU G.984.3 GPON technology standard, these upstream burst overhead parameters are determined between the OLT and the ONU according to the following method: in a register process which starts up periodically, the OLT broadcasts a part of the upstream burst overhead parameters required by the OLT, including the parameters (2), (3) and (4) in the above-mentioned upstream burst overhead parameters, to all ONUs which communicate with

the OLT. As shown in FIG. 1, after the ONU acquires downstream physical layer synchronization and enters into a waiting state (i.e., O2 state), it continuously monitors a message carrying the part of the upstream burst overhead parameters broadcasted by the OLT in the downlink; once the message is received successfully, the ONU records the carried upstream burst overhead parameters, and then transfers to a serial number state (i.e., O3 state); and the ONU uses these received upstream burst overhead parameters in the subsequent working process without modification.

In addition, in the existing Gigabit Passive Optical Network (GPON) standards, state notification mechanism of the parameter (1) FEC in the upstream burst overhead parameters is independent from communication mechanism of the above-mentioned parameters (2), (3) and (4). The on/off notification of the parameter (1) FEC is indicated in real time by a fixed indication bit in a tag field assigned for each upstream burst bandwidth of each ONU in a bandwidth assignment field of the downstream frame.

Content of the Invention

The actual implementation in the prior art has two problems:

Complexity problem: indications of the upstream burst overhead parameters in the GPON system are performed separately, thus it has high complexity.

Efficiency problem: Once the ONU in the GPON system determines the upstream burst overhead parameters such as preamble and delimiter, these parameters are not updated any more; after the quality of some links is improved, and at the time relatively short preamble is allowed to be used for upstream communication, there is no corresponding mechanism provided for negotiation, and the original upstream burst overhead parameters are forced to be used for upstream communication, which is not flexible and cannot improve bandwidth efficiency along with quality improvement of the link.

The present invention provides a method for managing upstream burst overhead parameters between optical access nodes to improve the bandwidth utilization.

In order to solve the above problem, the present invention provides a method for

managing the upstream burst overhead parameters, comprising:

an optical line terminal (OLT) or an optical network unit (ONU) detecting transmission quality of a downlink between the OLT and the ONU;

The OLT or the ONU determining upstream burst overhead parameters suitable for the ONU according to the transmission quality; and

The ONU starting to use the upstream burst overhead parameters suitable for the ONU after the switching time determined by the ONU itself or indicated by the OLT.

Before the step of the OLT or the ONU detecting the transmission quality of the downlink between the OLT and the ONU, the method further comprises:

the OLT determining and identifying N kinds of upstream burst overhead parameter sets according to different levels of link quality; wherein, N is an integer and is larger than zero; and

the OLT sending a parameter value or an identification of one default upstream burst overhead parameter set to the ONU, and the ONU receiving the parameter value or the identification of the upstream burst overhead parameter set in a waiting state and using the upstream burst overhead parameter set; or,

the OLT sending parameter values or identifications of more than one upstream burst overhead parameter set to the ONU, and the ONU receiving the parameter values or the identifications of the more than one upstream burst overhead parameter set in a waiting state and using one of the more than one upstream burst overhead parameter set.

After the step of the ONU receiving the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s), the method further comprises: the ONU entering into a serial number state;

the step of the ~~ONU~~ OLT detecting the transmission quality of the downlink between the OLT and the ONU comprises: in the serial number state of the ONU, the OLT detecting the downlink between the ONU and the OLT to acquire the quality information of the downlink;

the step of the OLT determining the upstream burst overhead parameters suitable for the ONU according to the transmission quality comprises: the OLT determining the upstream burst overhead parameter set(s) suitable for the ONU according to the quality information of the

downlink, and notifying the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) suitable for the ONU to the ONU via a unicast message or a broadcast message.

After the step of the ONU receiving the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s), the method further comprises: the ONU entering into a serial number state;

the step of the ONU detecting the transmission quality of the downlink between the OLT and the ONU comprises: in the serial number state of the ONU, the ONU detects the downlink between the ONU and the OLT to acquire the quality information of the downlink;

after the step of acquiring the quality information of the downlink, the method further comprises: the ONU notifying the quality information of the downlink to the OLT;

the step of the OLT determining the upstream burst overhead parameters suitable for the ONU according to the transmission quality comprises: the OLT determining the upstream burst overhead parameter set(s) suitable for the ONU according to the quality information of the downlink, and notifying the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) suitable for the ONU to the ONU via a unicast message or a broadcast message.

After the step of the ONU receiving the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s), the method further comprises: the ONU entering into a serial number state;

the step of the ONU detecting the transmission quality of the downlink between the OLT and the ONU comprises: in the serial number state of the ONU, the ONU detecting the downlink between the ONU and the OLT to acquire the quality information of the downlink;

the step of the ONU determining the upstream burst overhead parameters suitable for the ONU according to the transmission quality comprises: the ONU determining the upstream burst overhead parameter set(s) suitable for the ONU according to the quality information of the downlink, and notifying the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) suitable for the ONU to the OLT via a unicast message or a broadcast

message.

While or after the OLT notifies the ONU the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s), or while or after the ONU notifies the OLT the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s), the method further comprises: the OLT setting a switching index value of the upstream burst overhead parameters in the tag field assigned for the bandwidth of the ONU and sending it to the ONU via a downstream frame; the step of the ONU starting to use the upstream burst overhead parameters after the switching time indicated by the OLT comprises: after the ONU receives the switching index value, it using the upstream burst overhead parameters suitable for the ONU in the next frame; or

while or after the OLT notifies the ONU the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s), or while or after the ONU notifies the OLT the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s), the method further comprises: the OLT notifying the ONU a hyper frame number; the step of the ONU starting to use the upstream burst overhead parameters after the switching time indicated by the OLT comprises: after the ONU receives the hyper frame number, it starting to use the upstream burst overhead parameters suitable for the ONU after the frame indicated by the hyper frame number arrives; or

while or after the OLT notifies the ONU the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s), or while or after the ONU notifies the OLT the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set, the method further comprises: the ONU notifying the ONU a hyper frame number; the step of the ONU starting to use the upstream burst overhead parameters after the switching time determined by the ONU itself comprises: after the frame indicated by the hyper frame number arrives, the ONU starting to use the upstream burst overhead parameters suitable for the ONU.

The upstream burst overhead parameter set comprises: state of forward error correction, delimiter, preamble, and guard band.

In the step of the OLT sending the parameter values or the identifications of more than

one upstream burst overhead parameter set to the ONU, the OLT sends the parameter values or identifications of one or more upstream burst overhead parameter sets to all ONUs or one or more ONUs which communicate with the OLT.

In order to solve the above technical problem, the present invention also provides a PON system for managing the upstream burst overhead parameters, comprising an OLT or an ONU. The OLT is used to detect the transmission quality of the downlink between the OLT and the ONU, determine the upstream burst overhead parameters suitable for the ONU according to the transmission quality and notify the parameters to the ONU; and the OLT is further used to indicate the switching time to the ONU. The ONU is used to detect the transmission quality of the downlink between the OLT and the ONU and determine the upstream burst overhead parameters suitable for the ONU according to the transmission quality; or, the ONU directly receives from the OLT the transmission quality of the downlink determined by the OLT; and the ONU is further used to start to use the upstream burst overhead parameters after the switching time determined by the ONU itself or indicated by the OLT.

In order to solve the above problem, the present invention also provides an ONU for managing the upstream burst overhead parameters, and the ONU comprises a first parameter acquisition module and a switching module; wherein:

the first parameter acquisition module is configured to:

detect transmission quality of a downlink between the OLT and the ONU or receive the transmission quality of the downlink detected and sent by the OLT, determine upstream burst overhead parameters suitable for the ONU according to the transmission quality, and send the upstream burst overhead parameters suitable for the ONU to the OLT; or,

detect transmission quality of a downlink between an OLT and the ONU, send the transmission quality to the OLT, and receive from the OLT the upstream burst overhead parameters suitable for the ONU determined according to the transmission quality; or,

directly receive from the OLT the upstream burst overhead parameters suitable for the ONU determined by the OLT; and,

while or after notifying the OLT the upstream burst overhead parameters suitable for the ONU, or while or after receiving the upstream burst overhead parameters suitable for the ONU sent by the OLT, indicate the switching module;

the switching module is configured to:

while or after receiving an indication from the first parameter acquisition module, determine ~~a~~ switching ~~event~~ time or receive switching time indicated by the OLT, and start to use the upstream burst overhead parameters suitable for the ONU after the switching time determined by the ONU itself or indicated by the OLT.

The ONU also comprises a burst overhead parameter set receiving module.

The burst overhead parameter set receiving module is configured to: receive, in a waiting state, a parameter value or an identification of one default upstream burst overhead parameter set sent by the OLT to the ONU after the OLT determines and identifies N kinds of upstream burst overhead parameter sets according to different levels of link quality, and use this upstream burst overhead parameter set; or,

receive, in a waiting state, parameter values or identifications of more than one upstream burst overhead parameter set sent by the OLT to the ONU after the OLT determines and identifies N kinds of upstream burst overhead parameter sets according to different levels of link quality, and use one of the upstream burst overhead parameter sets;

Wherein, N is an integer and is larger than zero.

the switching module is further configured to: while or after receiving the indication from the first parameter acquisition module, receive a switching index value of the upstream burst overhead parameters which is sent from the OLT to the ONU via a downstream frame and are set in a tag field assigned for a bandwidth of the ONU by the optical line terminal; and, the switching module is configured to start to use the upstream burst overhead parameters after the switching time indicated by the OLT according to the following manner: after receiving the switching index value, using the upstream burst overhead parameters in a next frame; or

the switching module is further configured to: while or after receiving the indication from

the first parameter acquisition module, receive a hyper frame number notified by the OLT to the ONU; and, the switching module is configured to start to use the upstream burst overhead parameters after the switching time indicated by the OLT according to the following manner: after a frame indicated by the hyper frame number arrives, starting to use the upstream burst overhead parameters; or

the switching module is further configured to: while or after receiving the indication from the first parameter acquisition module, notify a hyper frame number to the ONU; and, the ONU is configured to start to use the upstream burst overhead parameters after the switching time determined by the ONU itself according to the following method: after a frame indicated by the hyper frame number arrives, start to use the upstream burst overhead parameters.

In order to solve the above-mentioned method, the present invention also provides an optical line terminal (OLT) for managing the upstream burst overhead parameters, and the OLT comprises: a second parameter acquisition module and a switching time transceiving module, wherein:

The second parameter acquisition module is configured to:

detect transmission quality of a downlink between the OLT and an ONU, send the transmission quality to the ONU, and receive upstream burst overhead parameters suitable for the ONU determined by the ONU according to the transmission quality sent by the OLT; or,

detect transmission quality of a downlink between the OLT and an ONU, determine upstream burst overhead parameters suitable for the ONU according to the transmission quality, and notify the determined upstream burst overhead parameters suitable for the ONU to the ONU; or,

receive transmission quality of a downlink detected and sent by an ONU, determine the upstream burst overhead parameters suitable for the ONU according to the transmission quality, and notify the determined upstream burst overhead parameters suitable for the ONU to the ONU; or,

receive upstream burst overhead parameters suitable for an ONU which are sent and

determined by the ONU according to transmission quality of a downlink detected and acquired by the ONU itself; and

while or after notifying the determined upstream burst overhead parameters suitable for the ONU to the ONU, or while or after receiving the upstream burst overhead parameters suitable for the ONU sent by the ONU, indicate switching time transceiving module;

The switching time transceiving module is configured to:

while or after receiving an indication from the second parameter acquisition module, indicate the switching time to the ONU or receive the switching time sent by the ONU, so that the ONU start to use the upstream burst overhead parameters after the switching time.

A upstream burst overhead parameter set acquisition module, configured to: determine and identify N kinds of upstream burst overhead parameter sets according to different levels of link quality; wherein, N is an integer and is larger than zero; and send a parameter value or an identification of one default upstream burst overhead parameter set to the ONU, or, send the parameter values or the identifications of more than one upstream burst overhead parameter set to the ONU,

so that the ONU can receive the parameter value or the identification of one upstream burst overhead parameter set in a waiting state and use this upstream burst overhead parameter set; or, the ONU can receive the parameter values or the identifications of more than one upstream burst overhead parameter set in a waiting state and use one of them.

The switching time transceiving module is configured to indicate the switching time to the ONU according to the following manner: setting a switching index value of the upstream burst overhead parameters in a tag field assigned for a bandwidth of the ONU, and sending the switching index value to the ONU via a downstream frame, so that after the ONU receives the switching index value, the ONU uses the upstream burst overhead parameters in a next frame; or,

the switching time transceiving module is configured to indicate the switching time to the

ONU according to the following manner: notifying a hyper frame number to the ONU, so that the ONU starts to use the upstream burst overhead parameters after a frame indicated by the hyper frame number arrives; or,

the switching time transceiving module is configured to receive the switching time sent by the ONU according to the following method: receiving a hyper frame number notified by the ONT, so that the ONU starts to use the upstream burst overhead parameters after a frame indicated by the hyper frame number arrives.

The present invention is able to improve the bandwidth utilization and decrease the complexity of indicating the upstream burst overhead parameters in the PON system, thereby the ONU and the OLT can flexibly and simply select the upstream burst overhead parameters.

Brief Description of Drawings

FIG. 1 is a schematic diagram of an OLT periodically broadcasting upstream burst overhead parameters in a GPON system in the prior art;

FIG. 2 is a schematic diagram of a method for managing upstream burst overhead parameters between optical access nodes in accordance with an embodiment of the present invention;

FIG. 3 is a schematic diagram of a method for managing upstream burst overhead parameters in accordance with the first embodiment;

FIG. 4 is a schematic diagram of a method for managing upstream burst overhead parameters in accordance with the second embodiment;

FIG. 5 is a schematic diagram of a method for managing upstream burst overhead parameters in accordance with the third embodiment;

FIG. 6 is a schematic diagram of a method for managing upstream burst overhead parameters in accordance with the fourth embodiment;

FIG. 7 is a schematic diagram of a method for managing upstream burst overhead parameters in accordance with the fifth embodiment;

FIG. 8 is a schematic diagram of a method for managing upstream burst overhead

parameters in accordance with the sixth embodiment; and

FIG. 9 is a schematic diagram of a method for managing upstream burst overhead parameters in accordance with the seventh embodiment.

Preferred Embodiments of the Present Invention

As shown in FIG. 2, a method for managing upstream burst overhead parameters between optical access nodes includes the following steps:

Step 201, an OLT or an ONU detects transmission quality of a downlink between the OLT and the ONU when the ONU is at a serial number state (i.e., O3 state);

Step 202, the OLT or the ONU determines upstream burst overhead parameters suitable for using by the ONU according to the transmission quality; and

Step 203, the ONU starts to use the upstream burst overhead parameters after switching time is indicated by the OLT or determined by the ONU itself.

The method of the present invention will be described in detail in the following.

In the method of the present invention, when the ONU is at an initial state (i.e., O1 state), the OLT determines and identifies N kinds of upstream burst overhead parameter sets according to different levels of the link quality, wherein N is an integer and is larger than zero. Each upstream burst overhead parameter set includes the following parameters: state of forward error correction, delimiter, preamble and guard band.

The OLT sends a parameter value or an identification of one default upstream burst overhead parameter set to the ONU, and the ONU receives the parameter value or the identification of the upstream burst overhead parameter set in a waiting state (i.e., O2 state) and uses that upstream burst overhead parameter set; or, the OLT sends parameter values or identifications of more than one upstream burst overhead parameter set to the ONU, and after the ONU receives the parameter values or the identifications of more than one upstream burst overhead parameter set in the O2 state, it uses one of the upstream burst overhead parameter sets. When there is a plurality of the upstream burst overhead parameter sets, one of them can be set as a default set. After the ONU receives parameters of more than one upstream burst

overhead parameter set, it can select the default set or any one from the more than one upstream burst overhead parameter set to use.

The OLT can unicast the upstream burst overhead parameter set to a specific ONU or broadcast to all ONUs.

In steps 201 and 202, in the case that the OLT detects the downlink between the OLT and the ONU, the OLT acquires the quality information of that downlink by detecting the downlink, determines the upstream burst overhead parameter set used by the ONU according to the quality information of that downlink, and notifies the parameter value in the upstream burst overhead parameter set or the identification of the upstream burst overhead parameter set to the ONU via a unicast message or a broadcast message;

Or, in steps 201 and 202, in the case that the ONU detects the downlink between the OLT and the ONU, the ONU acquires the quality information of that downlink by detecting the downlink, and notifies the quality information of the downlink to the OLT; the OLT determines the upstream burst overhead parameter set used by the ONU according to the quality information of the downlink, and notifies the parameter value in the upstream burst overhead parameter set or the identification of the upstream burst overhead parameter set to the ONU via a unicast message or a broadcast message;

Or, in steps 201 and 202, in the case that the ONU detects the downlink between the OLT and the ONU, the upstream burst overhead parameter set used by the ONU also can be determined by the ONU itself. The ONU acquires the quality information of that downlink by detecting the downlink, determines the upstream burst overhead parameter set used by the ONU according to the quality information of the downlink, and notifies the parameter value in the upstream burst overhead parameter set or the identification of the upstream burst overhead parameter set to the OLT via a unicast message or a broadcast message.

In step 203, the OLT can notify the ONU to switch by a switching index value. Specifically, while or after the OLT notifies the determined upstream burst overhead parameter set to the ONU, the OLT sets the switching index value of the upstream burst overhead parameters in the tag field assigned for the bandwidth of the ONU and sends to the ONU via a downstream frame. After the ONU receives the switching index value, it uses the upstream

burst overhead parameters in the next frame;

Or, in step 203, the OLT also can notify the ONU to switch by indicating a hyper frame number. Specifically, while or after the OLT notifies the determined upstream burst overhead parameter set to the ONU, the OLT notifies the hyper frame number to the ONU, and after the ONU receives the hyper frame number, it starts to use the upstream burst overhead parameters after a hyper frame indicated by the hyper frame number arrives;

In step 203, the ONU can also determine the hyper frame number and notify it to the OLT. While or after the ONU notifies the determined upstream burst overhead parameter set to the OLT, the ONU notifies the hyper frame number to the OLT, and the ONU starts to use the upstream burst overhead parameters after the hyper frame indicated by the hyper frame number arrives.

The method of the present invention will be described below with embodiments. In the following embodiments, suppose the OLT determines three kinds of upstream burst overhead parameter sets according to the link quality, wherein, set 1 includes the general upstream burst overhead parameters which are parameters used in default and also correspond to parameters required by the typical link quality, and the index value is set as 0b00; set 2 includes the enhanced upstream burst overhead parameters which correspond to parameters used in situations that the link quality is worse than the typical link quality, and the index value is set as 0b01; and set 3 includes the weakened upstream burst overhead parameters which correspond to parameters used in situations that the link quality is better than the typical link quality, and the index value is set as 0b10. Only three kinds of sets are illustrated herein, however, more than thee corresponding parameter levels can be defined according to the practical condition of the link quality, so as to set various one–to-one correspondence upstream burst overhead parameter sets. Configuration of parameter sets in the subsequent embodiments can use the same method.

The first embodiment

In the first embodiment, the OLT broadcasts the default upstream burst overhead parameter set to the ONU, and after the ONU enters into the O3 state, it detects the quality of the downlink between the ONU and the OLT, and notifies the detected link quality signal to the OLT; the OLT determines the upstream burst overhead parameter set suitable for using by the

ONU according to that quality signal, notifies the upstream burst overhead parameter set to the ONU via a unicast message, and also indicates for switching in the tag field assigned for the bandwidth of the ONU; and after the ONU receives the above message, it uses the parameters in that received upstream burst overhead parameter set in the subsequent upstream frame.

As shown in FIG. 3, the first embodiment specifically includes the following steps.

Step 1001, the OLT determines each upstream burst overhead parameter set.

Step 1002, the OLT broadcasts an Upstream_overhead message carrying the parameters in the general upstream burst overhead parameter set (i.e., set 1) in a downstream direction.

The Upstream_overhead message may carry the parameters or the identification of that set 1.

That message can be sent once or time after time, which is not limited in the present invention.

Step 1003, the ONU is powered up, receives the Upstream_overhead message sent by the OLT in the O2 state, and transfers to the O3 state after successfully acquiring the carried upstream burst overhead parameters.

Step 1004, from the O3 state, the ONU starts to analyze the transmission quality of the downlink, acquiring result by using a currently general bit interleaved parity (BIP) detection method or a frequently used FEC result and the number of correction bits. In the present invention, the ONU may use other similar detection methods to acquire the transmission quality information of the downlink. Suppose that the result of the quality of the link detected by the ONU is good.

Step 1005, the ONU carries the result of quality detection (or evaluation) for the downlink by the ONU in the subsequent upstream frame (here the upstream frame uses the general upstream burst overhead parameters received in the step 1003) and reports the result to the OLT.

For example, when the ONU responds the serial number request bandwidth assignment (SN_Request) sent by the OLT in the O3 state, the link quality information – “good” acquired in step 1004 is carried in the upstream message “Serial_Number_ONU”, as shown in Table 1.

Table 1

Serial_Number_ONU ONU serial number information		
Octet	Content	Description
1	11111111 ONU-ID	=11111111: ONU-ID is not assigned, broadcast message ONU-ID is assigned, filled with value of ONU-ID, unicast message
2	00000001	Message type: "ONU serial number information"
3-6	VID1-VID4	Equipment provider identification: bit1- bit4
7-10	VID2	Serial number information bit1- bit4 defined by equipment provider
11	RRRRRRRR	High 8 bits of random experiment
12	RRRRAATT	RRRR = low 4 bits of random experiment AA: link quality measurement result notified to OLT by ONU, where it is set as "01" corresponding to "good" (00 - OLT neglects 01 - link quality is good 10 - link quality is OK 11 - link quality is poor) TT = ONU transmission power TT = 00 – Low Power TT = 01 – Medium Power TT = 10 – High Power TT = 11 – Reserved
13-20	Reserve	Reserved

Using the Serial_number_ONU message to carry that information is only an example. Idle bits in other upstream frame message can also be used to be endowed with the similar definition of the "AA" in the above table for notifying the OLT the link detection result, or a specifically defined message is used to transmit that detection result.

Step 1006, after the OLT receives that upstream frame, it records the link quality information corresponding to the ONU and determines the upstream burst overhead parameter set (e.g., set 3 in this embodiment) suitable for using by the ONU.

Step 1007, after the ONU is assigned with the ONU_ID, the OLT sends the parameter set to be used by the ONU and the corresponding index value to the ONU via a unicast

Upstream_overhead message, as shown in Table 2:

Table 2

Upstream_Overhead message upstream burst overhead parameters		
Octet	Content	Description
1	ONU-ID	ONU identification
2	00000001	Message identification "upstream burst overhead parameters"
3	000000ss	ss is the index value of the parameter set included in the message 00: parameter set 1 01: parameter set 2 10: parameter set 3 11: Reserved
4	Gggggggg	The number of guard band bits
5	Xxxxxxxx	The number of preamble bits
6-8	Bbbbbbbb bbbbbbbb Bbbbbbbb	Delimiter bit1- bit3
9-10	Xxxxxxxx xxxxxxxx Xxxxxxxx	xx = reserved:
11-12	Ddddddddd Ddddddddd	Pre-assigned delay parameters
13-20	Reserve	Reserved

Step 1008, after the ONU receives the unicast Upstream_overhead message sent by the OLT, the ONU records the physical layer parameters and the index value 0b10 of the set 3 carried by the message.

Step 1009, the OLT sets a switching index value of the upstream burst overhead parameters in the tag field assigned for the bandwidth of the ONU and sends the switching index value to the ONU via the downstream frame.

Step 1010, once the ONU receives the switching indication from step 1009, it immediately performs switching of the upstream burst overhead parameters in the next frame according to the indicated index value, and then uses the switched upstream burst overhead parameters in the

subsequent upstream transmission.

The second embodiment

In the second embodiment, the OLT broadcasts the default upstream burst overhead parameter set to the ONU; and after the ONU enters into the O3 state, the OLT detects the quality of the downlink between the ONU and the OLT, determines the upstream burst overhead parameter set suitable for using by the ONU according to that quality signal, and notifies it to the ONU via the unicast message; the OLT also indicates to switch in the tag field assigned for the bandwidth of the ONU; and after the ONU receives the message, it uses the parameters in the received upstream burst overhead parameter set in the subsequent upstream frames.

As shown in FIG. 4, the second embodiment specifically includes the following steps.

Step 2001, the OLT determines each upstream burst overhead parameter set.

Step 2002, the OLT broadcasts the Upstream_overhead message carrying the parameters in the general upstream burst overhead parameter set (i.e., set 1) in a downstream direction.

The Upstream_overhead message can carry the parameters or the identification of that set 1. That message can be sent once or time after time, which is not limited in the present invention.

Step 2003, the ONU is powered up, receives the Upstream_overhead message sent by the OLT in the O2 state, and after the ONU successfully acquires the upstream physical layer burst overhead parameters carried by the message, it transfers to the O3 state. The ONU performs normally data communication with the OLT in accordance with the specification constituted by standard (in the prior art).

Step 2004, the OLT starts to detect a link corresponding to a certain ONU to acquire its link quality information, and the detection result is “poor”, which corresponds to the upstream burst overhead parameter set 2.

In this step, the conditions of starting to detect can be various, and the conditions can be: increasing of upstream frame error codes, losing of the upstream frames or detecting required

actively by an operator. The detection method by the OLT can adopt the currently general BIP or the frequently used FEC, or any other similar detection method that can acquire the related information.

Step 2005, the OLT transmits the upstream burst overhead parameter set 2 to be used by the ONU to the ONU via the unicast Upstream_overhead message, as shown in Table 3:

Table 3

Upstream_Overhead message upstream burst overhead parameters		
Octet	Content	Description
1	ONU-ID	ONU identification
2	00000001	Message identification “upstream burst overhead parameters”
3	gggggggg	The number of guard band bits
4	xxxxxxxx	The number of preamble bits
5-7	bbbbbbbb bbbbbbbb bbbbbbbb	Delimiter bit1- bit3
8-10	xxxxxxxx xxxxxxxx xxxxxxxx	xx = reserved:
11-12	dddddddd dddddddd	Pre-assigned delay parameters
13-20	Reserve	Reserved

Step 2006, after the ONU receives the unicast Upstream_overhead message sent by the OLT, the ONU records the physical layer parameters carried by the message, so that the physical layer parameters are to be used in the subsequent switching.

The subsequent switching indication and operation can be the same as those in the first embodiment.

The third embodiment

The difference between the third embodiment and the second embodiment is that the OLT broadcasts all parameter sets to the ONU in advance in the third embodiment.

As shown in FIG. 5, the third embodiment specifically includes the following steps.

Step 3001, it is the same as step 2001;

Step 3002, the OLT broadcasts the Upstream_overhead message carrying all the upstream burst overhead parameters (i.e., sets 1, 2 and 3 are sent in one message) in a downstream direction. As shown in Table 4, that message can be sent once or time after time, which is not limited in the present invention.

Table 4

Upstream_Overhead message upstream burst overhead parameters		
Octet	Content	Description
1	11111111	broadcast message type
2	00000001	Message identification: "upstream burst overhead parameters"
3-7	gggggggg gggggggg gggggggg gggggggg gggggggg	Upstream burst overhead parameters -- set 1, which is also the default parameter set
8-12	xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx	Upstream burst overhead parameters -- set 2, which is to be used corresponding to the link having poor transmission quality
13-17	bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb	Upstream burst overhead parameters -- set 3, which is to be used corresponding to the link having good transmission quality
18-19	dddddddd dddddddd	Pre-assigned delay parameters

20	Reserve	Reserved

Step 3003, the ONU is powered up, receives the Upstream_overhead message sent by the OLT in the O2 state, and after the ONU successfully acquires all the upstream physical layer burst overhead parameter sets carried by the message, it transfers to the O3 state. Without any definite indication, the ONU uses the parameter set 1 by default. The ONU performs normal data communication in accordance with the specification constituted by standard (in the prior art).

Step 3004, it is the same as step 2004;

Step 3005, the OLT transmits the upstream burst overhead parameter set 2 to be used by the ONU to the ONU via the unicast message Upstream_overhead. The message format is shown as Table 5, wherein "BB" should be valued as "01".

Table 5

Overhead_ONU_Indication message upstream burst overhead parameter indication message		
Octet	Content	Description
1	ONU-ID	ONU identification
2	00000001	Message identification "upstream burst overhead parameter indication"
3	000000BB	BB: which upstream burst overhead parameter set adopted by the ONU indicated by the OLT 00: set 1 01: set 2 10: set 3 11: Reserved
4-20	Reserve	Reserved

Step 3006, after the ONU receives the unicast ONU overhead indication (Overhead_ONU_Indication) message sent by the OLT, it records the physical layer parameter BB(01) carried by the message and performs parameter switching subsequently according to the indication. The subsequent switching indication and operation are the same as those in the first embodiment.

The fourth embodiment

The difference between the ~~third~~ fourth embodiment and the ~~second~~ first embodiment is that the OLT broadcasts all parameter sets to the ONU in advance in the third embodiment.

As shown in FIG. 6, the fourth embodiment specifically includes the following steps.

Step 4001, it is the same as step 1001;

Step 4002, the OLT broadcasts the Upstream_overhead message carrying all the upstream burst overhead parameter sets (i.e., sets 1, 2 and 3 are sent in one message) in a downstream direction, and the message, as shown in Table 6. The message can be sent once or time after time, which is not limited in the present invention.

Table 6

Upstream_Overhead message upstream burst overhead parameters		
Octet	Content	Description
1	11111111 ONU-ID	=11111111: ONU-ID is not assigned, broadcast message ONU-ID is assigned, filled with ONU-ID value, unicast message
2	00000001	Message identification: "Upstream burst overhead parameters"
3	000000xx	xx: when this message is a unicast message, which upstream burst overhead parameter set adopted by ONU indicated by OLT 00: set 1 01: set 2 10: set 3 11: Reserved When this message is a broadcast message, xx is invalid and the ONU neglects it
4-8	gggggggg gggggggg gggggggg gggggggg gggggggg	Upstream burst overhead parameters -- set 1, which is also the default parameter set
9-13	xxxxxxxx	Upstream burst overhead parameters -- set 2, which is to be used

	xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx	corresponding to the link having poor transmission quality
14-18	bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb	Upstream burst overhead parameters -- set 3, which is to be used corresponding to the link having good transmission quality
19-20	dddddddd dddddddd	Pre-assigned delay parameters

Step 4003, it is the same as step 1003;

Step 4004, it is the same as step 1004;

Step 4005, it is the same as step 1005; When the ONU responds the serial number request bandwidth assignment (SN_request) sent by the OLT in the O3 state, the ONU carries, in the Serial_Number_ONU, the link quality information - "good" acquired in step 1004, as shown in Table 7.

Table 7

Serial_Number_ONU ONU serial number information		
Octet	Content	Description
1	11111111 ONU-ID	=11111111: ONU-ID is not assigned ONU-ID is assigned, filled with value of ONU-ID
2	00000001	Message type: "ONU serial number information"
3-6	VID1-VID4	Equipment provider identification: bit1- bit4
7-10	VID2	Serial number information bit1- bit4 defined by equipment provider
11	RRRRRRRR	High 8 bits of random experiment
12	RRRRAATT	RRRR = low 4 bits of random experiment AA: link quality measurement result notified to OLT by ONU, where it sets as "01" corresponding to "good" (00 - OLT neglects

		01 - link quality is good 10 - link quality is OK 11 - link quality is poor) TT = ONU transmission power TT = 00 – Low Power TT = 01 – Medium Power TT = 10 – High Power TT = 11 – Reserved
13-20	Reserve	Reserved

(Using the Serial_number_ONU message to carry that information is only an example. Idle bits in other upstream frame message can also be used to be endowed with the similar definition of the "AA" in the above table for notifying the OLT the link detection result, or a specifically defined message is used to transmit that detection result.)

Step 4006, it is the same as step 1006;

Step 4007, after the ONU is assigned with the ONU-ID, the OLT indicates via the unicast Upstream_overhead message ("xx" in the unicast message is set as "10") that the upstream burst overhead parameters to be used by the ONU is the set 3, as shown in Table 8.

Table 8

Upstream_Overhead message upstream burst overhead parameters		
Octet	Content	Description
1	11111111 ONU-ID	=11111111: ONU-ID is not assigned, broadcast message ONU-ID is assigned, filled with value of ONU-ID, unicast message
2	00000001	Message identification: "Upstream burst overhead parameters"
3	000000xx	xx: when this message is a unicast message, which upstream burst overhead parameter set adopted by ONU indicated by OLT 00: set 1 01: set 2 10: set 3 11: Reserved When this message is a broadcast message, xx is invalid and the ONU neglects it

4-8	gggggggg gggggggg gggggggg gggggggg gggggggg	Upstream burst overhead parameters -- set 1, which is also the default parameter set
9-13	xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx	Upstream burst overhead parameters -- set 2, which is to be used corresponding to the link having poor transmission quality
14-18	bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb	Upstream burst overhead parameters -- set 3, which is to be used corresponding to the link having good transmission quality
19-20	dddddddd dddddddd	Pre-assigned delay parameters

Step 4008, after the ONU receives the Upstream_overhead unicast message sent by the OLT, the ONU records the upstream burst overhead parameter indication carried by the message, and uses in the subsequent switching. The subsequent switching indication and operation are the same as those in the first embodiment.

The fifth embodiment

The difference between the fifth embodiment and the third embodiment is that, in the fifth embodiment, after the OLT detects the quality of the downlink, it notifies the ONU to record the upstream burst overhead parameters to be switched to and the switching hyper frame number via broadcast channel message Overhead_ONU_indication; and after the frame corresponding to the hyper frame number arrives, all ONUs switch to use the upstream burst overhead parameters indicated by the OLT to perform upstream transmission.

As shown in FIG. 7, the fifth embodiment specifically includes the following steps.

Steps 5001-5004, they are the same as steps 3001-3004.

Step 5005, the OLT transmits the upstream burst overhead parameter set 2 to be switched used by all ONUs as well as the hyper frame number which is used to perform the parameter switching, via the broadcast Overhead_ONU_Indication message. The message has the following message format, wherein BB should be valued as "01". The hyper frame number field (4-7) is filled with the value of the hyper frame number that needs to be switched, as shown in Table 9.

Table 9

Overhead_ONU_Indication message upstream burst overhead parameter indication message		
Octet	Content	Description
1	11111111	Broadcast message type
2	00000001	Message ID "Upstream burst overhead parameter indication"
3	000000BB	BB: which kind of upstream burst overhead parameter set adopted by ONU indicated by OLT 00: set 1 01: set 2 10: set 3 11: Reserved
4-7	ssssssss ssssssss ssssssss ssssssss	The hyper frame number that the OLT requires all ONUs to switch, wherein, before the hyper frame arrives, all ONUs switch to use the upstream burst overhead parameters indicated by the OLT to perform upstream transmission
8-20	Reserve	Reserved

Step 5006, after all ONUs receive the Overhead_ONU_Indication message broadcasted by the OLT, all ONUs record the physical layer parameter BB(01) and the hyper frame number that indicates the switching time carried in the message, and the parameter switching is performed subsequently according to the indication.

Step 5007, after the downstream frame corresponding to the subsequent hyper frame number arrives, the ONU performs switching operation of the upstream burst overhead parameter, and the parameters after the switching is used in upstream transmission.

This embodiment can be simply modified, that is, the message in steps 5005-5006 is designed as a unicast message to support the switching of a single ONU rather than all ONUs.

The sixth embodiment

The difference between the sixth embodiment and the fifth embodiment is that: in the sixth embodiment, after the OLT detects the quality of the downlink, it notifies the ONUs to record the upstream burst overhead parameters to be switched and the switching hyper frame number, via the broadcast channel message Overhead_ONU_indication; the OLT sets the switching index values of the upstream burst overhead parameters in the tag fields assigned for the bandwidths of all ONUs; and after the ONUs receive this switching indication, they perform the upstream burst overhead parameter switching in the next frame according to the indicated index value.

As shown in FIG. 8, the sixth embodiment specifically includes the following steps.

Steps 6001-6006, they are the same as steps 5001-5006.

Step 6007, the OLT sets the switching index values of the upstream burst overhead parameters in the tag fields assigned for the bandwidths of all ONUs and sends them to all ONUs via a downstream frame.

Once all ONUs receive the switching indication in step 6007, they perform the upstream burst overhead parameter switching immediately in the next frame according to the indicated index values, so that the switched parameters can be used in the subsequent upstream transmission.

This embodiment can be modified simply, that is, the message in steps 6005/6006/6007 is designed as a unicast message and is set according to a certain ONU, to support the switching of a single ONU rather than all ONUs.

The seventh embodiment

In the seventh embodiment, the ONU tests the quality of the link and determines the upstream burst overhead parameters used by the ONU itself according to the quality of the link,

and the ONU notifies the OLT the upstream burst overhead parameters and indicates the switching hyper frame number.

As shown in FIG. 9, the seventh embodiment specifically includes the following steps.

Steps 7001-7002, they are the same as steps 6001-6002.

Step 7003, the ONU is powered up, and receives the Upstream_overhead message sent by the OLT in the O2 state, and after successfully acquiring the upstream physical layer burst overhead parameters carried in the message, the ONU transfers to the O3 state.

Step 7004, from the O3 state, the ONU starts to analyze the transmission quality of the downlink, acquiring result by using the currently general BIP detection method or the frequently used FEC result and the number of correction bits. (The ONU can also use other similar detection method to acquire the transmission quality information of the downlink, as long as the method works). Suppose the result of the measurement is good.

Step 7005, after the ONU acquires the transmission quality information in step 7004, the subsequent upstream frame carries the detection result "good" by the ONU detecting the quality of the downlink; and the ONU determines the upstream burst overhead parameter set (i.e., set 3) according to the link quality, and then the ONU reports the determined upstream burst overhead parameter set 3 and the hyper frame number which represents the set 3 ready for switching to be used. For example, when the ONU responds the serial number request bandwidth assignment (SN_Request) sent by the OLT in the O3 state, the link quality information – "good" acquired in step 7004 is carried in the upstream message "Serial_Number_ONU", as shown in Table 10.

Table 10

Serial_Number_ONU ONU serial number information		
Octet	Content	Description
1	11111111 ONU-ID	=11111111: ONU-ID is not assigned, broadcast message ONU-ID is assigned, filled with value of ONU-ID, unicast message
2	00000001	Message type: "ONU serial number information"
3-6	VID1-VID4	Equipment provider ID: bit1- bit4
7-10	VID2	Serial number information bit1- bit4 defined by equipment provider
11	RRRRRRRR	High 8 bits of random experiment

12	RRRRAATT	RRRR = low 4 bits of random experiment AA: link quality measurement result notified to OLT by ONU, where it is set as "01" corresponding to "good" (00 - OLT neglects 01 - link quality is good 10 - link quality is OK 11 - link quality is poor) TT = ONU transmission power TT = 00 – Low Power TT = 01 – Medium Power TT = 10 – High Power TT = 11 – Reserved
13-16	ssssssss ssssssss ssssssss ssssssss	Hyper frame number of downstream frame which represents the parameter set 3 switched to be used by ONU. After the OLT sends the downstream frame corresponding to the hyper frame number, it uses new upstream burst overhead parameters to receive the upstream frames of the ONU.
17-20	Reserve	Reserved

Using the Serial_number_ONU message to carry the information is only an example. Idle bits in other upstream frame message can also be used to be endowed with the similar definition of the related field in the above table to notify the OLT the link detection result and the hyper frame number of the downstream frame related to the switching, or a specifically defined message is used to transmit the detection result.

Step 7006, after the OLT receives the message, it records the link quality information corresponding to that ONU and the hyper frame number of the downstream frame related to the switching, and determines the upstream burst overhead parameter set 3 suitable for used by the ONU.

Step 7007, after the OLT sends the downstream frame corresponding to the hyper frame number at a certain time, the ONU switches to use the parameter set 3 to send the upstream frame here, and the OLT uses the parameter set 3 to receive the upstream frames of that ONU.

The above methods can improve the bandwidth utilization and decrease the complexity of indicating the upstream burst overhead parameters in the PON system, so that the OLT and the ONU can flexibly and simply select the upstream burst overhead parameters.

The PON system for managing the upstream burst overhead parameters in the present invention comprises an OLT or an ONU, wherein, the functions of these two entities are the same as those described in the above methods. The detail description is as follows:

The OLT is configured to: detect the transmission quality of the downlink between the OLT and the ONU, determine the upstream burst overhead parameters suitable for the ONU according to the transmission quality and notify the parameters to the ONU; and indicate the switching time to the ONU; and

The ONU is configured to: detect the transmission quality of the downlink between the OLT and the ONU, determine the suitable upstream burst overhead parameters according to the transmission quality, or, directly receive, from the OLT, the transmission quality of the downlink determined by the OLT; and start to use the upstream burst overhead parameters after the switching time determined by the ONU itself or indicated by the OLT.

The OLT is further configured to determine and identify N kinds of upstream burst overhead parameter sets according to different levels of link quality, wherein N is an integer and is larger than zero. The OLT further used to send the parameter value or the identification of one default upstream burst overhead parameter set to the ONU, or, to send the parameter values or the identifications of more than one upstream burst overhead parameter set to the ONU. The ONU is further configured to: receive the parameter value or the identification of one upstream burst overhead parameter set in the waiting state and use this upstream burst overhead parameter set; or, after receiving the parameter values or the identifications of more than one upstream burst overhead parameter set in the waiting state, use one of the upstream burst overhead parameter sets.

The OLT is further configured to: while or after notifying the determined upstream burst

overhead parameter set to the ONU, set the switching index value of the upstream burst overhead parameters in the tag field assigned for the bandwidth of the ONU and sending it to the ONU via a downstream frame. The ONU is further used to use the upstream burst overhead parameters in the next frame after receiving the switching index value.

The OLT is further configured to: while or after notifying the determined upstream burst overhead parameter set to the ONU, notify the ONU the hyper frame number. The ONU is further configured to start to use the upstream burst overhead parameters after the frame indicated by the hyper frame number arrives.

The ONU is further configured to: while or after notifying the determined upstream burst overhead parameter set to the OLT, notify the OLT the hyper frame number, and start to use the upstream burst overhead parameters after the frame indicated by the hyper frame number arrives.

Based on the above system, the present invention also provides an optical network unit (ONU) for managing the upstream burst overhead parameters, and the ONU comprises a first parameter acquisition module and a switching module; wherein:

the first parameter acquisition module is configured to:

detect the transmission quality of the downlink between the OLT and the ONU or receive the transmission quality of the downlink detected and sent by the OLT, determine the upstream burst overhead parameters suitable for the ONU according to the transmission quality, and send the upstream burst overhead parameters suitable for the ONU to the OLT; or

detect the transmission quality of the downlink between the OLT and the ONU, send the transmission quality to the OLT, and receive the upstream burst overhead parameters suitable for the ONU which are determined according to the transmission quality and sent by the OLT; or,

directly receive, from the OLT, the upstream burst overhead parameters suitable for the ONU determined by the OLT; and

while or after notifying the determined upstream burst overhead parameters suitable for the ONU to the OLT, or, while or after receiving the upstream burst overhead parameters suitable for the ONU sent by the OLT, indicate the switching module; and

the switching module is configured to:

while or after receiving an indication from the first parameter acquisition module, determine the switching time or receive the switching time indicated by the OLT, and start to use the upstream burst overhead parameters suitable for the ONU after the switching time determined by the ONU itself or indicated by the OLT.

The ONU further comprises a burst overhead parameter set receiving module; wherein:

the burst overhead parameter set receiving module is configured to:

receive, in the waiting state, the parameter value or the identification of one default upstream burst overhead parameter set sent by the OLT to the ONU, wherein the default upstream burst overhead parameter set is one of N kinds of upstream burst overhead parameter sets determined and identified by the OLT according to different levels of link quality, and use this upstream burst overhead parameter set; or,

receive, in the waiting state, the parameter values or the identifications of more than one upstream burst overhead parameter set sent by the OLT to the ONU, wherein the upstream burst overhead parameter sets is one or more of N kinds of upstream burst overhead parameter sets determined and identified by the OLT according to different levels of link quality, and use one of the upstream burst overhead parameter sets;

wherein N is an integer and is larger than zero.

The switching module is further configured to: while or after receiving the indication from the first parameter acquisition module, receive the switching index value of the upstream burst overhead parameters which is set in the tag field assigned for the bandwidth of the ONU by the OLT and is sent by the OLT to the ONU via a downstream frame; and the switching module is

configured to start to use the upstream burst overhead parameters after the switching time indicated by the OLT according to the following manner: after receiving the switching index value, using the upstream burst overhead parameters in the next frame; or

The switching module is further configured to: while or after receiving the indication from the first parameter acquisition module, receive the hyper frame number notified to the ONU by the OLT; and the switching module is configured to start to use the upstream burst overhead parameters after the switching time indicated by the OLT according to the following manner: starting to use the upstream burst overhead parameters after the frame indicated by the hyper frame number arrives; or,

The switching module is further configured to: while or after receiving the indication from the first parameter acquisition module, notify the OLT the hyper frame number; and the ONU is configured to start to use the upstream burst overhead parameters after the switching time determined by the ONU itself according to the following manner: starting to use the upstream burst overhead parameters after the frame indicated by the hyper frame number arrives.

Based on the above-mentioned system, the present invention also provides an optical line terminal (OLT) for managing the upstream burst overhead parameters, and the OLT comprises a second parameter acquisition module and a switching time transceiving module, wherein:

the second parameter acquisition module is configured to:

detect the transmission quality of the downlink between the OLT and an optical network unit (ONU), send the transmission quality to the ONU, and receive the upstream burst overhead parameters suitable for the ONU determined by the ONU according to the transmission quality sent by the OLT; or,

detect the transmission quality of the downlink between the OLT and the ONU, determine the upstream burst overhead parameters suitable for the ONU according to the transmission quality, and notify the ONU the determined upstream burst overhead parameters suitable for the ONU; or,

receive the transmission quality of the downlink detected and sent by the ONU,

determine the upstream burst overhead parameters suitable for the ONU according to the transmission quality, and notify the ONU the determined upstream burst overhead parameters suitable for the ONU; or,

receive from the ONU the upstream burst overhead parameters suitable for the ONU determined according to the transmission quality of the downlink detected and acquired by the ONU itself; and

while or after notifying the ONU the determined upstream burst overhead parameters suitable for the ONU, or, while or after receiving from the ONU the upstream burst overhead parameters suitable for the ONU, indicate the switching time transceiving module; and

the switching time transceiving module is configured to:

while or after receiving an indication from the second parameter acquisition module, indicate the switching time to the ONU or receive the switching time sent by the ONU, so that the ONU starts to use the upstream burst overhead parameters after the switching time.

The OLT further comprises:

an upstream burst overhead parameter set acquisition module, which is configured to: determine and identify N kinds of upstream burst overhead parameter sets according to different levels of link quality, wherein, N is an integer and is larger than zero; and send the parameter value or the identification of one default upstream burst overhead parameter set to the ONU, or, send the parameter values or the identifications of more than one upstream burst overhead parameter set to the ONU,

so that the ONU receives the parameter value or the identification of one upstream burst overhead parameter set in the waiting state and uses this upstream burst overhead parameter set; or, the ONU receives the parameter values or the identifications of more than one upstream burst overhead parameter set in the waiting state and uses one of them.

The switching time transceiving module is configured to indicate the switching time to the ONU according to the following manner: setting the switching index value of the upstream

burst overhead parameters in the tag field assigned for the bandwidth of the ONU, and sending it to the ONU via a downstream frame, so that after the ONU receives the switching index value, it uses the upstream burst overhead parameters in the next frame; or,

the switching time transceiving module is configured to indicate the switching time to the ONU according to the following manner: notify the ONU the hyper frame number, so that the ONU starts to use the upstream burst overhead parameters after the frame indicated by the hyper frame number arrives; or,

the switching time transceiving module is configured to receive the switching time sent by the ONU according to the following manner: receiving the hyper frame number notified by the ONU ~~ONT~~, so that the ONU starts to use the upstream burst overhead parameters after the frame indicated by the hyper frame number arrives.

The above description is only the preferred embodiments of the present invention and is not intended to limit the present invention. For those skilled in the art, the description of the above scheme in the present invention can be modified or changed. Without departing from the spirit and essence of the present invention, all these kinds of modification, equivalent or variations should belong to the scope of the appending claims of the present invention.

Industrial Applicability

The present invention can improve the bandwidth utilization, decrease the complexity of indicating the upstream burst overhead parameters in the PON system, thereby the ONU and the OLT can flexibly and simply select the upstream burst overhead parameters.

Replace the Claims with the following amended Claims.

What is claimed is:

1. (Original) A method for managing upstream burst overhead parameters, comprising:

an optical line terminal or an optical network unit detecting transmission quality of a downlink between the optical line terminal and the optical network unit;

the optical line terminal or the optical network unit determining the upstream burst overhead parameters suitable for the optical network unit according to the transmission quality; and

the optical network unit starting to use the upstream burst overhead parameters suitable for the optical network unit after switching time determined by the optical network unit itself or indicated by the optical line terminal.

2. (Original) The method of claim 1, wherein, before the step of the optical line terminal or the optical network unit detecting the transmission quality of the downlink between the optical line terminal and the optical network unit, the method further comprises:

the optical line terminal determining and identifying N kinds of upstream burst overhead parameter sets according to different levels of link quality, wherein N is an integer and is larger than zero; and

the optical line terminal sending a parameter value or an identification of one default upstream burst overhead parameter set to the optical network unit; and the optical network unit receiving the parameter value or the identification of the upstream burst overhead parameter set in a waiting state and using the upstream burst overhead parameter set; or,

the optical line terminal sending parameter values or identifications of more than one upstream burst overhead parameter set to the optical network unit; and the optical network unit receiving the parameter values or the identifications of the upstream burst overhead parameter sets in a waiting state and using one of the received upstream burst overhead parameter sets.

3. (Currently amended) The method of claim 2, wherein:

after the step of the optical network unit receiving the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s), the method further comprises:

the optical network unit entering into a serial number state;

the step of the optical line terminal ~~network unit~~ detecting the transmission quality of the downlink between the optical line terminal and the optical network unit comprises: in the serial number state of the optical network unit, the optical line terminal detecting the downlink between the optical network unit and the optical line terminal to acquire quality information of the downlink;

the step of the optical line terminal determining the upstream burst overhead parameters suitable for the optical network unit according to the transmission quality comprises: the optical line terminal determining the upstream burst overhead parameter set suitable for the optical network unit according to the quality information of the downlink, and notifying the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) suitable for the optical network unit to the optical network unit via a unicast message or a broadcast message.

4. (Original) The method of claim 2, wherein:

after the step of the optical network unit receiving the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s), the method further comprises: the optical network unit entering into a serial number state;

the step of the optical network unit detecting the transmission quality of the downlink between the optical line terminal and the optical network unit comprises: in the serial number state of the optical network unit, the optical network unit detecting the downlink between the optical network unit and the optical line terminal to acquire quality information of the downlink;

after the step of acquiring the quality information of the downlink, the method further comprises: the optical network unit notifying the quality information of the downlink to the optical line terminal;

the step of the optical line terminal determining the upstream burst overhead parameters suitable for the optical network unit according to the transmission quality comprises: the optical line terminal determining the upstream burst overhead parameter set suitable for the optical network unit according to the quality information of the downlink, and notifying the parameter

value(s) or the identification(s) of the upstream burst overhead parameter set(s) suitable for the optical network unit to the optical network unit via a unicast message or a broadcast message.

5. (Original) The method of claim 2, wherein:

after the step of the optical network unit receiving the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s), the method further comprises: the optical network unit entering into a serial number state;

the step of the optical network unit detecting the transmission quality of the downlink between the optical line terminal and the optical network unit comprises: in the serial number state of the optical network unit, the optical network unit detecting the downlink between the optical network unit and the optical line terminal to acquire quality information of the downlink;

The step of the optical network unit determining the upstream burst overhead parameters suitable for the optical network unit according to the transmission quality comprises: the optical network unit determining the upstream burst overhead parameter set suitable for the optical network unit according to the quality information of the downlink, and notifying the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) suitable for the optical network unit to the optical line terminal via a unicast message or a broadcast message.

6. (Currently amended) The method of claim 3~~, 4 or 5~~, wherein:

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical line terminal setting a switching index value of the upstream burst overhead parameters in a tag field assigned for a bandwidth of the optical network unit, and sending the switching index value to the optical network unit via a downstream frame; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal comprises: after the optical network unit receives the switching index value, the optical network unit using the upstream burst overhead parameters suitable for the optical network unit in a next frame; or,

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical line terminal notifying a hyper frame number to the optical network unit; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal comprises: after the optical network unit receives the hyper frame number and after a frame indicated by the hyper frame number arrives, the optical network unit starting to use the upstream burst overhead parameters suitable for the optical network unit; or,

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical network unit notifying a hyper frame number to the optical line terminal; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time determined by the optical network unit itself comprises: after a frame indicated by the hyper frame number arrives, the optical network unit starting to use the upstream burst overhead parameters suitable for the optical network unit.

7. (Currently amended) The method of claim 3~~, 4 or 5~~, wherein:

the upstream burst overhead parameter set comprises: state of forward error correction, delimiter, preamble and guard band.

8. (Original) The method of claim 2, wherein:

in the step of the optical line terminal sending the parameter values or the identifications of more than one upstream burst overhead parameter set to the optical network unit, the optical line terminal sends the parameter values or the identifications of one or more upstream burst overhead parameter sets to all optical network units or one or more optical network units which communicate with the optical line terminal.

9. (Currently amended) An optical network unit for managing upstream burst overhead

parameters, comprising a first parameter acquisition module and a switching module; wherein:

the first parameter acquisition module is configured to:

detect transmission quality of a downlink between an optical line terminal and the optical network unit or receive transmission quality of a downlink detected and sent by the optical line terminal, determine upstream burst overhead parameters suitable for the optical network unit according to the transmission quality, and send the upstream burst overhead parameters suitable for the optical network unit to the optical line terminal; or,

detect transmission quality of a downlink between an optical line terminal and the optical network unit, send the transmission quality to the optical line terminal, and receive, from the optical line terminal, upstream burst overhead parameters suitable for the optical network unit determined according to the transmission quality; or,

directly receive, from an optical line terminal, upstream burst overhead parameters suitable for the optical network unit determined by the optical line terminal; and,

while or after notifying the upstream burst overhead parameters suitable for the optical network unit to the optical line terminal, or while or after receiving the upstream burst overhead parameters suitable for the optical network unit sent by the optical line terminal, indicate the switching module;

the switching module is configured to:

while or after receiving an indication from the first parameter acquisition module, determine ~~a~~ switching ~~event~~ time or receive switching time indicated by the optical line terminal, and start to use the upstream burst overhead parameters suitable for the optical network unit after the switching time determined by itself or indicated by the optical line terminal.

10. (Original) The optical network unit of claim 9, further comprising:

a burst overhead parameter set receiving module, configured to:

receive, in a waiting state, a parameter value or an identification of one default upstream burst overhead parameter set sent by the optical line terminal to the optical network unit after the optical line terminal determines and identifies N kinds of upstream burst overhead parameter sets according to different levels of link quality, and use the upstream burst overhead

parameter set; or,

receive, in a waiting state, parameter values or identifications of more than one upstream burst overhead parameter set sent by the optical line terminal to the optical network unit after the optical line terminal determines and identifies N kinds of upstream burst overhead parameter sets according to different levels of link quality, and use one of the upstream burst overhead parameter sets;

wherein, N is an integer and is larger than zero.

11. (Original) The optical network unit of claim 9, wherein:

the switching module is further configured to: while or after receiving the indication from the first parameter acquisition module, receive a switching index value of the upstream burst overhead parameters which is sent from the optical line terminal to the optical network unit via a downstream frame and are set in a tag field assigned for a bandwidth of the optical network unit by the optical line terminal; and, the switching module is configured to start to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal according to the following manner: after receiving the switching index value, using the upstream burst overhead parameters in a next frame; or

the switching module is further configured to: while or after receiving the indication from the first parameter acquisition module, receive a hyper frame number notified by the optical line terminal to the optical network unit; and, the switching module is configured to start to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal according to the following manner: after a frame indicated by the hyper frame number arrives, starting to use the upstream burst overhead parameters; or

the switching module is further configured to: while or after receiving the indication from the first parameter acquisition module, notify a hyper frame number to the optical line terminal; and, the optical network unit is configured to start to use the upstream burst overhead parameters after the switching time determined by the optical network unit itself according to the following method: after a frame indicated by the hyper frame number arrives, start to use the upstream burst overhead parameters.

12. (Original) An optical line terminal for managing upstream burst overhead parameters, comprising: a second parameter acquisition module and a switching time transceiving module, wherein:

the second parameter acquisition module is configured to:

detect transmission quality of a downlink between the optical line terminal and an optical network unit, send the transmission quality to the optical network unit, and receive upstream burst overhead parameters suitable for the optical network unit determined by the optical network unit according to the transmission quality sent by the optical line terminal; or,

detect transmission quality of a downlink between the optical line terminal and an optical network unit, determine upstream burst overhead parameters suitable for the optical network unit according to the transmission quality, and notify the determined upstream burst overhead parameters suitable for the optical network unit to the optical network unit; or,

receive transmission quality of a downlink detected and sent by an optical network unit, determine the upstream burst overhead parameters suitable for the optical network unit according to the transmission quality, and notify the determined upstream burst overhead parameters suitable for the optical network unit to the optical network unit; or,

receive upstream burst overhead parameters suitable for an optical network unit which are sent and determined by the optical network unit according to transmission quality of a downlink detected and acquired by the optical network unit itself; and

while or after notifying the determined upstream burst overhead parameters suitable for the optical network unit to the optical network unit, or while or after receiving the upstream burst overhead parameters suitable for the optical network unit sent by the optical network unit, indicate switching time transceiving module;

the switching time transceiving module is configured to:

while or after receiving an indication from the second parameter acquisition module, indicate the switching time to the optical network unit or receive the switching time sent by the optical network unit, so that the optical network unit start to use the upstream burst overhead parameters after the switching time.

13. (Original) The optical line terminal of claim 12, further comprising:

a upstream burst overhead parameter set acquisition module, configured to: determine and identify N kinds of upstream burst overhead parameter sets according to different levels of link quality; wherein N is an integer and is larger than zero; and send a parameter value or an identification of one default upstream burst overhead parameter set to the optical network unit, or, send parameter values or identifications of more than one upstream burst overhead parameter set to the optical network unit,

so that the optical network unit receives the parameter value or the identification of the one upstream burst overhead parameter set in a waiting state and uses the upstream burst overhead parameter set; or, the optical network unit receives the parameter values or the identifications of more than one upstream burst overhead parameter set in a waiting state and uses one of the upstream burst overhead parameter sets.

14. (Currently amended) The optical line terminal of claim 12, wherein:

the switching time transceiving module is configured to indicate the switching time to the optical network unit according to the following manner: setting a switching index value of the upstream burst overhead parameters in a tag field assigned for a bandwidth of the optical network unit, and sending the switching index value to the optical network unit via a downstream frame, so that after the optical network unit receives the switching index value, the optical network unit uses the upstream burst overhead parameters in a next frame; or,

the switching time transceiving module is configured to indicate the switching time to the optical network unit according to the following manner: notifying a hyper frame number to the optical network unit, so that the optical network unit starts to use the upstream burst overhead parameters after a frame indicated by the hyper frame number from the optical line terminal arrives; or,

the switching time transceiving module is configured to receive the switching time sent by the optical network unit according to the following method: receiving a hyper frame number notified by the optical network ~~terminal~~ unit, so that the optical network unit starts to use the upstream burst overhead parameters after a frame indicated by the hyper frame number arrives.

15. (New) The method of claim 4, wherein:

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical line terminal setting a switching index value of the upstream burst overhead parameters in a tag field assigned for a bandwidth of the optical network unit, and sending the switching index value to the optical network unit via a downstream frame; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal comprises: after the optical network unit receives the switching index value, the optical network unit using the upstream burst overhead parameters suitable for the optical network unit in a next frame; or,

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical line terminal notifying a hyper frame number to the optical network unit; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal comprises: after the optical network unit receives the hyper frame number and after a frame indicated by the hyper frame number arrives, the optical network unit starting to use the upstream burst overhead parameters suitable for the optical network unit; or,

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical network unit notifying a hyper frame number to the optical line terminal; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time determined by the optical network unit itself

comprises: after a frame indicated by the hyper frame number arrives, the optical network unit starting to use the upstream burst overhead parameters suitable for the optical network unit.

16. (New) The method of claim 5, wherein:

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical line terminal setting a switching index value of the upstream burst overhead parameters in a tag field assigned for a bandwidth of the optical network unit, and sending the switching index value to the optical network unit via a downstream frame; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal comprises: after the optical network unit receives the switching index value, the optical network unit using the upstream burst overhead parameters suitable for the optical network unit in a next frame; or,

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical line terminal notifying a hyper frame number to the optical network unit; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal comprises: after the optical network unit receives the hyper frame number and after a frame indicated by the hyper frame number arrives, the optical network unit starting to use the upstream burst overhead parameters suitable for the optical network unit; or,

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical network unit notifying a hyper frame number to the

optical line terminal; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time determined by the optical network unit itself comprises: after a frame indicated by the hyper frame number arrives, the optical network unit starting to use the upstream burst overhead parameters suitable for the optical network unit.

17. (New) The method of claim 4, wherein:

the upstream burst overhead parameter set comprises: state of forward error correction, delimiter, preamble and guard band.

18. (New) The method of claim 5, wherein:

the upstream burst overhead parameter set comprises: state of forward error correction, delimiter, preamble and guard band.

REMARKS

In the preliminary amendment, as set forth above, page 2, the second paragraph from bottom of the description is amended in that the term "the ONU" is replaced with "the OLT".

In the preliminary amendment, as set forth above, page 7 of the description is amended in that the term "a switching event" is replaced with "switching time".

In the preliminary amendment, as set forth above, page 21, 1st paragraph of the description is amended in that the term "the third embodiment and the second embodiment" is replaced with "the fourth embodiment and the first embodiment".

In the preliminary amendment, as set forth above, page 27, step 7005 of the description is amended in that the term "… acquired in step 4" is replaced with "… acquired in step 7004".

In the preliminary amendment, as set forth above, page 34 of the description is amended in that the term "by the ONT" is replaced with "by the ONU".

In the preliminary amendment, as set forth above, claim 3 has been amended as that the term "the optical network unit" is replaced with "the optical line terminal".

In the preliminary amendment, as set forth above, claim 9 has been amended as that the term "a switching event" is replaced with "switching time".

In the preliminary amendment, as set forth above, claim 14 has been amended as that the term "the optical network terminal" is replaced with "the optical network unit".

In the preliminary amendment, as set forth above, the multiple dependent claims 6 and 7 are separated into several singularly dependent claims and the generated claims from the separation are added in sequence following the last original claim 14.

In the preliminary amendment, as set forth above, the drawings are amended in that: the term "set 2 corresponding to the parameters used in the link with good quality, and set 3 corresponding to the parameters used in the link with poor quality" in the first step of the FIGS. 3-8 is replaced with "set 2 corresponding to the parameters used in the link with poor quality, and set 3 corresponding to the parameters used in the link with good quality", and the term "and the detection result is "poor" corresponding to the upstream burst overhead parameter set 3" in the step 3004 of the FIG. 5 is replaced with "and the detection result is "poor" corresponding to

the upstream burst overhead parameter set 2"; and substituted drawings are attached.

Support for the preliminary amendment set forth above can be found in the claims and the specification including drawings as originally filed. Applicant asserts that no new matter is added.

It is believed that the application is in condition for allowance and such allowance is respectfully requested.

Respectfully submitted,

By: _____

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	Filing Date	2011-09-20
	First Named Inventor	Dezhi ZHANG et al.
	Art Unit	
	Examiner Name	Unknown
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	Application Number	13257621
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	Art Unit	
	Examiner Name	Unknown
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Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

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☐ 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	/Ling Wu/	Date (YYYY-MM-DD)	2012-04-01
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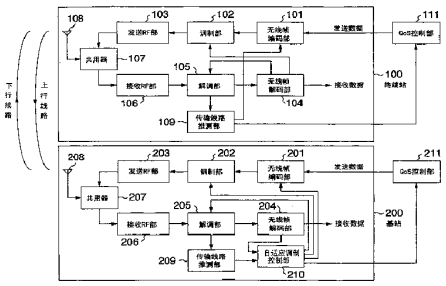
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权利要求书 2 页 说明书 16 页 附图 6 页

[54] 发明名称 使用自适应调制方式的无线通信方法及无线通信装置

[57] 摘要

本发明涉及在多个无线通信装置之间使用自适应调制方式进行双向通信的系统中所使用的无线通信方法及无线通信装置。 在终端站的传输线路推定部中，检测下行线路的 RSSI 平均值，将其结果通知给基站。 而在基站中，从上述终端站接收下行线路的 RSSI 平均值，同时通过传输线路推定部检测上行线路的 RSSI 平均值。 而且，在自适应调制控制部中，将上述所接收的下行线路的 RSSI 平均值和上述所检测的上行线路的 RSSI 平均值中差的一方，与阈值进行比较，确定调制方式，将该确定的调制方式通知给终端站，在调制部及解调部上进行设定，并且同步于该终端站上的设定定时，在基站的调制部及解调部上分别设定上述确定的调制方式。



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1、一种无线通信方法，在第 1 通信装置和第 2 通信装置之间，使用自适应调制方式进行双向通信，其特征在于，包括：

对用于从上述第 1 通信装置向第 2 通信装置传输信息的第 1 传输线路的状态进行推定的步骤；

将上述推定的第 1 传输线路的状态，从上述第 2 通信装置通知给第 1 通信装置的步骤；

对用于从上述第 2 通信装置向第 1 通信装置传输信息的第 2 传输线路的状态进行推定的步骤；

在上述第 1 通信装置中，根据由上述第 2 通信装置通知的上述第 1 传输线路的状态、及上述推定的第 2 传输线路的状态，确定在上述双向通信中使用的调制方式的步骤；以及

使用上述确定的调制方式，在上述第 1 通信装置和第 2 通信装置之间进行上述双向通信的步骤。

2、一种无线通信装置，在下述的系统中作为第 1 通信装置使用，所述系统在第 1 通信装置和第 2 通信装置之间使用自适应调制方式进行双向通信，并且具上述第 2 通信装置对用于从上述第 1 通信装置向第 2 通信装置传输信息的第 1 传输线路的状态进行推定、并通知给第 1 通信装置的功能，其特征在于，该无线通信装置包括：

接收由上述第 2 通信装置通知的上述第 1 传输线路的状态的装置；

对用于从上述第 2 通信装置向第 1 通信装置传输信息的第 2 传输线路的状态进行推定的装置；

根据由上述第 2 通信装置通知的上述第 1 传输线路的状态和上述被推定的第 2 传输线路的状态，确定在上述双向通信中使用的调制方式的装置；以及

使用上述被确定的调制方式，在与上述第 2 通信装置之间进行上述双向通信的装置。

3、如权利要求 2 所述的无线通信装置，其特征在于：

在上述第 1 传输线路和第 2 传输线路之间具有对称性时，确定上述

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调制方式的装置从上述第 1 传输线路状态和第 2 传输线路状态中优先选择质量差的一方，根据该被选择的传输线路状态确定调制方式。

4、如权利要求 2 所述的无线通信装置，其特征在于：

在上述第 1 传输线路和第 2 传输线路之间具有非对称性时，确定上述调制方式的装置从上述第 1 传输线路状态和第 2 传输线路状态中，优先考虑选择传输频带宽的一方的传输线路状态，根据该选择的传输线路状态确定调制方式。

5、如权利要求 2 所述的无线通信装置，其特征在于：

确定上述调制方式的装置具有：不考虑当前的调制方式，只根据新推定的第 1 及第 2 传输线路的状态，确定上述双向通信中使用的调制方式的装置。

6、如权利要求 2 所述的无线通信装置，其特征在于：

确定上述调制方式的装置，当将当前的调制方式变更为传输速度慢的一方的调制方式来作为下一个调制方式时，对当前的调制方式和下一个调制方式进行比较，在其间有多个调制方式时，逐渐变更为传输速度慢的一侧的调制方式，来变更为最终的调制方式。

7、一种固定式无线通信系统，在多个终端站和基站之间使用自适应调制方式进行双向通信，具有上述终端站对用于从上述基站向终端站传输信息的第 1 传输线路的状态进行推定、并通知给基站的功能，其特征在于，上述基站包括：

接收由上述终端站通知的上述第 1 传输线路的状态的装置；

对用于从上述终端站向基站传输信息的第 2 传输线路的状态进行推定的装置；

根据由上述终端站通知的上述第 1 传输线路的状态和上述推定的第 2 传输线路的状态，确定上述双向通信中使用的调制方式的装置；

使用上述确定的调制方式，在与上述终端站之间进行上述双向通信的装置。

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使用自适应调制方式的无线通信方法及无线通信装置

技术领域

本发明涉及在多个无线通信装置之间使用自适应调制方式进行双向通信的系统中所使用的无线通信方法及无线通信装置。

背景技术

在无线传输线路中，由于衰减（fading）及降雨衰减（attenuation）等影响，传输质量容易随时间而变化。例如，在噪声、干扰波、及衰减多的情况下，传输质量容易变差，反之在噪声、干扰波、及衰减少的情况下，传输质量有变好的倾向。为此，此前为了应付上述传输线路中传输质量随时间变化，提倡用自适应调制方式。

例如，在传输质量好时，为使传输效率优先，作为调制方式而使用将 4 位映射到复数平面的 16QAM（Quadrature Amplitude Modulation）、及将 6 位映射到复数平面的 64QAM（Quadrature Amplitude Modulation）等多值调制方式，来传输数据。其结果，可以在短时间内发送很多信息源编码数据。

对此，在传输质量变差时，为了使对传输误差（error）的承受性优先，作为调制方式而使用将 2 位映射到复数平面的 QPSK（Phase Shift Keying），来传输数据。这样，无论传输质量是否处于恶化的状态，都可以进行误差少的数据发送。

但是，作为使调制方式进行自适应变化的方式，此前例如有以下几种。

（1）以接收电场强度（RSSI：Received Signal Strength Indicator）或均衡器的均衡误差输出为基础，判断本站（自局）的接收状态，并根据该接收状态的判断结果，选择在本站发送中使用的调制方式（例如，参照特开平 10-93650 号公报）。

（2）使对方站检测本站发送的无线信号接收质量并确定调制方式，

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通过从对方站接收该确定的调制方式的通知，来可变地设定本站的调制方式（例如，参照特开平 10-41876 号公报）。

然而，若特开平 10-93650 号公报如 TDD（Time Division Duplex，即，时分双工）系统那样，上行传输线路和下行传输线路使用同一频率的系统，则由于上行传输线路和下行传输线路的传输线路特性大体相同，所以是妥当的。但是，在如 FDD（Frequency Division Duplex，频分双工）系统那样，上行传输线路和下行传输线路使用不同频率的系统中，由于上行传输线路和下行传输线路的传输线路特性一般不同，所以不一定能够选择适当的调制方式。

另一方面，特开平 10-41876 号公报的方法中，即使如 FDD 系统那样，在上行传输线路和下行传输线路的传输线路特性不同的系统中，也有可能设定适合传输线路特性的最佳调制方式。但是，各站为了分别独立确定对方站的调制方式，有时在上行传输线路和下行传输线路上设定不同的调制方式。这时，上行传输线路和下行传输线路的传输速度可能按一定的比率变化，所谓在对称性传输线路上不能保持上行和下行之间的对称性。另外，上行传输线路和下行传输线路的传输速度可能以不同的比率变化，产生所谓在非对称性传输线路上不能维持所期望的传输比率的不良情况。

发明内容

本发明是着眼于上述问题而提出的，其目的在于提供一种无线通信方法及无线通信装置，使用了虽然是双向多路方式但能够使上行传输线路和下行传输线路的调制方式总是一致的自适应调制方式。

为了达到上述目的，根据本发明的一个方面，在第 1 通信装置和第 2 通信装置之间，使用自适应调制方式进行双向通信的系统中所使用的无线通信方法及无线通信装置，由第 2 通信装置对用于从上述第 1 通信装置向第 2 通信装置传输信息的第 1 传输线路的状态进行推定，将该推定的第 1 传输线路状态通知给第 1 通信装置。与此同时，由第 1 通信装置对用于从上述第 2 通信装置向第 1 通信装置传输信息的第 2 传输线路的状态进行推定。而且，在上述第 1 通信装置中，根据由上述第 2 通信

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装置通知的上述第 1 传输线路的状态、及由第 1 通信装置推定的第 2 传输线路的状态，确定在上述双向通信中使用的调制方式，并使用该确定的调制方式，在上述第 1 通信装置和第 2 通信装置之间进行双向通信。

从而，根据本发明，在第 1 通信装置中，在第 1 及第 2 的各传输线路的传输线路特性双方都考虑的基础上确定调制方式。因此，不只在 TDD 系统，就是在 FDD 系统中，也可以根据传输线路的状态设定适当的调制方式，而且可以使第 1 传输线路和第 2 传输线路上使用的调制方式总是一致。从而，在对称性传输线路上，可以确实保持第 1 及第 2 传输线路间的对称性，而在非对称性传输线路上，可以使随调制方式不同而非对称传输的比率不变化，维持稳定的非对称传输。还在第 1 通信装置中统一确定第 1 及第 2 传输线路的调制方式。因此，其优点是例如即使需要变更调制方式的变更条件时，只用第 1 通信装置的变更就可以解决。

另外，本发明的又一特征是，为确定调制方式的装置、及使用确定的调制方式进行双向通信的装置，采用以下的各种构成。

第 1 构成是，在第 1 传输线路和第 2 传输线路之间具有对称性时，在第 1 传输线路状态和第 2 传输线路状态中优先选择质量差的一方，根据该选择的传输线路状态确定调制方式。

根据这样的构成，根据传输线路质量差的一方的传输线路质量，确定在第 1 及第 2 各传输线路上所使用的调制方式。即，优先确保传输线路质量，确定调制方式。从而，在 FDD 系统中，在第 1 及第 2 各传输线路中一方的传输线路质量差时，该传输线路质量也可以维持差的传输线路上的传输容错性，系统可进行误差少而稳定的无线通信。

第 2 构成是，在上述第 1 传输线路和第 2 传输线路之间具有非对称性时，在上述第 1 传输线路状态和第 2 传输线路状态中，选择传输频带宽的一方、或者传输速度快的一方的传输线路状态，根据该选择的传输线路状态确定调制方式。

通过这样的构成，根据在第 1 及第 2 各传输线路中传输频带宽的一方的传输线路传输质量，确定调制方式。即，优先确保传输效率，确定

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调制方式。从而，例如当窄频带一方传输线路的传输质量比宽频带一方传输线路的传输线路质量差时，可以不受窄频带一方传输线路的传输线路质量的限制，而充分确保宽频带一方传输线路的传输容量。

第 3 构成是，将过去推定的第 1 及第 2 传输线路的状态和过去所确定的调制方式中至少一方，作为履历信息存储起来，根据新推定的第 1 及第 2 传输线路的状态和上述存储的履历信息，确定调制方式。

这样的构成，不仅考虑上行及下行各传输线路的最新传输线路质量，也考虑了过去的传输线路质量的基础上，确定调制方式。因此，可以减轻传输线路一时变动的影响，稳定确定调制方式。

第 4 构成是，当包括第 1 通信装置将所确定的调制方式的指示信息发送给第 2 通信装置，而第 2 通信装置接收上述指示信息，根据该接收的指示信息，变更自身调制方式的装置时，在第 1 通信装置中包括推定从发送上述指示信息到第 2 通信装置变更调制方式之间所需时间的装置、及变更定时控制装置。而且，通过变更定时控制装置，根据所推定的时间，延迟控制第 1 通信装置变更自身调制方式的定时。

这样的构成，可以在第 1 通信装置和第 2 通信装置之间，使调制方式的变更定时一致，这样，即使进行调制方式的变更，也可以实现顺利地双向通信。

第 5 构成是，当第 1 及第 2 通信装置包括 QoS（Quality of Service）控制装置时，在第 1 通信装置中具有判断调制方式变更形式的装置、及变更定时控制装置；所述 QoS（Quality of Service）控制装置，在传输速率不小于第 1 值时，分别传输第 1 信息、及比该第 1 信息重要性低的第 2 信息，而在传输速率比第 1 值小时，优先传输第 1 信息的。而且，当判断调制方式从对应于第 1 传输速率的第 1 调制方式，变更为对应于比上述第 1 传输速率低的第 2 传输速率的第 2 调制方式时，通过上述变更定时控制装置，在经过上述 QoS 控制装置进行传输信息切换控制所需的时间后，变更调制方式。

这样的构成，当随着传输线路特性的恶化，将传输速率及调制方式变更为低速时，可考虑 QoS 控制所需要的时间，进行调制方式的变更。

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因此，就可以避免 QoS 控制跟不上传输速率及调制方式变更的不良情况，可防止由此造成的信息损失。

总之，本发明分别推定构成双向传输线路的第 1 及第 2 各传输线路的状态，且双方都考虑所推定的各传输线路的状态，对该各传输线路，选择使用共同的调制方式。

从而，根据本发明，可以提供一种无线通信方法及无线通信装置，使用了虽然是双向多路方式，但仍使用可以使上行传输线路和下行传输线路的调制方式总是一致的自适应调制方式。

附图说明

图 1 是表示本发明第 1 实施例所涉及的无线通信系统构成的方框图。

图 2A 及图 2B 是表示图 1 中所示的系统中所使用的传送帧格式的图。

图 3 是图 1 中所示系统的操作说明中使用的误差率（error rate）特性图。

图 4 是说明图 1 中所示系统的操作时序的图。

图 5 是说明第 1 实施例中的调制方式确定操作的流程图。

图 6 是表示本发明第 2 实施例所涉及的无线通信系统的操作时序的图。

图 7 是说明本发明中调制方式确定操作的变形例的流程图。

图 8 是表示将本发明适用于 FWA 无线通信系统中的构成例的概略图。

具体实施方式

图 1 是表示本发明所涉及的无线通信系统的第 1 实施例的构成方框图。该系统是将基站 200 和多个终端站 100 之间，利用由上行线路和下行线路构成的双向传输线路进行连接的系统。双向传输方式使用 FDD（Frequency Division Duplex）方式。由于各终端站 100 的构成相同，所以在图中只示出了 1 个站，省略了其他站的图示。

终端站 100 的发送系统包括无线帧编码部 101、调制部 102、发送

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RF 部 103，而接收系统包括接收 RF 部 106、解调部 105、无线帧解码部 104。而且，这些发送系统及接收系统通过共用器 107 连接在天线 108 上。

无线帧编码部 101 在对从未图示的信息输入输出单元供给的发送数据进行误差校正编码处理之后，插入到上行传输帧的数据字段中。调制部 102 具有对应于自适应调制方式的功能，将插入了上述编码发送数据的上行传输帧，按照所指定的调制方式变换成调制信号，供给发送 RF 部 103。发送 RF 部 103 具有频率变换器及发送功率放大器。而且，将从上述调制部 102 供给的调制信号变换成上行线路用的无线频率，并放大到规定的发送功率电平，通过共用器 107 将该放大的无线信号供给天线 108，使之发送出去。

接收 RF 部 106 包括低噪声放大器及频率变换器。而且，将通过天线 108 接收的无线信号用低噪声放大器放大之后，通过频率变换器变换成中频或者基带频率的接收信号。解调部 105 将通过上述接收 RF 部 106 进行频率变换的接收信号，通过与上述调制部 102 所设定的调制方式对应的解调方式进行解调，并将下行传输帧输入到无线帧解码部 104。无线帧解码部 104 对插入到上述输入的下行传输帧中的信息数据，进行误差校正解码处理及用于扩展数据的解码处理。而且，将由这些解码处理所再生的接收数据，供给未图示的信息输入输出单元。

而终端站 100 的作为本发明所涉及的功能包括：推定下行线路的传输线路的功能、将该推定结果通知给基站 200 的功能、及设定由基站 200 所指示的调制方式的功能。在传输线路推定部 109 中，设置推定下行线路的传输线路的功能。传输线路推定部 109 从上述解调部 105 取入下行线路的接收信号，检测出其 RSSI（Received Signal Strength Indicator）。而且，将该 RSSI 的检测值作为传输线路推定结果，供给无线帧编码部 101。

将传输线路推定结果通知给基站 200 的功能，设置在无线帧编码部 101 中。如图 2（b）所示，无线帧编码部 101 生成上行传输帧，该上行传输帧由同步字（SW）、上行用自适应调制控制信道（MCHU）、及信

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息数据字段（DATA）构成。而且，将从上述传输线路推定部 109 供给的 RSSI 检测值，插入于上述上行自适应调制控制信道（MCHU）中，向基站 200 发送。

设定由基站200所指出的调制方式的功能，设置在无线帧解码部104中。如图 2（b）所示，从基站 200 传输的下行传输帧，由同步字（SW）、下行用自适应调制控制信道（MCHD）、及信息数据字段（DATA）构成。无线帧解码部 104，从所接收的下行传输帧的下行用自适应调制控制信道（MCHD）抽出调制指示数据。而且，根据该抽出的调制指示数据，对调制部 102 及解调部 105 指定调制方式。该调制方式的指定定时，设定为与上行及下行的各传输帧的发送接收定时相同步。

另一方面，基站 200 如下构成。即，基站 200 也与上述终端站 100 一样，发送系统包括无线帧编码部 201、调制部 202、及发送 RF 部 203，而接收系统包括接收 RF 部 206、解调部 205、及无线帧解码部 204。而且，通过共用器 207 将这些发送系统及接收系统连接在天线 208 上。

无线帧编码部 201 对从未图示的信息处理装置供给的发送数据，进行误差校正编码处理之后，插入到下行传输帧的数据字段中。调制部 202 具有对应于自适应调制方式的功能，将插入了上述编码发送数据的下行传输帧，按照所指定的调制方式变换成调制信号之后，供给发送 RF 部 203。发送 RF 部 203 具有频率变换器及发送功率放大器。而且，将从上述调制部 202 供给的调制信号变换成下行线路用的无线频率，并放大到规定的发送功率电平，通过共用器 207 将该放大的无线信号供给天线 208，使之发送出去。

接收 RF 部 206 包括低噪声放大器及频率变换器。而且，将通过天线 208 接收的无线信号，用低噪声放大器放大之后，通过频率变换器变换成中频或者基带频率的接收信号。解调部 205 将通过上述接收 RF 部 206 频率变换的接收信号，通过与上述调制部 202 所设定的调制方式对应的解调方式进行解调，来再现上行传输帧，并将该再现的上行传输帧输入到无线帧解码部 204。无线帧解码部 204 对插入到上述输入的上行传输帧中的信息数据，进行误差校正解码处理及用于扩展数据的解码处

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理。而且，将由这些解码处理所再现的接收数据，供给未图示的信息处理装置。

而基站 200 的作为本发明所涉及的功能包括：推定上行线路的传输线路的功能、从终端站 100 通知的下行线路的 RSSI 检测值接收功能、调制方式的确定功能、及将该确定结果通知给终端站 100 的功能。推定上行线路的传输线路的功能被设置在传输线路推定部 209 中。传输线路推定部 209 从上述解调部 205 取入上行线路的接收信号，检测出其 RSSI（Received Signal Strength Indicator，接收信号强度指示器）。

下行线路的 RSSI 检测值的接收功能设置在无线帧解码部 204 中。如上述的图 2(a)所示，从终端站 100 传输的上行传输帧，由同步字(SW)、上行用自适应调制控制信道（MCHD）、及信息数据字段（DATA）构成。无线帧解码部 204，从所接收的上行传输帧的上行用自适应调制控制信道（MCHD）抽出 RSSI 检测值。

调制方式确定功能设置在自适应调制控制部 210 中。自适应调制控制部 210 如在后详述，从上述传输线路推定部 209 取入上行线路的 RSSI 检测值，并从上述无线帧解码部 204 取入下行线路的 RSSI 检测值。而且，将该取入的上行线路及下行线路的各 RSSI 检测值中小的一个 RSSI 检测值，与预先设定的阈值进行比较，来确定调制方式。而且，将该确定的调制方式通知给无线帧编码部 201，并且分别在调制部 202 及解调部 205 中进行设定。该设定定时的设定考虑到：在将上述调制方式通知给终端站 100 之后，在终端站 100 中设定调制方式之前的处理延迟。

将确定的调制方式通知给终端站 100 的功能，设置在无线帧编码部 201 中。如图 2（a）所示，无线帧编码部 201 生成下行传输帧，该下行传输帧由同步字（SW）、下行用自适应调制控制信道（MCHU）、及信息数据字段（DATA）构成。而且，将从上述自适应调制控制部 210 通知的调制方式指示数据，插入到上述下行自适应调制控制信道（MCHU）中，向终端站 100 发送。

下面，对以上构成的系统的自适应调制方式的控制操作进行说明。图 4 是表示该操作操作步骤的时序图。

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当在基站 200 和终端站 100 之间开始信息数据通信时，终端站 100 在传输线路推定部 109 中，定期进行下行线路的传输线路质量的推定。在接收作为推定对象的下行传输帧的数据字段期间，通过检测接收信号的 RSSI 平均值，进行该传输线路质量的推定。当检测上述下行线路的 RSSI 平均值时，在无线帧编码部 101 中，如图 4 中所示，该检测出的 RSSI 平均值插入到下一个上行传输帧的自适应调制控制信道（MCHU）中。而且，由调制部 102 进行调制，再由发送 RF 部 103 变换成无线信号之后，从天线 107 发送给基站 200。

另一方面，在基站 200 中，通过传输线路推定部 209，定期进行上行线路的传输线路质量推定。该传输线路质量的推定，也与上述终端站 100 一样，在接收作为推定对象的上行传输帧的数据字段期间，通过检测接收信号的 RSSI 平均值来进行。与此同时，基站 200 每当从终端站 100 接收上行传输帧时，都从所接收的上行传输帧的自适应调制控制信道（MCHU）中，抽出下行线路的 RSSI 平均值。

当得到上述上行线路的 RSSI 平均值及下行线路的 RSSI 平均值时，在自适应调制控制部 210 中进行用于确定调制方式的处理。通过对应于所准备的多个调制方式预先设定好 RSSI 的阈值，并将上行线路的 RSSI 平均值和下行线路的 RSSI 平均值中质量差的一方与上述阈值进行比较，来执行上述调制方式的确定处理。

例如，当假定调制方式准备了 QPSK、16QAM 及 64QAM，则对这些调制方式的 C/N（载波功率与噪声功率比）的位错率（BER：Bit Error Rate）的特性理论值如图 3 所示。在该图中横轴为 C/N，该 C/N 在适当构成的通信装置中与 RSSI 等效。在该图中，当使所要的 BER 为 1.0×10^{-4} 时，分别对应于 16QAM 及 64QAM，阈值由 $V_{2\text{-}1}$、$V_{1\text{-}2}$、$V_{3\text{-}2}$、$V_{2\text{-}3}$ 设定。

而且，在这样的条件下，自适应调制控制部 210 根据图 5 中所示的流程图，按以下确定调制方式。即，首先，判断当前的调制方式例如是否设定了 QPSK（步骤 501），当设定了 QPSK 时转到步骤 505，当设定了 QPSK 以外的调制方式时，转到步骤 502。在步骤 502 中判断当前的调制方式是否设定了 16QAM，当设定了 16QAM 时，转到步骤 503，而

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当设定了 16QAM 以外的调制方式时，转到步骤 506。

在步骤 505 中，判断上行线路的 RSSI 平均值和下行线路的 RSSI 平均值中质量差的一方是否超过了阈值 V_{1-2}，当超过了阈值 V_{1-2} 时，作为调制方式选择 16QAM（步骤 508）。而当在阈值 V_{1-2} 以下时，作为调制方式维持 QPSK（步骤 507）。

另外，当前的调制方式在设定了 16QAM 的状态，在步骤 503 中，判断上行线路的 RSSI 平均值和下行线路的 RSSI 平均值中质量差的一方是否小于阈值 V_{2-1}，再在步骤 504 中判断是否超过了阈值 V_{2-3}。当上行线路的 RSSI 平均值和下行线路的 RSSI 平均值中质量差的一方超过了阈值 V_{2-3} 时，调制方式选择 64QAM（步骤 511）。反之，当上行线路的 RSSI 平均值和下行线路的 RSSI 平均值中质量差的一方超过了阈值 V_{2-1}，而在阈值 V_{2-3} 以下时，调制方式维持 16QAM（步骤 510）。另外，当上行线路的 RSSI 平均值和下行线路的 RSSI 平均值中质量差的一方小于阈值 V_{2-1} 时，调制方式选择 QPSK。

同样，在当前的调制方式在设定了 64QAM 的状态，在步骤 506 中，判断上行线路的 RSSI 检测值和下行线路的 RSSI 检测值中质量差的一方是否超过了阈值 V_{3-2}。当小于阈值 V_{3-2} 时，调制方式选择 16QAM（步骤 512）。反之，当超过阈值 V_{3-2} 时，调制方式维持 64QAM（步骤 513）。

不使阈值 $V_{2-1}=V_{1-2}$、$V_{3-2}=V_{2-3}$，是为了在边界附近不频繁发生调制方式的变更。

如上所述，决定调制方式时，在自适应调制控制部 210 中作出对上述确定的调制方式发出的变更指示数据，该变更指示数据通知给无线帧编码部 201。无线帧编码部 201 将上述变更指示数据按图 4 中所示，插入到后续的下行传输帧的自适应调制控制信道（MCHD）中，输出给调制部 202。结果，上述变更指示数据由调制部 202 进行调制，再在发送 RF 部 203 中变换成无线信号之后，从天线 207 发送给通信对方的终端站 100。

对此，终端站 100，当从上述基站 200 接收下行传输帧时，在无线帧解码部 104 中，从上述所接收的下行传输帧的自适应调制控制信道

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（MCHD）抽出变更指示数据。然后，根据所抽出的变更指示数据，在下一个上行和下行各传输帧的开始时刻，从无线帧解码部 104 对调制部 102 和解调部 105，分别赋予各调制方式及与其对应的解调方式的设定指示，这样在调制部 102 和解调部 105 上分别设定对应于上述接收的变更指示数据的调制方式及与其对应的解调方式。从而，以后从终端站 100 发送的上行传输帧，通过上述设定的调制方式进行调制后发送。

另外，在基站 200 中，当确定上述调制方式时，自适应调制控制部 210 对调制部 202 及解调部 205，分别赋予调制方式及与其对应的解调方式的设定指示，这样，在调制部 202 及解调部 205 上分别设定上述所确定的调制方式及与其对应的解调方式。

这时，对上述调制部 202 及解调部 205 的调制方式及解调方式的设定定时，如图 4 中所示，在发送上述变更指示数据的下行传输帧的下一个帧的开始时刻设定。因此，基站 200 中的调制方式及解调方式的变更定时，与终端站 100 中的调制方式及解调方式的变更定时一致。从而，以后在基站 200 和终端站 100 之间，可以根据上述变更的调制方式及解调方式，在相互同步的状态，进行信息数据的双向通信。

如上所述，第 1 实施例在终端站 100 的传输线路推定部 109 中，检测下行线路的 RSSI 平均值，通过上行传输帧的自适应调制控制信道（MCHC），将该检测结果通知给基站 200。另一方面，在基站 200 中，从上述终端站 100 接收下行线路的 RSSI 平均值，并且通过传输线路推定部 209 检测上行线路的 RSSI 平均值。然后，在自适应调制控制部 210 中，对上述所接收的下行线路的 RSSI 平均值和上述检测的上行检测的上行线路的 RSSI 平均值进行比较，选择值差的一个，并通过将所选择的 RSSI 平均值与阈值 V_{2-1}、V_{1-2}、V_{3-2}、V_{2-3} 进行比较，确定调制方式。然后，通过下行传输帧的自适应调制控制信道（MCHD），将调制方式的变更指示数据通知给终端站 100，这样，在调制部 102 和解调部 105 中，分别设定上述确定的调制方式及与其对应的解调方式。并且与其同时，在基站 200 中，与上述终端站 100 的设定定时相同步，在调制部 202 及解调部 205 上分别设定上述确定的调制方式及与其对应的解调方式。

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从而，根据本实施例，对上行及下行的各线路的传输线路特性双方都考虑基础上确定调制方式。因此，可以在上行线路和下行线路之间使调制方式总是一致。从而，在对称性传输线路上可以确实保持上行和下行各线路之间的对称性，在非对称性传输线路上不会因调制方式不同而使非对称性传输比率变化，可以维持稳定的非对称性传输。

另外，在确定调制方式时，根据传输线路特性差的一方的线路质量设定调制方式。即，优先确保传输线路质量，确定调制方式。从而在 FDD 系统中，即使在上行及下行的各传输线路中只是一方的传输线路质量差时，该传输线路质量也可以维持差的传输线路上传输容错性，系统可进行误差少而稳定的双向无线信息通信。

还有，在基站 200 中统一确定上行及下行的各传输线路的调制方式。因此，其优点是例如即使需要变更阈值时，只用基站 200 的变更就可以解决。

再进行使基站 200 上的调制方式的设定定时，应与终端站 100 上的设定定时同步的延迟控制。因此，可以在基站 200 和终端站 100 之间，使调制方式的变更定时一致，这样，即使进行调制方式的变更，也可以实现顺利地双向通信。

本发明的第 2 实施例，当基站及终端站具有 QoS（Quality of Service）控制装置时，即在可得到规定速度以上传输速度时传输所有的数据，而当传输速度降低到规定速度以下时优先传输要求实时性的数据及控制数据等重要性高的数据时，通过将本发明所涉及的自适应调制控制与上述 QoS 控制组合，可进行更有效的 QoS 控制。

图 6 是为说明本发明第 2 实施例的系统时序图。有关基站及终端站的基本构成，由于与上述第 1 实施例相同，故在本实施例中也使用图 1 进行说明。

基站 200 及终端站 100 以 64 个传输帧作为 1 周期，按下述执行自适应调制及 QoS 控制。首先，在帧序号为“0”～“9”的 10 帧期间，分别推定上行线路及下行线路的传输线路特性。该传输线路特性的推定，是通过在各帧“0”～“9”中分别计算接收数据的均衡误差来进行的。

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终端站 100 使用上行传输帧的自适应调制控制信道（MCHU），将上述计算的下行线路的 10 帧量的均衡误差依次或一起发送给基站。而基站 200 接收从上述终端站 100 发送的均衡误差，暂时存储在自适应调制控制部内的存储器中。同样，将在本站内的传输线路推定部 209 中所计算的上行线路的 10 帧量的均衡误差，存储在自适应调制控制部 210 内的存储器中。

接着，基站 200 的自适应调制控制部 210，在帧“11”的传输期间，从上述存储器分别读出下行线路的 10 帧量的均衡误差、及上行线路的 10 帧量的均衡误差，分别计算出这些均衡误差的平均值。然后对所算出的下行线路的均衡误差平均值、及上行线路的均衡误差平均值进行比较，选择其中均衡误差平均值大的一个。即选择上行线路及下行线路中传输线路特性差的一个。接着自适应调制控制部 210 将上述选择的均衡误差平均值与预先设定的阈值进行比较，确定最适合该均衡误差平均值的调制方式。确定该最佳调制方式的算法，可以使用第 1 实施例中所述的算法。

接着，基站 200 的自适应调制控制部 210，根据上述确定的调制方式的变更内容，执行调制方式的通知控制。即，首先调制方式例如从 64QAM 及 16QAM 这种高效率的调制方式，变更为 QPSK 这种低效率的调制方式时，如图 6 中所示，在帧“12”期间，使用其自适应调制控制信道（MCHD），将调制方式的变更指示数据通知给终端 100。即，使用在确定上述调制方式的处理之后发送的下行传输帧，通知调制方式。

当收到上述调制方式的变更指示数据时，终端站 100 将对应于该变更指示数据的传输速度变更信息，立刻供给 QoS 控制部 111。而且，在帧“0”的开始时刻，对调制部 102 及调制部 105，进行调制方式及与其对应的解调方式的切换设定。从而，终端站 100 的 QoS 控制部 111，可以利用从由帧“12”取得传输速度变更信息到在帧“0”切换调制方式的充分长的期间，进行 QoS 控制的准备处理。因此，可以预先避免由 QoS 控制的对应延迟产生的信息数据损失。

另外，基站 200 的自适应调制控制部 210，与对上述终端站 100 的

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变更指示操作一样，对本站的 QoS 控制部 211 也在帧“12”期间供给传输速度变更信息。而且，在帧“0”的开始时刻，对调制部 202 及调制部 205，进行调制方式及与其对应的解调方式的切换设定。从而，在基站 200 的 QoS 控制部 211 中，也可以利用从由帧“12”取得传输速度变更信息到在帧“0”切换调制方式的充分长的期间，进行 QoS 控制的准备处理。因此，可以避免由 QoS 控制的对应延迟产生的信息数据损失。

另一方面，假设调制方式例如是从 QPSK 及 16QAM 这种低效率的调制方式，变更为 16QAM 或 64QAM 这种高效率的调制方式。这时，基站 200 的自适应调制控制部 210，如图 5 中所示，在帧“63”期间，使用其自适应调制信道（MCHD），将调制方式的变更指示数据通知给终端站 100。即，使用调制方式切换定时（帧“0”的开始时刻）之前的帧，通知调制方式。因此，终端站 100 与上述第 1 实施例一样，可以在接收变更指示数据的帧的下一帧开始时刻，切换调制方式。即，不进行延迟控制就可以进行调制方式的切换控制。

另外，基站 200 的自适应调制控制部 210 对本站的 QoS 控制部 211 也同样，在帧“63”期间供给传输速度变更信息。而且，在帧“0”的开始时刻，对调制部 202 及调制部 205，进行调制方式及与其对应的解调方式的切换设定。

这样，根据第 2 实施例，在调制方式从高效率的调制方式向低效率的调制方式变更时、及从低效率的调制方式向高效率的调制方式变更时，使对 QoS 控制部 111、211 的传输速度变更信息的供给定时是不同的。因此，传输速度在从高速向低速切换时，可以利用充分长的期间，进行 QoS 控制的准备处理，这样可以确实避免 QoS 控制的对应延迟所造成的信息数据损失。

在上述各实施例中，是根据上行线路和下行线路中传输特性差的一方的线路质量确定调制方式。但是，并不限于此，例如，在上行线路和下行线路的传输频带为非对称时，也可以选择传输频带宽的一方，通过将该选择的线路的传输线路质量与阈值进行比较，确定调制方式。这是根据传输频带传输更重要通信的想法，使其不影响重要性更低的线路条

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件，使传输效率优先。这时，由于传输频带窄的线路状态被忽视，所以有时该线路条件差，有可能在传输中产生误差，但是原本重要性低，通过自动重发控制等措施，完全可以救助。这种方法例如在从终端站对因特网等通信网络上的服务器进行存取，从该服务器下载应用程序及大容量数据等方面特别重要。

以上的例子是考虑当前的调制方式确定下一个调制方式的方法。但是，在确定下一个调制方式时，也可以不考虑当前的调制方式，而从上行线路及下行线路的各 RSSI 检测值，直接确定新的调制方式。这样，例如对于接收状态急骤恶化，可以迅速向适当的调制方式变更。调制方式例如采用 QPSK、16QAM、64QAM 三种调制方式之一时的流程图如图 7 中所示。

在步骤 701 上，判断上行线路的 RSSI 平均值及下行线路的 RSSI 平均值中质量差的一方是否超过了阈值 V_1，当比阈值 V_1 小时，作为调制方式选择 QPSK（步骤 702）。而在上行线路的 RSSI 平均值及下行线路的 RSSI 平均值中质量差的一方不小于阈值 V_1 时，转到步骤 703，判断是否超过了阈值 V_2（$V_1<V_2$）。当上行线路的 RSSI 平均值及下行线路的 RSSI 平均值中质量差的一方超过了阈值 V_2 时，调制方式选择 64QAM（步骤 705）。而当比不大于阈值 V_2 时，作为调制方式选择 16QAM（步骤 704）。

在以上的例子中，将当前的调制方式变更为作为下一个调制方式的传输速度慢的一方的调制方式时，也可以按阶段逐渐变更调制方式。例如对当前的调制方式和下一个调制方式进行比较，在此其间有多个调制方式时，逐渐向传输速度慢的一方的调制方式变更，使之变更到最终的调制方式。

还可以计算上行线路的传输线路特性的推定值和下行线路的传输线路特性推定值的平均值，通过将该计算出的平均值，与阈值进行比较，确定调制方式。另外，在计算上述平均值时，也可以在上行线路的传输线路特性的推定值及下行线路的传输线路特性的推定值上，分别乘以根据上行线路和下行线路的重要程度确定的加权系数后，计算出平均值。

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另外，在上述各实施例中，是通过检测接收信号的 RSSI 或者计算出均衡误差，来推定传输线路特性，但是也可以通过检测表示信号噪声比（Ec/No）等质量的其他值进行推定。另外也可以将这些值进行组合来推定传输线路特性。

另外，在上述各实施例中，是以在基站设置自适应调制控制部时为例进行了说明，但是也可以在终端站设置自适应调制控制部。

另外，本发明也可以适用于 FWA 无线通信系统中，图 8 是表示使用本发明的 FWA 无线通信系统构成例的概略图。

在该 FWA 无线通信系统中，在固定设置的基站 1 的无线通信服务区中，固定设置多个终端站 2。在这些基站 1 和终端站 2 之间进行无线通信，通过基站 1，在与终端站 2 连接的 PC 等用户终端装置（未图示）之间进行数据通信，或与连接在基站 1 的基干（backbone）线路间进行数据通信。

这些基站 1 和终端站 2 是分别具有无线通信功能的站装置，这些基站 1 和终端站 2 的无线功能部分具有与图 1 相同的构成。

在 FWA 无线通信系统中，为了在基站 1 和终端站 2 之间收发数据，基站 1 和终端站 2 的某个无线机也可以成为发送端或接收端。

另外，本发明也可以适用于固定式无线通信系统，该固定式无线通信系统具有这样的功能：在多个终端站和基站之间使用自适应调制方式进行双向通信，并且上述终端站对从上述基站向终端站传输信息的第 1 传输线路状态进行推定之后，通知给基站。

此外，关于系统的种类、第 1 及第 2 通信装置的构成、第 1 及第 2 通信装置中的自适应调制控制步骤及其内容、调制方式的种类和数量等，只要不脱离本发明的要点的范围，可以进行种种变形来实施。

总之，本发明并不限定上述各实施例，在实施阶段，在不脱离其要点的范围内，可以对构成要素变形进行具体化。另外，通过上述各实施例所公开的多个构成要素的适当组合，可以形成种种发明。例如，也可以从各实施例所示的全构成要素中删除一些构成要素，还可以将不同的实施例中的构成要素进行适当组合。

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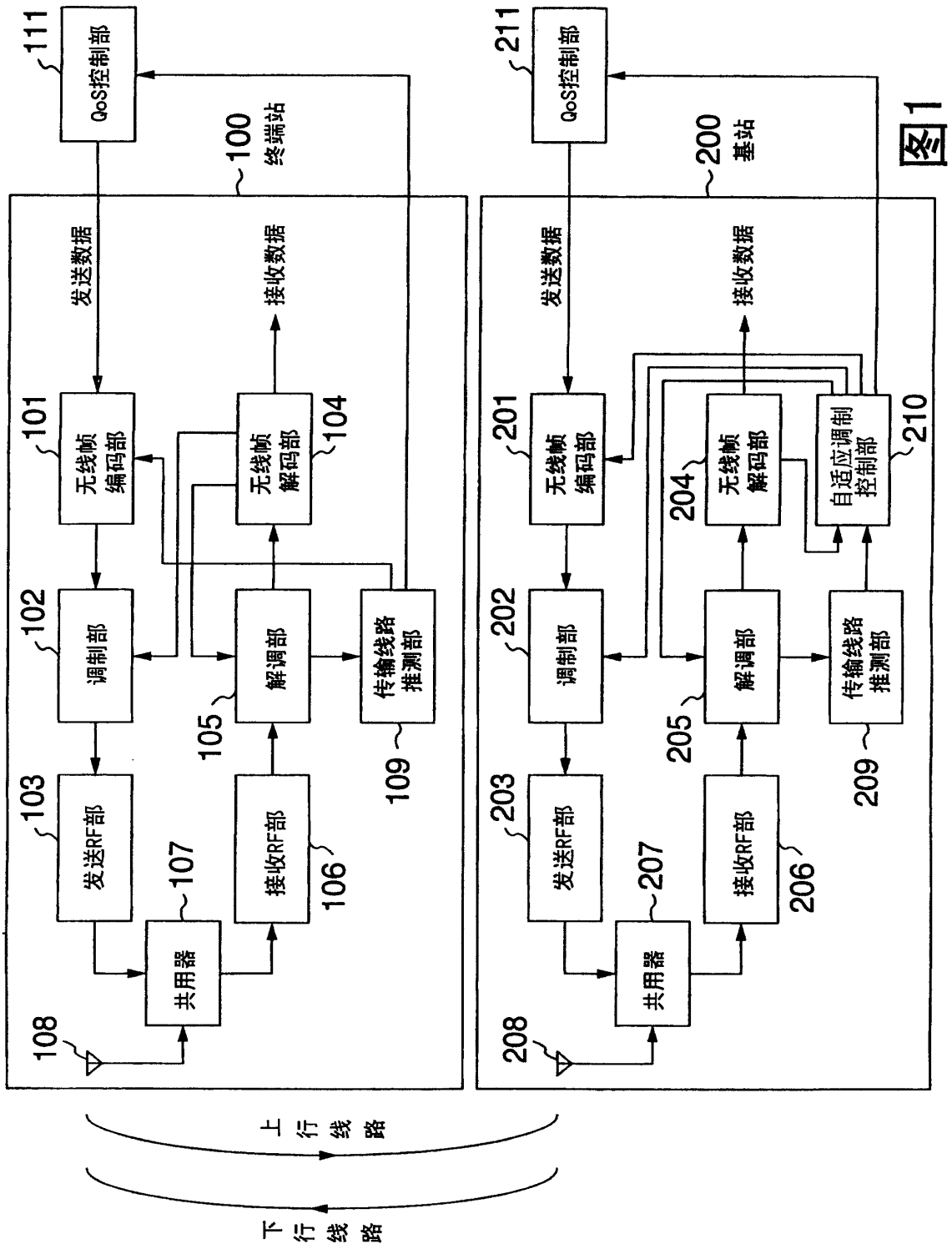


图1

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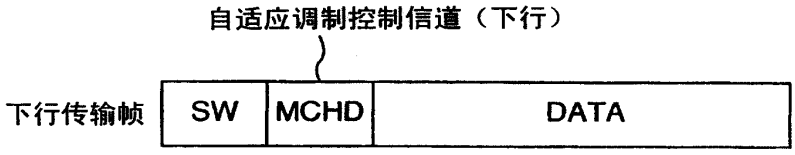


图2A

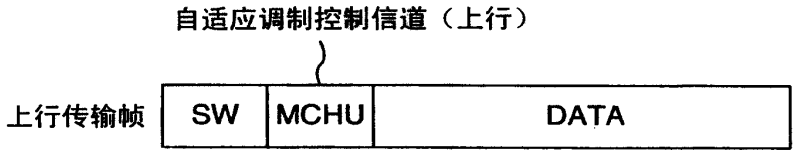


图2B

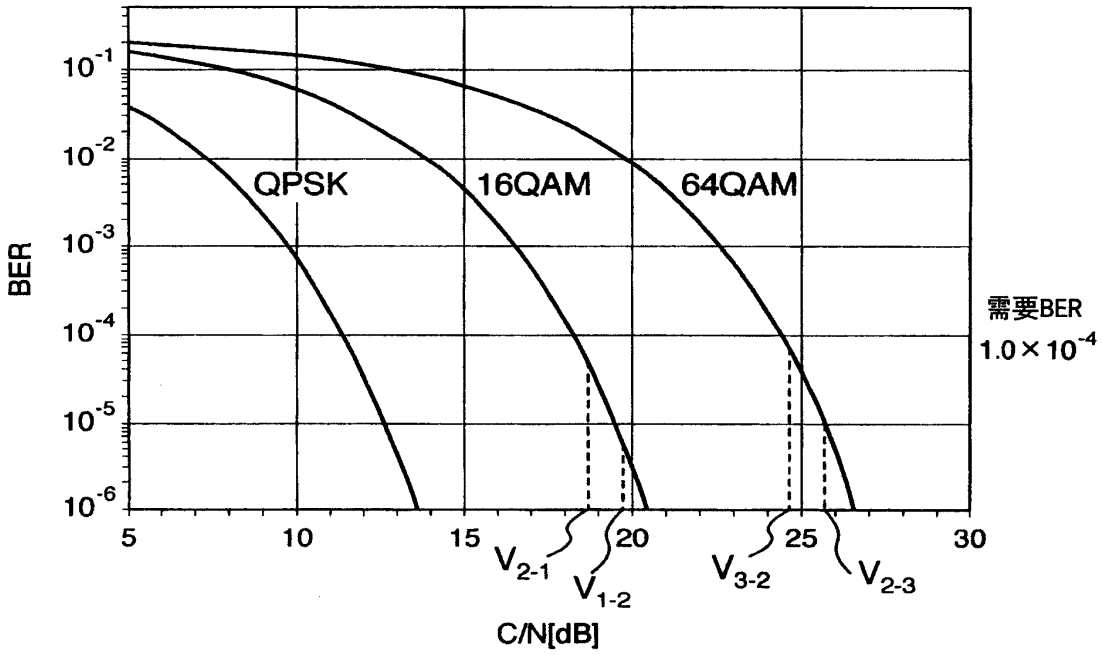


图3

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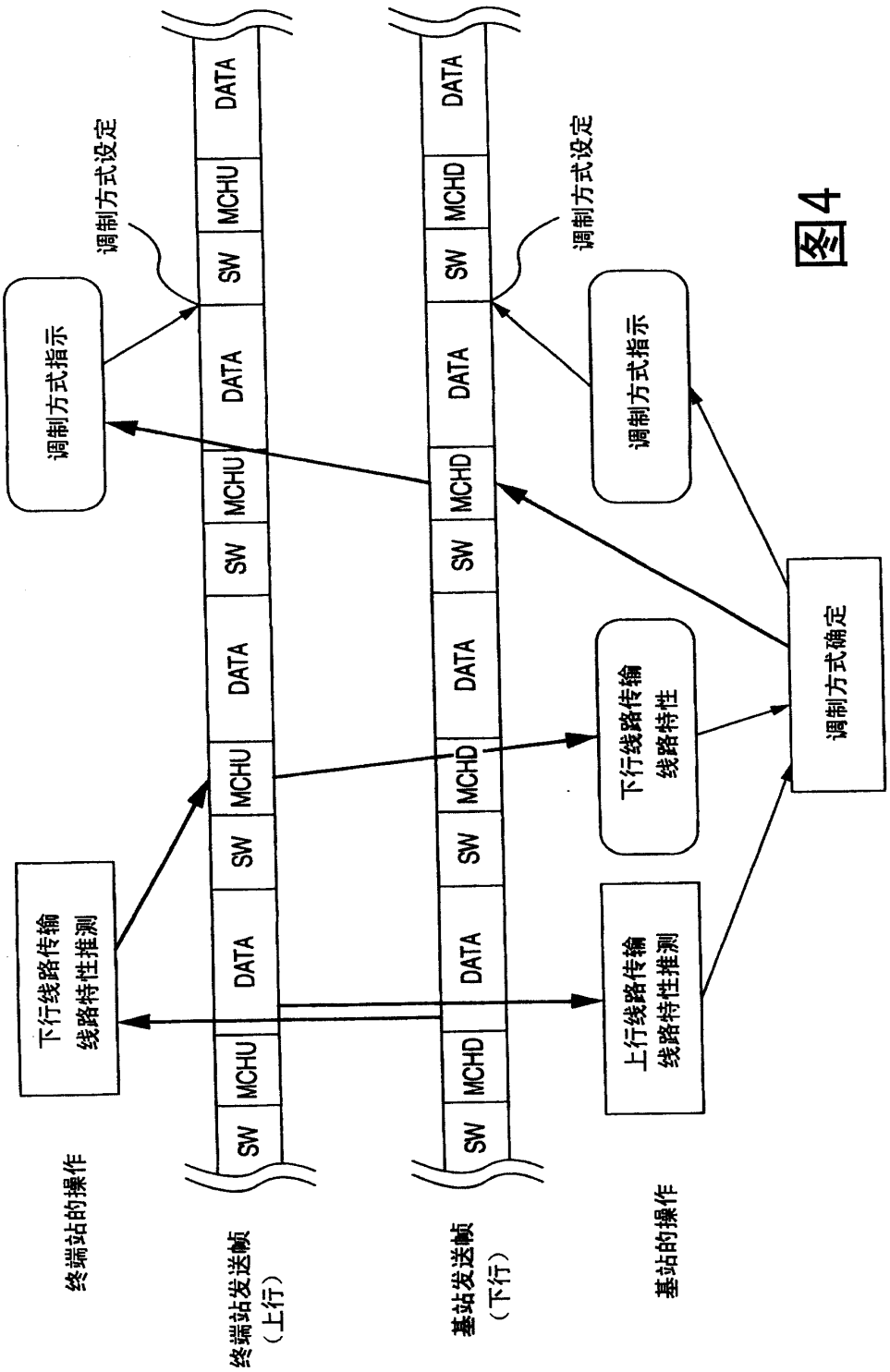


图4

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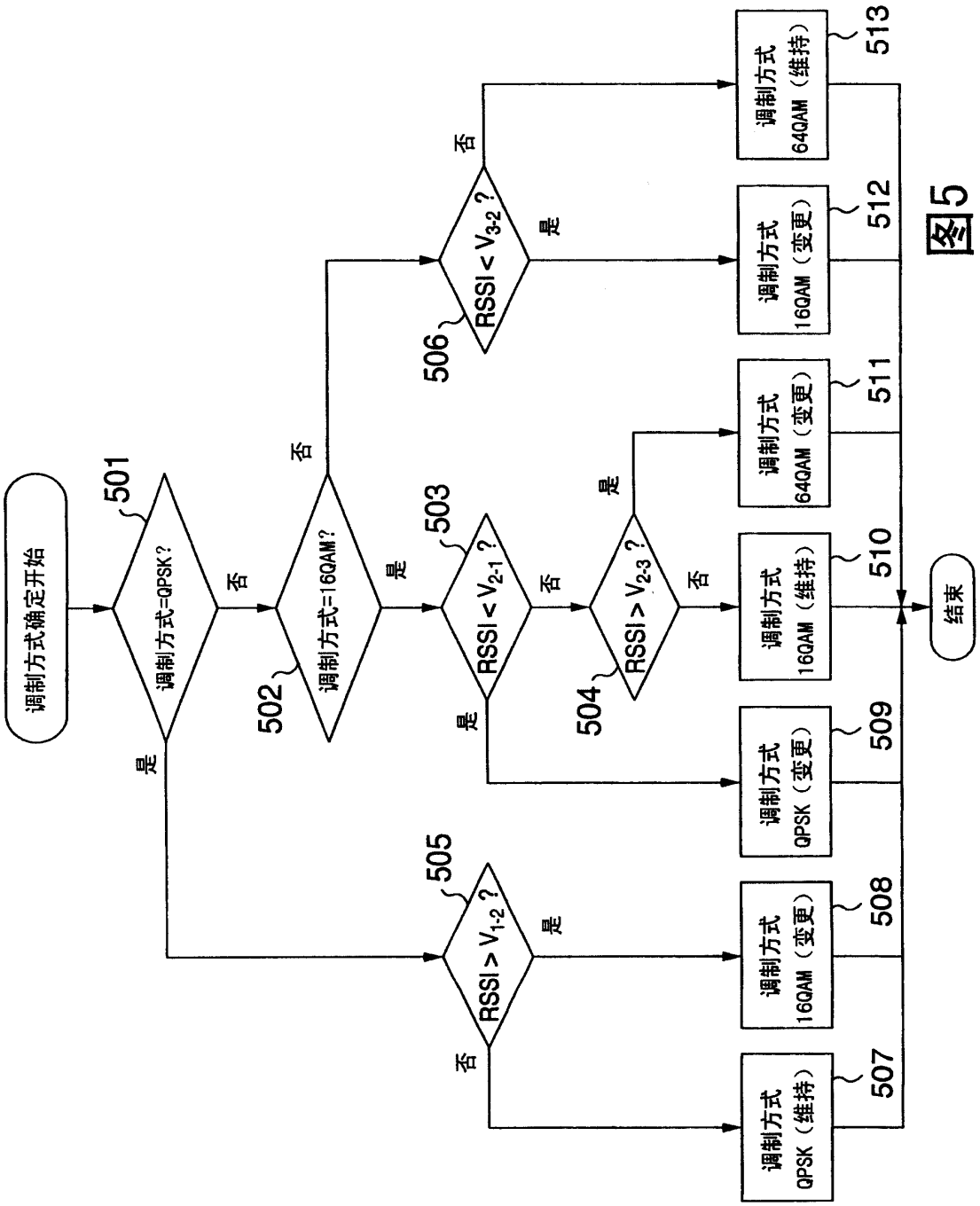


图5

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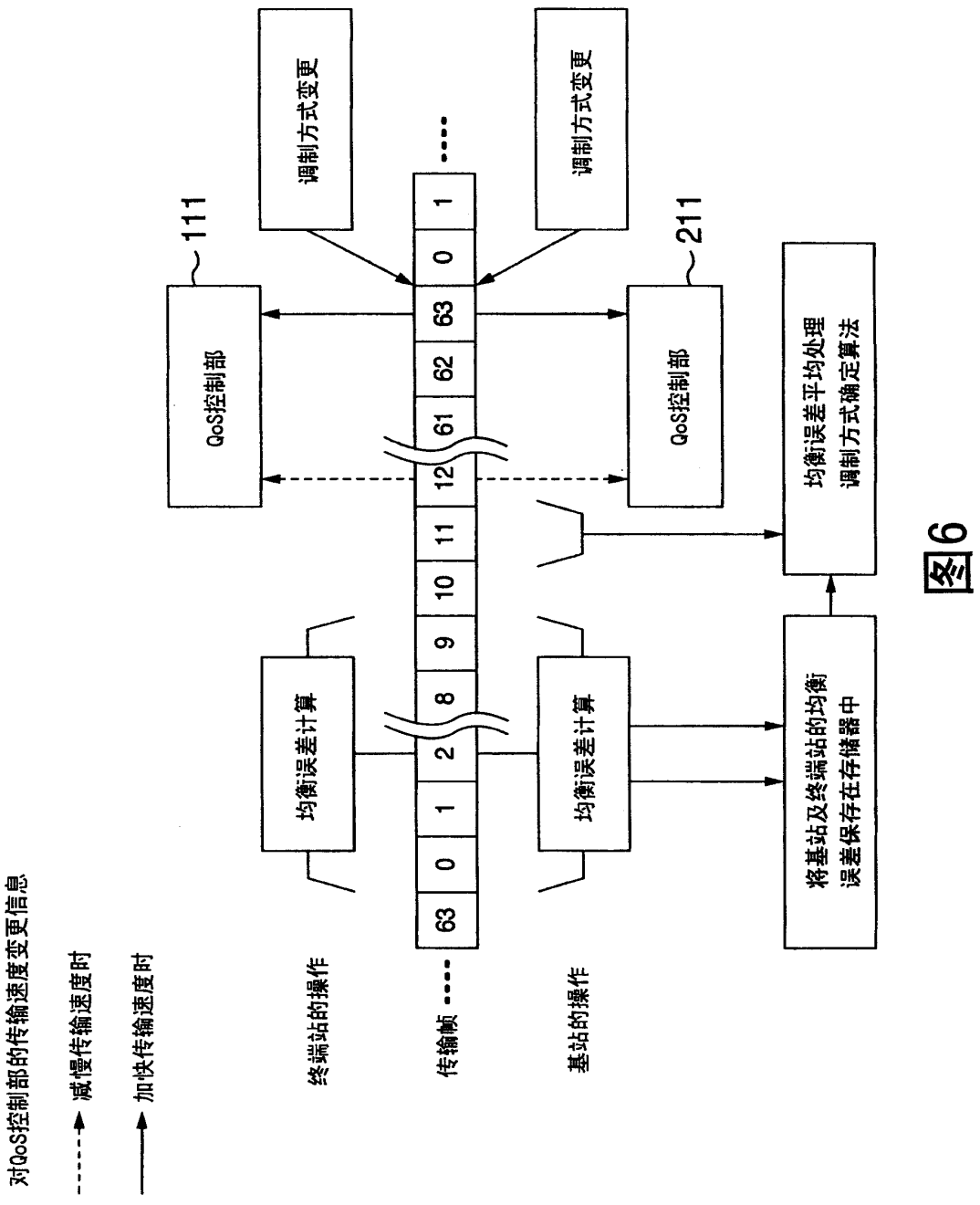


图6

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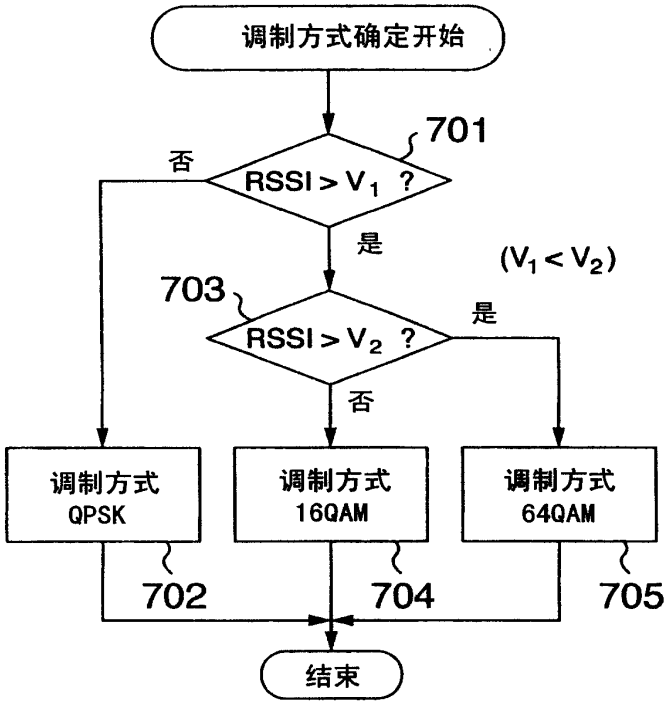


图7

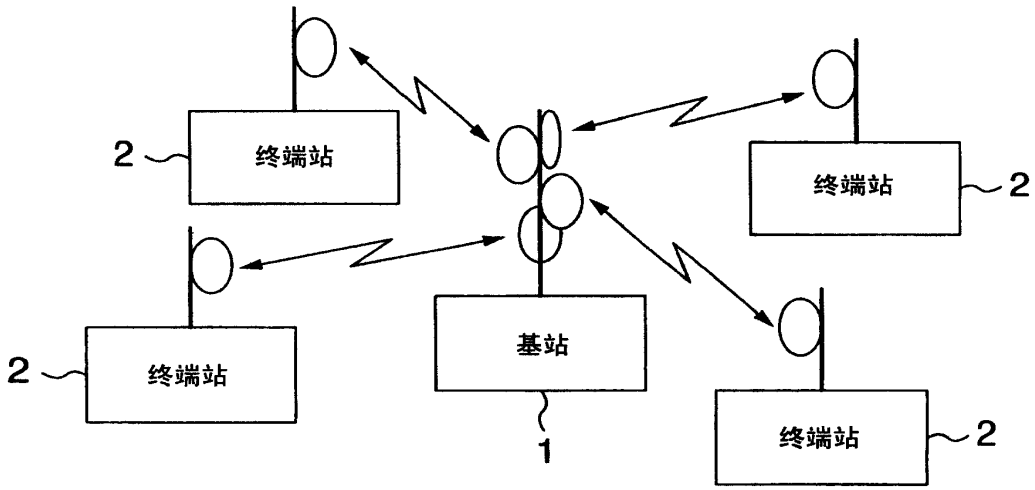


图8

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[19] 中华人民共和国国家知识产权局

[51] Int. Cl.
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[32] 2005.10.31 [33] JP [31] 317569/2005
[32] 2006. 1.17 [33] JP [31] 009300/2006
[86] 国际申请 PCT/JP2006/322210 2006.10.31
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权利要求书 2 页 说明书 19 页 附图 25 页

[54] 发明名称

决定上行链路的发送参数的装置及方法

[57] 摘要

决定用于上行链路的发送参数的装置包括：从移动台接收信道状态信息的部件；用于存储信道状态信息、上行链路的调制方式及信道编码率、以及移动台的发送功率和发送带宽的两者或者其一之间的对应关系的部件；根据对应关系导出一组发送参数的部件；以及将一组发送参数通知给所述移动台的部件。

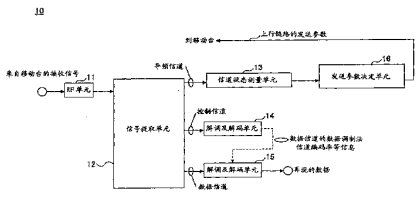


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1、一种装置，决定用于在上行链路中传输信号的发送参数，其特征在于，包括:

从移动台接收信道状态信息的部件;

存储信道状态信息、上行链路的调制方式及信道编码率、以及移动台的发送功率和发送带宽的两者或者其一之间的对应关系的部件;

根据所述对应关系导出一组发送参数的部件；以及

将所述一组发送参数通知给所述移动台的部件。

2、如权利要求 1 所述的装置，其特征在于，

导出所述一组发送参数，以在某个一定的期间内，上行链路的数据速率被自适应地调整，但发送功率维持一定。

3、如权利要求 1 所述的装置，其特征在于，

导出所述一组发送参数，以在某个一定的期间内，上行链路的数据速率维持一定，但发送功率被可变地调整。

4、如权利要求 1 所述的装置，其特征在于，

导出所述一组发送参数，使得上行链路的接收误码率及吞吐量的至少一个被改善。

5、如权利要求 1 所述的装置，其特征在于，

所述接收的部件从多个移动台接收多个信道状态信息，

移动台各自的一组发送参数由所述多个信道状态信息导出。

6、如权利要求 1 所述的装置，其特征在于，

接收信道状态信息的部件接收对于通过多个接收天线接收到的多个信号的信道状态信息。

7、如权利要求 6 所述的装置，其特征在于，

在某个一定的期间内，对于多个上行链路中每一个的数据速率被自适应地调整，对于多个上行链路的多个发送功率维持一定。

8、如权利要求 6 所述的装置，其特征在于，

在某个一定的期间内，对于多个上行链路中每一个的多个发送功率被自适应地调整，对于多个上行链路的数据速率维持一定。

9、如权利要求 6 所述的装置，其特征在于，

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所述多个信号是从同一个通信终端发送的信号。

10、如权利要求 6 所述的装置，其特征在于，

所述多个信号的至少两个是从不同的通信终端发送的信号。

11、一种方法，决定用于在上行链路中传输信号的发送参数，其特征在于，包括:

从移动台接收信道状态信息;

根据信道状态信息、上行链路的调制方式及信道编码率、以及移动台的发送功率和发送带宽的两者或者其一之间的已存储的对应关系导出一组发送参数；以及

将所述一组发送参数通知给所述移动台。

12、如权利要求 11 所述的方法，其特征在于，

根据信道状态信息的时间平均值导出发送功率，

根据信道状态信息的瞬时值导出发送带宽、调制阶数以及信道编码率。

13、如权利要求 11 所述的方法，其特征在于，

根据信道状态信息的时间平均值导出发送功率以及发送带宽，

根据信道状态信息的瞬时值导出调制阶数以及信道编码率。

14、如权利要求 11 所述的方法，其特征在于，

根据信道状态信息的时间平均值导出发送带宽、调制阶数以及信道编码率，

根据信道状态信息的瞬时值导出发送功率。

15、如权利要求 11 所述的方法，其特征在于，

根据信道状态信息的时间平均值导出调制阶数以及信道编码率，

根据信道状态信息的瞬时值导出发送功率以及发送带宽。

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决定上行链路的发送参数的装置及方法

技术领域

本发明一般涉及无线通信的技术领域，特别涉及决定用于在上行链路中传输共享分组数据信道的发送参数的装置及方法。

背景技术

在这种技术领域中为了提高被无线传输的上行信号的质量，使用了各种各样的技术。这样的技术中有一个发送功率控制法。在该技术中，测量从移动台发送并被基站接收到的上行导频信道的接收质量，计算传播损失（路径损失）等，决定移动台的发送功率以补偿这些损失，所决定的发送功率被通知给移动台。由此，在基站中的接收信号质量在一定程度上得以确保。提高信号质量的其他技术有自适应调制/信道编码法（AMC: Adaptive Modulation and channel Coding）。AMC 法根据无线信道的好坏来自适应地变更调制阶数及编码率，达到在当前的通信状态下所能达到的最佳的吞吐量。AMC 法例如以高速下行链路分组接入（HSDPA）方式采用。关于 HSDPA 例如记载在非专利文献 1 中。

通过这样适当地设定发送功率或调制阶数等传输参数，可以提高吞吐量。期望吞吐量中当然包含用户各自的吞吐量，以及还包含系统整体的吞吐量，并将两者同时提高。尤其是在将来的通信系统中，要求达到比现在更大的吞吐量。因此，使传输参数与信道状态适当地匹配，提高信号的传输质量（称为“链路自适应（adaptation）”）变得越发重要。

非专利文献 1: 3GPP,TR25.848: “Physical Layer Aspects of UTRAN High Speed Downlink Packet Access”

发明内容

发明要解决的课题

本发明的课题是提供一种决定与上行链路的无线信道状态相符的发送参数的装置以及方法。

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解决课题的方案

本发明用于决定上行链路的发送参数的装置包括：从移动台接收信道状态信息的部件；存储信道状态信息、上行链路的调制方式及信道编码率、以及移动台的发送功率和发送带宽的两者或者其一之间的对应关系的部件；根据所述对应关系导出一组发送参数的部件；以及将所述一组发送参数通知给所述移动台的部件。

发明效果

根据本发明，能够决定与上行链路的无线信道状态相符合的发送参数。

附图说明

图 1 表示本发明一实施例的基站的概略方框图。

图 2 表示本发明一实施例的移动台的概略方框图。

图 3 表示本发明一实施例的发送参数决定方法的流程图（1）。

图 4 是表示查找表（look up table）的一例的图。

图 5 是表示决定发送带宽的情况的说明图。

图 6 是表示信道状态和 MCS 序号(number)之间的对应关系的图。

图 7 是表示 MCS 表的具体例的图。

图 8 表示本发明一实施例的其他的发送参数决定方法的流程图（2）。

图 9 表示本发明一实施例的其他的发送参数决定方法的流程图（3）。

图 10 表示本发明一实施例的其他的发送参数决定方法的流程图（4）。

图 11 是表示考虑多个移动台后决定发送带宽的情况的图。

图 12 是表示第 1 至第 4 实施例的比较例的图表。

图 13 是表示单一用户 MIMO 方式的图。

图 14 是表示多用户 MIMO 方式的图。

图 15 是表示单一用户 MIMO 方式中的频带的图。

图 16 是表示多用户 MIMO 方式中的频带的图。

图 17 表示本发明一实施例的基站的概略方框图。

图 18 表示本发明一实施例的移动台的概略方框图。

图 19 表示本发明一实施例的发送参数决定方法的流程图（1）。

图 20 是表示图 19 所示的流程图的变形例的图。

图 21 表示本发明一实施例的发送参数决定方法的流程图（2）。

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图 22 是表示图 21 所示的流程图的变形例的图。

图 23 表示本发明一实施例的发送参数决定方法的流程图（3）。

图 24 是表示图 23 所示的流程图的变形例的图。

图 25 表示本发明一实施例的发送参数决定方法的流程图（4）。

图 26 是表示图 25 所示的流程图的变形例的图。

图 27 是表示第 7 至第 10 实施例的比较例的图表。

标号说明

10 基站

11 无线单元

12 信号提取单元

13 信道状态测量单元

14、15 解调及解码单元

16 发送参数决定单元

20 移动台

21 发送缓冲器

22、23 调制及编码单元

24 复用单元

25 频带限制滤波器

26 无线单元

27 功率放大单元

28 下行控制信道的解调及解码单元

171 信号分离单元

具体实施方式

根据本发明的一个方式，基于从移动台接收到的信道状态信息，导出一组发送参数。一组发送参数根据信道状态信息、上行链路的调制方式及信道编码率、以及移动台的发送功率和发送带宽的两者或者其一之间的已存储的对应关系导出，并通知给移动台。移动台与该发送参数相匹配地进行各种设定，发送以后的上行链路的信号。

不仅是 AMC 或发送功率，发送带宽也根据通信状况而被调整，因此可以大大地增加发送参数的组合数，可以与信道状态相匹配地将发送参数更加

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适当地进行组合，能够进一步提高信号的传输质量。

也可以导出一组发送参数，以在某个一定的期间内，上行链路的数据速率被自适应地调整，但发送功率维持一定。具体地说，例如根据信道状态信息的时间平均值导出发送功率，根据信道状态信息的瞬时值导出发送带宽、调制阶数以及信道编码率。或者也可以根据信道状态信息的平均值导出发送功率以及发送带宽。由此，可以提高系统整体的吞吐量，能够进一步提高资源的利用效率。

或者，也可以导出所述一组发送参数，以在某个一定的期间内，上行链路的数据速率维持一定，但发送功率被可变地调整。具体地说，例如根据信道状态信息的时间平均值导出发送带宽、调制阶数以及信道编码率，根据信道状态信息的瞬时值导出发送功率。这种情况对于要求实时性的通信特别有利。

也可以导出所述一组发送参数，使得上行链路的接收误码率及吞吐量的至少一个被改善。

也可以是从多个移动台接收多个信道状态信息，移动台各自的一组发送参数根据多个信道状态信息导出。不仅是各个移动台，连多个移动台之间也考虑在内，从而能够决定更加适合的发送带宽。

实施例 1

图 1 表示本发明一实施例的基站的概略方框图。基站 10 包括：无线单元（RF 单元）11、信号提取单元 12、信道状态测量单元 13、解调及解码单元 14、15、发送参数决定单元 16。

无线单元（RF 单元）11 进行用于将从移动台发送并由未图示的天线接收到的无线分组转换为基带信号的各种处理（例如，频率转换、频带限制、模数转换等）。无线分组不一定要从移动台发送，也可以是从包含固定台的任何通信终端发送，但为了简化说明，以移动台为例进行说明。

信号提取单元 12 连接到 RF 单元 11 的输出，提取接收信号中所包含的导频信道、共享分组控制信道（简称为“控制信道”）以及共享分组数据信道（简称为“数据信道”），并输出这些信道。导频信道、控制信道以及数据信道通过时间复用、频率复用、码复用或者这些的组合而被复用并且被无线传输。因此，信号提取单元 12 适当地分离所复用的这些信号，还作为信号分离器（demultiplexer）起作用。

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信道状态测量单元 13 连接到信号提取单元 12 的一个输出，测量导频信道的接收质量，并准备接收质量的瞬时值。接收质量或者信道状态的好坏典型的是由接收到的导频信道的信号功率对噪声功率比（SIR 或者接收 SIR）测量，更一般的也可以由适当的任意一个信道状态信息（CQI: Channel Quality Indicator）测量。此外，信道状态测量单元 13 将接收质量的瞬时值在一定期间（例如，10ms 到 1s 左右的期间）内进行平均化，计算接收质量的时间平均值，还输出平均的信道状态。

解调及解码单元 14、15 从信号提取单元 12 分别接收控制信道以及数据信道。解调及解码单元 14 对接收到的控制信道进行解调及解码，提取用于解调数据信道等所需的信息（调制阶数（modulation level）、信道编码率等），并将其通知给解调及解码单元 15。解调及解码单元 15 基于被通知的控制信息，对接收到的数据信道进行解调及解码，为进一步的数据传输等处理做准备。

发送参数决定单元 16 连接到信道状态测量单元 13 的输出，基于接收质量的瞬时值以及时间平均值导出与以后的上行链路有关的一组发送参数，并将其输出。一组发送参数中包含移动台的发送功率、发送频带、调制阶数、信道编码率等与上行链路的信号传输有关的参数。这样的一组发送参数对于每个移动台以适当的频度被导出。所导出的发送参数由下行链路的控制信道被通知给各移动台。对于发送参数的具体导出方法将在后面叙述。

图 2 表示本发明一实施例的移动台的概略方框图。移动台 20 包括：发送缓冲器 21、调制及编码单元 22、23、复用单元 24、频带限制滤波器 25、RF 单元 26、功率放大单元 27、控制信道的解调及解码单元 28（与数据信道有关的解调及解码单元等为了简化图示而没有描绘）。

发送缓冲器 21 暂时保存用户要发送的业务(traffic)数据，并将其与所指示的数据速率相一致地输出。实际上也有保存及输出用于控制信道的数据的要素，但为了简化图示而没有描绘这些。该业务数据构成发送信号内的数据信道。

调制及编码单元 22 连接到发送缓冲器 21 的输出，对数据信道进行信道编码以及数据调制，以实现所指示的数据速率。

调制及编码单元 23 进行控制信道的信道编码以及数据调制。

复用单元 24 连接到调制及编码单元 22、23 的输出，对数据信道以及控

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制信道进行复用。复用可以是时间复用、频率复用、码复用或者这些的组合。

频带限制滤波器 25 根据指示内容来设定发送信号的带宽。在本实施例中，系统准备有 1.25MHz、2.5MHz、5MHz、10MHz 以及 20MHz 等 5 种带宽，适当地选择其中一个。具体的带宽值或所准备的带宽的种类不限于此，可以使用各种各样的数值。

无线单元（RF 单元）26 进行用于将基带信号转换为无线信号的各种处理（例如，数模转换、频率转换等）。

功率放大单元 27 根据指示内容适当地放大发送信号的功率。

控制信道的解调及解码单元 28 对于在下行链路中接收到的控制信道进行解调以及信道解码，并提取包含发送功率、发送带宽、调制阶数以及信道编码率等的一组发送参数。解调及解码单元 28 将提取的发送参数的内容通知到发送缓冲器 21、调制及编码单元 22、23、频带限制滤波器单元 25 以及功率放大单元 27。

图 3 表示本发明一实施例的发送参数决定方法的流程图。该流程在基站进行，主要在图 1 的信道状态测量单元 13 及发送参数决定单元 16 进行。流程从步骤 S0 开始，从各个移动台以上行链路接收导频信道。在步骤 S1 中，基于导频信道的接收功率等级测量接收质量或者信道状态的瞬时值。如上所述，接收质量或者信道状态也可以用接收 SIR 测量。该接收 SIR 作为信道状态信息（CQI）使用。基站也可以基于接收 SIR 进行频率调度(scheduling)，对移动台分配适合的频带。

在步骤 S2 中，信道状态信息的瞬时值在一定期间（典型的是 10ms 到 1s 左右的期间，但也可以根据用途来使用各种长度的期间）内被测量，计算信道状态信息的时间平均值。

在步骤 S3 中，基于信道状态的时间平均值决定移动台发送数据信道时的发送功率。在这种情况下，除了信道状态信息的时间平均值之外，还可以考虑与各移动台的发送功率有关的余量（margin）。这是因为移动台可达到的发送功率值有可能依赖于移动台的性能而有所不同。移动台的发送功率在本实施例中通过参照查找表来决定。

图 4 表示查找表的一例。在图示的例子中，表示基站中的导频信道的接收功率 R_1~R_X、信道状态信息 CQI_1~CQI_X、移动台的发送功率 PT_1~PT_X、每个带宽在基站中的接收功率 $D_{1,W}$~$D_{X,W}$ 的对应关系。接收功率对于多个带宽

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W 的每一个准备。该对应关系被保存在任意一个存储部件中，根据需要读出或者更新。在当前的步骤 S3 的阶段中，确定相当于信道状态信息的时间平均值的 CQI_i，通过找出与该 CQI_i 对应的发送功率 PT_i，从而决定发送功率。另外，查找表中的信道状态信息和发送功率的关系也可以在考虑了对周边小区带来的干扰或多个移动台的各个移动台能够实现的数据速率的公平性(fairness)后决定。即，处在小区边界附近的移动台若只考虑接收状态而增加发送功率，则对于相邻的周边小区的干扰会变大，因此优选考虑将对周边小区的干扰考虑在内的查找表。另一方面，处在基站附近的移动台对周边小区带来的干扰较小，因此通过进一步增加发送功率，能够增大可实现的数据速率，而不会增加对于周边小区的干扰。但是，在进行如上那样的操作时，牺牲小区边界附近的移动台可实现的数据速率，从而进行基站周边的移动台的数据速率的增大，因此优选考虑多个移动台的每一个能够实现的数据速率的公平性。

在图 3 的步骤 S4 中，基于信道状态的瞬时值 CQI_t 以及所决定的发送功率 PT_i，决定用于上行数据信道的发送带宽。在本实施例中，用于上行链路而准备有 1.25MHz、2.5MHz、5MHz、10MHz 以及 20MHz 等 5 种带宽。在本步骤选择这些带宽中与当前的信道状态最适合的带宽。图 4 所示的每个单位频带的（基站中的）接收功率表示，移动台以某一带宽 W 且发送功率 PT_i 发送了信号时，基站所接收的功率的估计值。例如，在带宽为 1.25MHz 且发送功率为 PT_1 的情况下，基站中每个单位频带的接收功率是 $D_{1,1.25}$。相同的发送功率且带宽为 2.5MHz 的情况下，基站中的接收功率表示为 $D_{1,2.5}$。如此，表中准备了对于 5 种带宽的各个带宽，发送功率为 PT_1~PT_X 时的基站中的每个带宽的接收功率 $D_{1,1.25}$，…，$D_{X,20}$。此外，在决定发送带宽时也可以考虑移动台所支持的发送带宽。这是因为移动台可达到的发送带宽有可能依赖于移动台的性能而有所不同。并且，发送带宽的分配在考虑相应的移动台所需的数据速率的同时，还可以考虑对于其他的移动台的发送带宽的分配。这种情况下，作为考虑对于多个移动台的发送带宽的分配的频率调度的一个环节，进行发送带宽的分配。在步骤 3 中所导出的发送功率 PT_i 是根据信道状态信息的时间平均值导出的，由此导出的接收功率 $D_{i,W}$ 也表示平均的值。在本实施例中，该平均的接收功率被信道状态信息的瞬时值 CQI_t 进一步校正，导出瞬时的接收功率 $D_{i,W}'$。基于这样导出的瞬时的接收功率的估计值以及规定的阈

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值，导出瞬时的最佳的发送带宽。

图 5 表示决定最佳的发送带宽的情况。首先，用瞬时的信道状态信息校正平均的接收功率的结果，得到接收功率 $D_{i,W}'$，假设带宽以及接收功率的关系成为图 5 所示的关系。假设规定的阈值处于虚线所示的位置。在本实施例中，选择发送带宽，以在基站中的每个单位频带的接收功率超过阈值，尽量成为宽带。在图示的例子中，作为超出阈值的带宽，可列举 1.25MHz、2.5MHz 以及 5MHz 的带宽作为候选，这其中最宽的 5MHz 被决定为发送带宽。另外，根据阈值的设定方法，也可以选择发送带宽，使得接收功率低于阈值，尽量成为窄带。无论如何，从取得频率分集效应从而提高耐衰落性的观点出发，期望设为较宽的带宽。此外，为了将基站中的接收质量确保为一定程度以上，基站中的接收功率需要达到一定程度。但是，从减小信号的峰值功率的观点出发，优选设为能够使基站中的接收功率降低的带宽。

在图 3 的步骤 S5 中，基于信道状态信息的瞬时值 CQI_t 以及发送带宽，决定调制阶数以及信道编码率。在本实施例中，事先规定了调制阶数以及信道编码率的组合，组合的每一个是通过指定 MCS 表中的 MCS 序号（MCS_1，…，MCS_X）而确定。如图 6 所示，信道状态信息和 MCS 序号之间的对应关系已事先规定。图 7 表示 MCS 表的一例，还表示调制阶数以及信道编码率的组合的一例。在图示的例子中设定组合，以使相对的比特速率随着 MCS 序号增加而增加。

在图 3 的步骤 S6 中，基站将在步骤 S3、S4 以及 S5 中所决定的一组发送参数（发送功率、发送带宽以及 MCS 序号）用下行控制信道通知给移动台。移动台对下行控制信道进行解调，与发送参数相匹配地分别设定信道编码率、调制阶数、发送带宽以及发送功率。

根据本实施例，发送带宽以及 MCS 序号基于信道状态信息的瞬时值而被瞬时地变更，因此从将传输频带作为系统整体而有效使用的观点出发，本实施例非常理想。在本实施例中数据速率被瞬时变更，另一方面发送功率被平均地维持固定。因此本实施例在实时性的要求较少的非实时的数据通信等中特别有利。

根据本实施例，不仅控制 AMC，还进行发送功率以及发送带宽的控制，可以大幅增加上行链路的发送参数的组合数，可以与信道状态相一致地将发送参数更加适当地进行组合。若只有 AMC 以及发送功率控制，则例如在信

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道状态良好时，只有减少发送功率或者增加 MCS 序号的选择项。但是，根据本实施例，还准备了变更发送带宽的选择项。在提供的发送功率下，存在带宽变宽时每个单位频带的发送功率（以至于基站中的接收功率）减少，而在带宽变窄时每个单位频带的发送功率（以至于基站中的接收功率）增加的倾向。因此，在信道状态较差时，也可以通过减少带宽来增加每个单位频带的功率，从而代替通过维持带宽并增加发送功率来增加每个单位频带的功率。或者，在信道状态较好时，在上述的选择项以外例如也可以只是将发送带宽变窄，而不减少发送功率或者增加 MCS 序号。这样，能够节约系统资源而不改变传输速率。这些只不过是一例，可以对发送参数进行各种各样的组合。

另外，在基站导出一组发送参数时，除了信道状态信息 CQI 之外还可以参考误码率的大小或吞吐量的好坏。例如，在用已说明的方法导出一组发送参数后，也可以基于误码率的大小等修正发送功率值等。此外，也可以根据发送带宽的宽窄来调整扩频码的扩频率。

实施例 2

图 8 表示本发明一实施例的其他的发送参数决定方法的流程图。流程从步骤 S0 开始，从各个移动台用上行链路接收导频信道。在步骤 S1 中，基于导频信道的接收功率等级测量接收质量或信道状态信息的瞬时值。

在步骤 S2，信道状态信息的瞬时值在一定期间内被测量，计算信道状态信息的时间平均值。

在步骤 S3，基于信道状态的时间平均值决定移动台发送数据信道时的发送功率。在这种情况下，除了信道状态的时间平均值之外，还可以考虑与各移动台的发送功率有关的余量。移动台的发送功率通过参照图 4 所示的那样的查找表来决定。更具体地说，确定相当于信道状态信息的时间平均值的 CQI_i，通过找出与该 CQI_i 对应的发送功率 PT_i，从而决定发送功率。

进而在本实施例的步骤 S3，基于信道状态信息的平均值 CQI_i，还导出发送带宽。即，导出与信道状态信息的平均值 CQI_i 以及所决定的发送功率 PT_i 对应的在基站中的每个单位频带的接收功率 $D_{i,W}$，并根据该接收功率 $D_{i,W}$ 和规定的阈值之间的关系导出发送带宽。对于从接收功率 $D_{i,W}$ 导出发送带宽的方法，可以适用已在图 5 中说明的方法。

在步骤 S4，基于信道状态信息的瞬时值 CQI_t，决定调制阶数以及信道编码率。

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在步骤 S5，基站用下行控制信道对移动台通知在步骤 S3 以及 S4 中所决定的一组发送参数（发送功率、发送带宽以及 MCS 序号）。移动台对下行控制信道进行解调，与发送参数有关的指示内容相匹配地分别设定信道编码率、调制阶数、发送带宽以及发送功率。

本实施例不是瞬时地变更发送带宽，而是平均地决定。从容易适用于以固定带宽进行 AMC 的现有系统的观点来看，本实施例较为理想。

实施例 3

图 9 表示本发明一实施例的其他的发送参数决定方法的流程图。流程从步骤 S0 开始，从各个移动台用上行链路接收导频信道。在步骤 S1 中，基于导频信道的接收功率等级测量接收质量或信道状态信息的瞬时值。

在步骤 S2，信道状态信息的瞬时值在一定期间内被测量，计算信道状态信息的时间平均值。

在步骤 S3，基于信道状态的时间平均值决定移动台发送数据信道时的发送带宽以及 MCS 序号。在这种情况下，除了信道状态信息的时间平均值之外，还可以考虑与各移动台的发送功率有关的余量。移动台的发送带宽通过参照图 4 所示那样的查找表来导出。具体地说，导出与信道状态信息的平均值 CQI_i 对应的在基站中的每个单位频带的接收功率 $D_{i,W}$，并根据该接收功率 $D_{i,W}$ 和规定的阈值之间的关系导出发送带宽。对于从接收功率 $D_{i,W}$ 导出发送带宽的方法，可以适用已在图 5 中说明的方法。

进而在本实施例的步骤 S3，基于信道状态信息的平均值 CQI_i，还导出 MCS 序号。信道状态的平均值和 MCS 序号的对应关系可以事先准备，可以根据该对应关系导出 MCS 序号。

在步骤 S4，根据信道状态信息的瞬时值 CQI_t，导出移动台的发送功率。信道状态的瞬时值和发送功率的对应关系也可以事先准备，可以根据该对应关系导出发送功率。

在步骤 S5，基站用下行控制信道对移动台通知在步骤 S3 以及 S4 中所决定的一组发送参数（发送功率、发送带宽以及 MCS 序号）。移动台对下行控制信道进行解调，与发送参数相匹配地分别设定信道编码率、调制阶数、发送带宽以及发送功率。

在本实施例中不是瞬时地变更发送带宽以及 MCS 序号，而是平均地决定。从而数据速率相对固定，因此本实施例例如在实时通信中特别有利。

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实施例 4

图 10 表示本发明一实施例的发送参数决定方法的流程图。流程从步骤 S0 开始，从各个移动台用上行链路接收导频信道。在步骤 S1 中，基于导频信道的接收功率等级测量接收质量或信道状态信息的瞬时值。

在步骤 S2，信道状态信息的瞬时值在一定期间（典型的是 10ms 到 1s 左右的期间）内被测量，计算信道状态信息的时间平均值。

在步骤 S3，基于信道状态的时间平均值决定移动台发送数据信道时的 MCS 序号。在这种情况下，除了信道状态信息的时间平均值之外，还可以考虑与各移动台的发送功率有关的余量。

在步骤 S4，根据信道状态信息的瞬时值 CQI_t 以及所决定的 MCS 序号，导出移动台的发送功率。

在步骤 S5，基于信道状态信息的瞬时值 CQI_t 以及所决定的发送功率，决定发送带宽。

在步骤 S6，基站用下行控制信道对移动台通知在步骤 S3、S4 以及 S5 中所决定的一组发送参数（发送功率、发送带宽以及 MCS 序号）。移动台对下行控制信道进行解调，与发送参数相匹配地分别设定信道编码率、调制阶数、发送带宽以及发送功率。

根据本实施例，本实施例中数据速率被维持一定，另一方面，发送功率以及发送带宽被瞬时地变更。因此，本实施例在实时性的要求较多的通信等（例如语音通信等）中特别有利。

图 12 表示决定发送功率、发送带宽以及调制方式等的第 1 至第 4 实施例的方法的比较例。图中，“低”意味着在各列的最上位行所示的量（发送功率等）由低速控制所决定，意味着通过信道状态信息的长周期的时间平均值的控制所决定。“高”意味着在各列的最上位行所示的量由高速控制所决定，意味着通过使用信道状态信息的瞬时值的控制而自适应地决定。

实施例 5

在第 1 至第 4 实施例中，发送参数对于每个移动台分别独立决定。在本发明的第 5 实施例中，不仅是各个移动台，还考虑多个移动台之间，从而决定发送带宽。

图 11 表示通过本实施例决定发送带宽的情况。为了便于说明，假设在系统的上行链路中准备的带宽为 2.5MHz、5MHz、10MHz 以及 15MHz。并且，

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假设对于用户 A、B 的在基站中的每个单位频带的接收功率为图 11 的（A）、（B）所示的大小关系。这种情况下，超过规定阈值的候选(candidate)中的最宽的带宽对于用户 A 和用户 B 都是 10MHz。因此，若系统整体的带宽为 20MHz 以上，则可以对双方分配 10MHz 的带宽。但是，若系统整体可使用的带宽例如只有 15MHz，则无法进行这样的分配。本实施例提供用于处理这样的状况的方法。

在图示的状况中，对于用户 B 的从阈值开始的余量 m_B 大于对于用户 A 的从阈值开始的余量 m_A（$m_B>m_A$）。这意味着有关用户 B 的信道状态更好，基站能够以更高的信号质量进行接收。因此，在本实施例中，对用户 B 分配较宽的 10MHz 带宽，而对用户 A 分配较窄的 5MHz 带宽，发送带宽被有效分配。信道状态良好的用户 B 以较宽的频带能够享受较大的分集效应，另一方面，用户 A 能够确保更大的每个单位频带的功率，因此对应于各自的信道状态来提高发送质量。

实施例 6

在实施例 5 中说到的那样，移动台的发送参数可以对各个移动台独立地决定，也可以在多个移动台之间进行任意调整。进而对于发送功率控制，还考虑以下的（1）~（3）的方法。

（1）也可以控制移动台的发送功率，使得所有的移动台在基站中成为相同的接收功率。该方法中所有的移动台能够实现相同程度的吞吐量或误码率，从确保移动台之间的公平性的观点来看是有利的。但是，小区边沿的移动台可能对其他小区带来较大干扰的这一点也许会不利。

（2）也可以控制发送功率，使得所有的移动台以相同的发送功率进行发送。该方法从能够使小区内的吞吐量最大化的观点来看是有利的。但是，也许小区端部的用户的吞吐量会恶化，丧失用户之间的公平性。

（3）作为（1）和（2）的中间方法，也可以进行发送功率控制，使得所有的移动台在基站中成为一定程度以上的接收功率，并控制移动台的发送功率，使得来自基站周边的移动台的信号以更高的功率在基站被接收。由此，既照顾了移动台之间的公平性，又能够改善小区内的吞吐量。

实施例 7

本发明的第 7 至第 10 实施例是与多天线系统或者多输入多输出（MIMO: Multiple Input Multiple Output）系统关联的实施例。一般，MIMO 系统中有单

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一用户 MIMO 方式和多用户 MIMO 方式。

图 13 表示单一用户 MIMO 方式的原理图。为了简化说明，表示了从具有两个发送天线的通信终端（UE）到具有两个接收天线的基站（NodeB），但天线数量不限于这样的数，可以使用各种条数的天线。在图示的例子中，不同的信号同时以相同的频带从通信终端（UE）的发送天线#1、#2 发送。基站接收在空间被复用的这些信号，通过执行某种信号分离法，还原从各个发送天线发送的信号序列的各个序列。

图 14 表示多用户 MIMO 方式的原理图。为了简化说明，具有一个以上的发送天线的通信终端有两台（UE1、UE2），从各个通信终端发送不同的信号。在空间被复用的这些信号在基站被接收。对接收到的信号应用某种信号分离法，从各个通信终端发送的各个信号序列被复原。

在单一用户 MIMO 以及多用户 MIMO 的任一情况下，同一频带内的不同信号在基站同时被接收，这些通过信号分离法被分离，上行链路的信号分别被复原。如下所述，本发明也可以适用于多天线系统中的上行链路的信号。但是，以多个发送天线或者多个用户使用的频带共用作为前提。

图 15 表示在单一用户 MIMO 方式中，以第 1 发送天线#1 通信的信号的频带和以第 2 发送天线#2 通信的信号的频带相同的情况。例如，赋予系统的频带（系统带宽）为 20MHz，对某一用户分配了 5MHz 的频带时，第 1 以及第 2 发送天线#1、#2 分别使用相同的 5MHz 的频带。

图 16 表示在多用户 MIMO 方式中，第 1 用户通信的信号的频带和第 2 用户通信的信号的频带相同的情况。例如，赋予系统的频带为 20MHz，假定对第 1、第 2 用户分配了相同的 5MHz 的频带。

图 17 表示具有两个接收天线的基站的概略方框图。基站包括：无线单元（RF 单元）11-1、11-2、信号分离单元 171、信号提取单元 12、信道状态测量单元 13-1、13-2、解调及解码单元 14-1、15-1、14-2、15-2、发送参数决定单元 16。为了便于说明而接收天线为两个，但也可以使用比两个更多的接收天线数。此外，说明了单一用户 MIMO 方式，但本发明在多用户 MIMO 方式中同样可以适用。

无线单元（RF 单元）11-1、11-2 进行用于将从移动台发送并由未图示的多个接收天线接收到的无线分组转换为基带信号的各种处理（例如，频率转换、频带限制、模数转换等）。

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信号分离单元 171 通过对空间上复用并且同时接收到的两个信号或者数据序列应用某种信号分离法，从而取得从发送天线#1、#2 发送的两个信号。

信号提取单元 12 提取所分离的发送信号中包含的导频信道、共享分组控制信道（简称为“控制信道”）以及共享分组数据信道（简称为“数据信道”），并输出这些信道。导频信道、控制信道以及数据信道通过时间复用、频率复用、码复用或者这些的组合而被复用，并从各个发送天线无线传输。因此，信号提取单元 12 适当地分离所复用的这些信号，还作为信号分离器起作用。

信道状态测量单元 13-1、13-2 连接到与信号提取单元 12 的导频信道有关的输出，用每个发送天线测量导频信道的接收质量，并分别测量接收质量的瞬时值。信道状态测量单元 13-1、13-2 将接收质量的瞬时值在一定期间（例如，10ms 到 1s 左右的期间）内对于各个发送天线进行平均化，计算接收质量的时间平均值，还输出平均的信道状态。

解调及解码单元 14-1、14-2、15-1、15-2 用每个发送天线分别从信号提取单元 12 接收控制信道以及数据信道。解调及解码单元 14-1、14-2 对每个发送天线接收到的控制信道分别进行解调及解码，提取用于解调数据信道等所需的信息（调制阶数、信道编码率等），并将其通知给解调及解码单元 15-1、15-2。解调及解码单元 15-1、15-2 基于被通知的控制信息，对接收到的数据信道进行解调及解码，为进一步的数据传输等处理做准备。

发送参数决定单元 16 连接到信道状态测量单元 13-1、13-2 的输出，基于接收质量的瞬时值以及时间平均值导出与以后的上行链路有关的一组发送参数，并将其输出。一组发送参数中包含移动台的发送功率、发送频带、调制阶数、信道编码率等与上行链路的信号传输有关的参数。这样的一组发送参数对于每个移动台以适当的频度被导出。所导出的发送参数通过下行链路的控制信道被通知给各移动台。对于发送参数的具体导出方法将在后面叙述。

图 18 表示本发明一实施例的移动台的概略方框图。移动台包括：发送缓冲器 21、调制及编码单元 22-1、22-2、频带限制滤波器 25-1、25-2、RF 单元 26-1、26-2、功率放大单元 27-1、27-2、控制信道的解调及解码单元 28（与控制信道有关的编码及调制等为了简化图示而没有描绘）。

发送缓冲器 21 暂时保存用户要发送的业务数据，并将其与所指示的数据速率相符地输出。

调制及编码单元 22-1、22-2 连接到发送缓冲器 21 的输出，对数据信道进

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行信道编码以及数据调制，以实现对每个发送天线所指示的数据速率。

频带限制滤波器单元 25-1、25-2 根据每个发送天线的指示内容来设定发送信号的带宽。在本实施例中，系统准备有 1.25MHz、2.5MHz、5MHz、10MHz 以及 20MHz 等 5 种带宽，被适当地选择其中一个。如上所述通过两个发送天线发送的信号分别占据相同的频带。

无线单元（RF 单元）26-1、26-2 在每个发送天线中进行用于将基带信号转换为无线信号的各种处理（例如，数模转换、频率转换等）。

功率放大单元 27-1、27-2 根据每个发送天线的指示内容适当地放大发送信号的功率。

控制信道的解调及解码单元 28 对于在下行链路中接收到的控制信道进行解调以及信道解码，并对每个发送天线提取包含发送功率、发送带宽、调制阶数以及信道编码率等的一组发送参数。解调及解码单元 28 将提取的发送参数的内容对每个发送天线分别通知给发送缓冲器 21、调制及编码单元 22-1、22-2、频带限制滤波器单元 25-1、25-2 以及功率放大单元 27-1、27-2。

图 19 表示本发明一实施例的发送参数决定方法的流程图。该流程在基站进行，主要在图 17 的信道状态测量单元 13-1、13-2 及发送参数决定单元 16 进行。流程从步骤 S11、S12 开始，从移动台的各个发送天线发送的上行链路的导频信道由基站的两个接收天线所接收。图示的流程表示进行了某种信号分离法之后的处理。上行链路有两种，一个是来自第 1 发送天线#1 的上行链路，另一个是来自第 2 发送天线#2 的上行链路。为了简化说明，进行了单一用户 MIMO 方式中的说明，但本发明在多用户 MIMO 方式中也可以适用。这种情况下也有来自第 1 用户的上行链路和来自第 2 用户的上行链路。在步骤 S11、S21 中，基于上行导频信道的接收功率等级测量接收质量或者信道状态的瞬时值。

在步骤 S12、S22 中，信道状态信息的瞬时值在一定期间内被测量，在步骤 S13 中计算信道状态信息的时间平均值。一定期间典型的是 10ms 到 1s 左右的期间，但也可以根据用途来使用各种长度的期间。信道状态信息的瞬时值在发送天线#1、#2 中有所不同，但预测这些的时间平均值为同样的值。因此，步骤 S13 关于各个上行链路而公共地进行。

在步骤 S14，基于信道状态的时间平均值决定移动台发送数据信道时的发送功率。这种情况下，除了信道状态信息的时间平均值之外，还可以考虑

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与各移动台的发送功率有关的余量。这是因为移动台可达到的发送功率值有可能依赖于移动台的性能而有所不同。移动台的发送功率在本实施例中也可以通过与图 4 关联说明的方法来决定。

在步骤 S15，基于与上行链路的各个链路有关的信道状态的瞬时值 $CQI_t^{(1)}$ 、$CQI_t^{(2)}$以及在步骤 S14 决定的发送功率 PT_i，决定用于上行数据信道的发送带宽。在本实施例中，用于上行链路而准备有 1.25MHz、2.5MHz、5MHz、10MHz 以及 20MHz 等 5 种带宽。这些带宽中与当前的信道状态最适合的带宽通过与图 4 关联说明的相同的方法来选择。在步骤 S14 中所导出的发送功率 PT_i 是根据信道状态信息的时间平均值导出的，因此根据该值估计出的基站中的接收功率 $D_{i,W}$ 也表示平均的值。在本实施例中，进而使用信道状态信息的瞬时值 CQI_t 校正该平均的接收功率，导出瞬时的接收功率 $D_{i,W}'$。基于这样导出的接收功率以及规定的阈值，导出瞬时的最佳的发送带宽。

在步骤 S16、S26 中，基于信道状态信息的瞬时值 CQI_t 以及发送带宽，对于上行链路的各个链路决定调制阶数以及信道编码率的组合。在本实施例中，事先规定了调制阶数以及信道编码率的组合，组合的每一个是通过指定 MCS 表中的 MCS 序号（MCS_1，…，MCS_X）而确定。

在步骤 S17 中，基站将在步骤 S14、S15 以及 S16 中对于各个上行链路分别决定的一组发送参数（发送功率、发送带宽以及 MCS 序号）用下行控制信道通知给移动台。移动台对下行控制信道进行解调，与发送参数相匹配地对每个发送天线分别设定信道编码率、调制阶数、发送带宽以及发送功率。

根据本实施例，发送带宽以及 MCS 序号基于信道状态信息的瞬时值而对于上行链路的各个链路被瞬时地变更，因此从将传输频带作为系统整体而有效使用的观点出发，本实施例是非常理想的。在本实施例中数据速率被瞬时变更，另一方面发送功率被平均地维持固定。因此本实施例在实时性的要求较少的非实时的数据通信等中特别有利。

图 20 表示本发明一实施例的其他的发送参数决定方法的流程图。本流程与图 19 中已说明的流程大致相同，但有关步骤 S16′的处理内容有所不同。在本流程的步骤 S16′中，基于关于发送天线#1、#2 所测量的瞬时的信道状态值以及所决定的发送带宽，决定上行链路的双方（发送天线#1、#2 双方）公共使用的 MCS 序号。由此，可以节约进行 AMC 控制时的控制信道（信令信道）的控制比特数。

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实施例 8

图 21 表示本发明一实施例的其他的发送参数决定方法的流程图。流程从步骤 S11、S21 开始，接收来自移动台的各个发送天线的上行导频信道。在步骤 S12、S22 中，基于导频信道的接收功率等级测量接收质量或信道状态信息的瞬时值。

在步骤 S13，信道状态信息的瞬时值在一定期间内被测量，计算信道状态信息的时间平均值。

在步骤 S14，基于信道状态的时间平均值决定移动台从各个发送天线发送数据信道时的发送功率。在这种情况下，除了信道状态的时间平均值之外，还可以考虑与各移动台的发送功率有关的余量。移动台的发送功率通过参照图 4 所示那样的查找表来决定。更具体地说，确定相当于信道状态信息的时间平均值的 CQI_i，通过找出与该 CQI_i 对应的发送功率 PT_i，从而决定发送功率。

进而在本实施例的步骤 S14，基于信道状态信息的平均值 CQI_i，还导出发送带宽。

在步骤 S15、S25，基于信道状态信息的瞬时值 CQI_t 以及发送带宽，对每个发送天线决定调制阶数以及信道编码率的组合。在本实施例中事先规定了调制阶数以及信道编码率的组合，组合的每一个是通过指定 MCS 表中的 MCS 序号（MCS_1，…，MCS_X）而确定。

在步骤 S16，基站用下行控制信道对移动台通知在步骤 S14、S15 以及 S25 中对于各个上行链路分别决定的一组发送参数（发送功率、发送带宽以及 MCS 序号）。移动台对下行控制信道进行解调，与发送参数相匹配地对每个发送天线分别设定信道编码率、调制阶数、发送带宽以及发送功率。

本实施例不是瞬时地变更发送带宽，而是平均地决定。从容易适用于以固定带宽进行 AMC 的现有系统的观点来看，本实施例较为理想。

图 22 表示本发明一实施例的其他的发送参数决定方法的流程图。本流程与图 21 中已说明的流程大致相同，但有关步骤 S15′的处理内容有所不同。在本流程的步骤 S15′中，基于关于发送天线#1、#2 所测量的瞬时的信道状态值以及所决定的发送带宽，决定发送天线#1、#2 的双方公共使用的 MCS 序号。由此，可以节约进行 AMC 控制时的控制信道的控制比特数。

实施例 9

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图 23 表示本发明一实施例的其他的发送参数决定方法的流程图。流程从步骤 S11、S21 开始，接收来自移动台的各个发送天线的上行导频信道。在步骤 S12、S22 中，基于导频信道的接收功率等级对于各个上行链路测量接收质量或信道状态信息的瞬时值。

在步骤 S13，信道状态信息的瞬时值在一定期间内被测量，计算信道状态信息的时间平均值。

在步骤 S14，基于信道状态的时间平均值决定移动台发送数据信道时的发送带宽。并且在本实施例的步骤 S14 中，基于信道状态信息的平均值 CQI_i，还导出 MCS 序号（调制阶数以及信道编码率）。信道状态的平均值和 MCS 序号的对应关系可以事先准备，可以根据该对应关系导出 MCS 序号。

在步骤 S15、S25，根据信道状态信息的瞬时值 CQI_t，导出与移动台的各个发送天线有关的发送功率。

在步骤 S16，基站用下行控制信道对移动台通知在步骤 S14、S15 以及 S25 中对于各个上行链路所决定的一组发送参数（发送功率、发送带宽以及 MCS 序号）。移动台对下行控制信道进行解调，与各个发送天线有关的发送参数相匹配地分别设定信道编码率、调制阶数、发送带宽以及发送功率。

在本实施例中不是瞬时地变更发送带宽以及 MCS 序号，而是平均地决定。从而数据速率相对固定，因此本实施例例如在实时通信中特别有利。

图 24 表示本发明一实施例的其他的发送参数决定方法的流程图。本流程与图 23 中已说明的流程大致相同，但有关步骤 S15′的处理内容有所不同。在本流程的步骤 S15′中，基于关于发送天线#1、#2 所测量的瞬时的信道状态值以及所决定的发送带宽以及 MCS 序号，决定发送天线#1、#2 的双方公共使用的发送功率。由此，可以节约进行 AMC 控制时的控制信道的控制比特数。

实施例 10

图 25 表示本发明一实施例的发送参数决定方法的流程图。流程从步骤 S11、S21 开始，接收来自移动台的各个发送天线的上行导频信道。在步骤 S12、S22 中，基于导频信道的接收功率等级，关于各个上行链路而测量接收质量或信道状态信息的瞬时值。

在步骤 S13，信道状态信息的瞬时值在一定期间（典型的是 10ms 到 1s 左右的期间）内被测量，计算信道状态信息的时间平均值。

在步骤 S14，基于信道状态的时间平均值对于上行链路的各个链路而决

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定移动台发送数据信道时的 MCS 序号。

在步骤 S15、S25，根据与各个发送天线有关的信道状态信息的瞬时值 CQI_t 以及所决定的 MCS 序号，分别导出与上行链路的各个链路有关的发送功率。

在步骤 S16，基站用下行控制信道对移动台通知在步骤 S14、S15 以及 S25 中关于各个上行链路所决定的一组发送参数（发送功率、发送带宽以及 MCS 序号）。移动台对下行控制信道进行解调，关于各个发送天线与发送参数相匹配地分别设定信道编码率、调制阶数、发送带宽以及发送功率。

根据本实施例，本实施例中数据速率被维持一定，另一方面，与各个发送天线有关的发送功率被瞬时地变更。因此，本实施例在实时性的要求较多的通信等（例如语音通信等）中特别有利。

图 26 表示本发明一实施例的其他的发送参数决定方法的流程图。本流程与图 25 中已说明的流程大致相同，但有关步骤 S15′的处理内容有所不同。在本流程的步骤 S15′中，基于关于发送天线#1、#2 所测量的瞬时的信道状态值以及所决定的 MCS 序号，决定发送天线#1、#2 的双方公共使用的发送功率。由此，可以节约进行 AMC 控制时的控制信道的控制比特数。

图 27 表示决定发送带宽以及调制方式等的第 7 至第 10 实施例的方法的比较例。与图 12 的情况同样地，图中，“低”意味着在各列的最上位行所示的量（发送功率等）由低速控制所决定，意味着通过信道状态信息的长周期的时间平均值的控制所决定。“高”意味着在各列的最上位行所示的量由高速控制所决定，意味着通过使用信道状态信息的瞬时值的控制而自适应地决定。“相同”意味着该量在发送天线之间相同地设定。“不同”意味着该量在发送天线之间设定得各不相同。

以上，说明了本发明的优选实施例，但本发明不限于此，在本发明的宗旨的范围内可以进行各种变形以及变更。为了便于说明，本发明划分为几个实施例进行了说明，但各个实施例的划分对于本发明不是本质性的，也可以根据需要使用一个以上的实施例。

本国际申请主张基于 2005 年 10 月 31 日申请的日本专利申请第 2005-317569 号的优先权，并将其全部内容引用到本国际申请中。

本国际申请主张基于 2006 年 1 月 17 日申请的日本专利申请第 2006-009300 号的优先权，并将其全部内容引用到本国际申请中。

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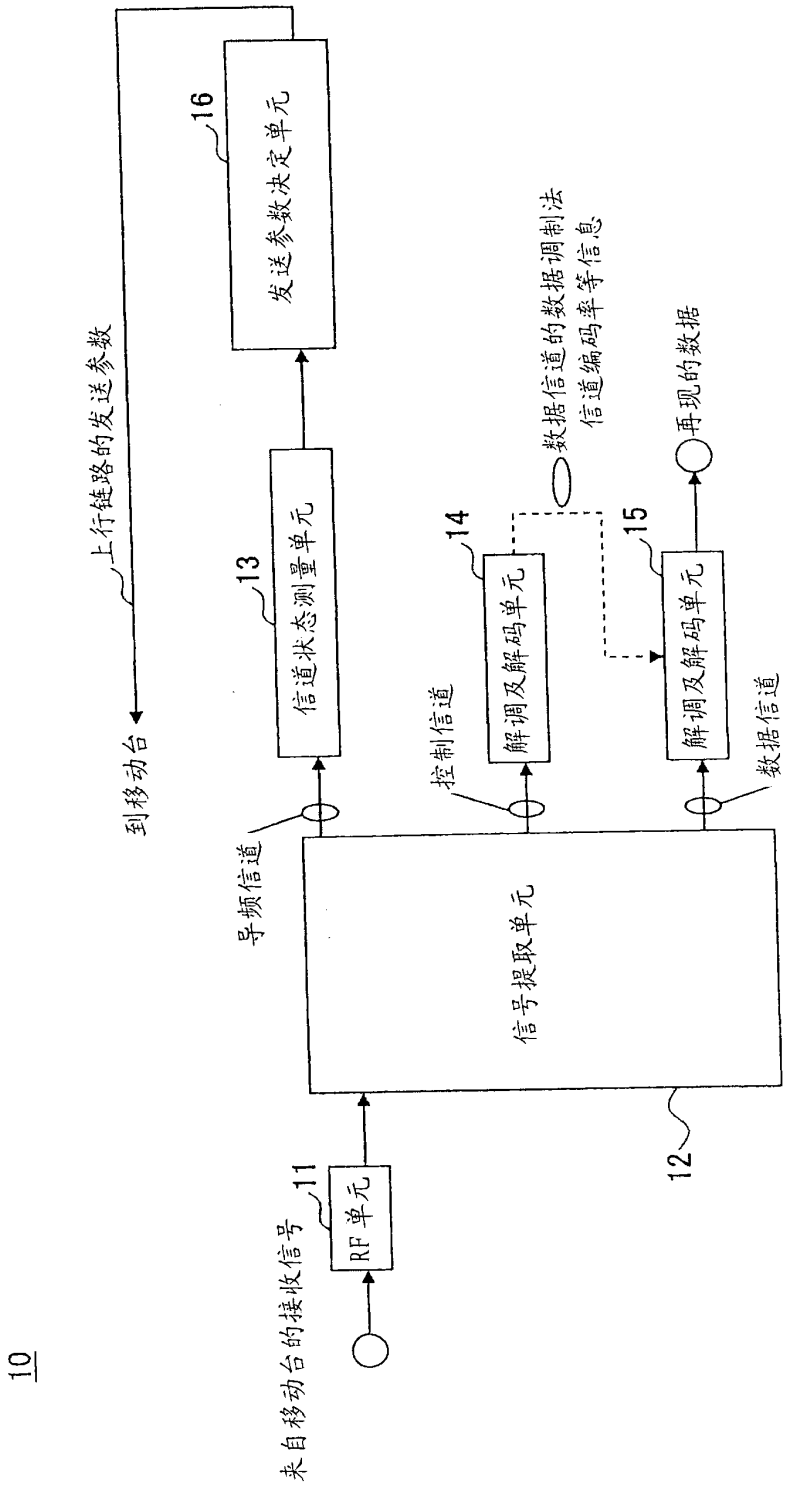


图 1

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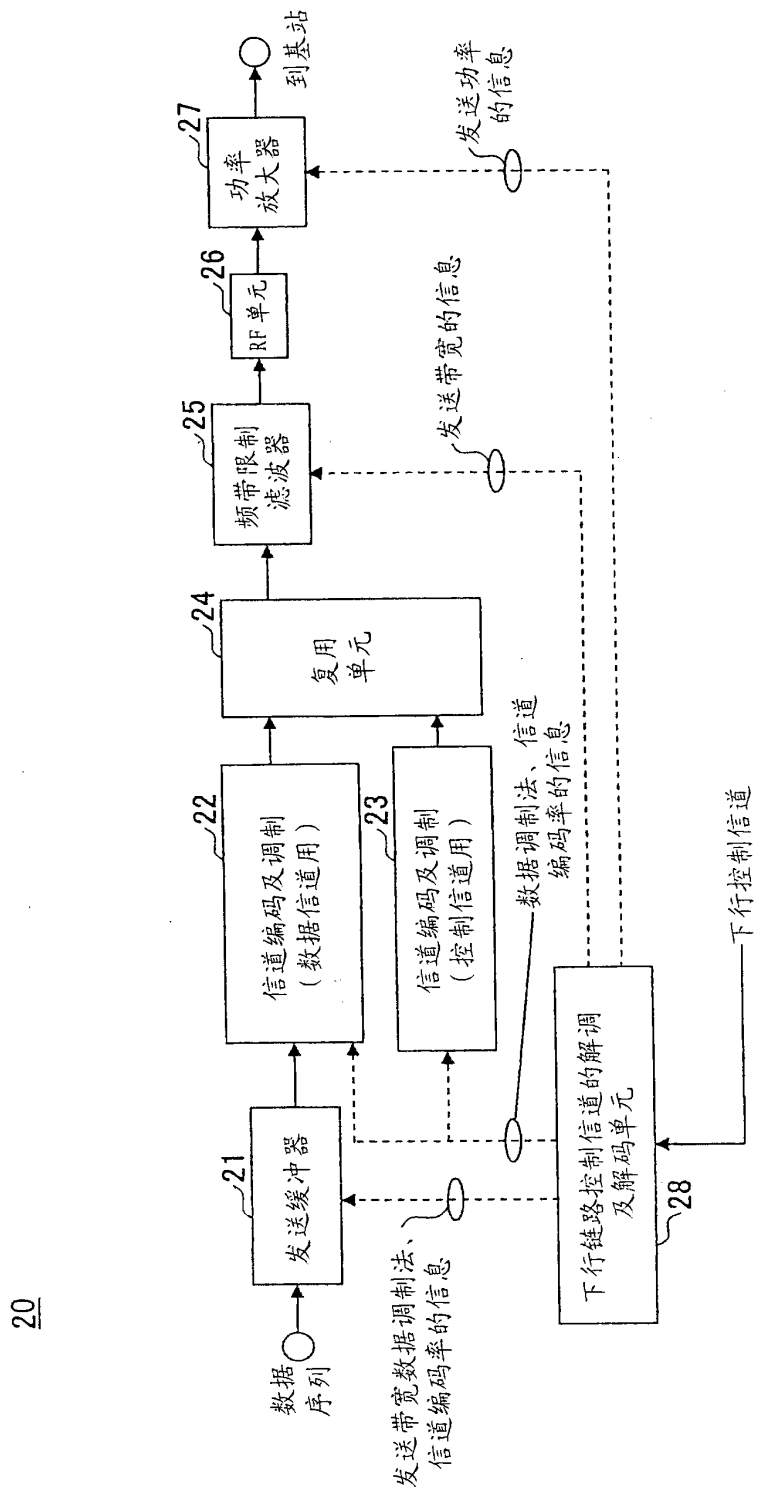


图 2

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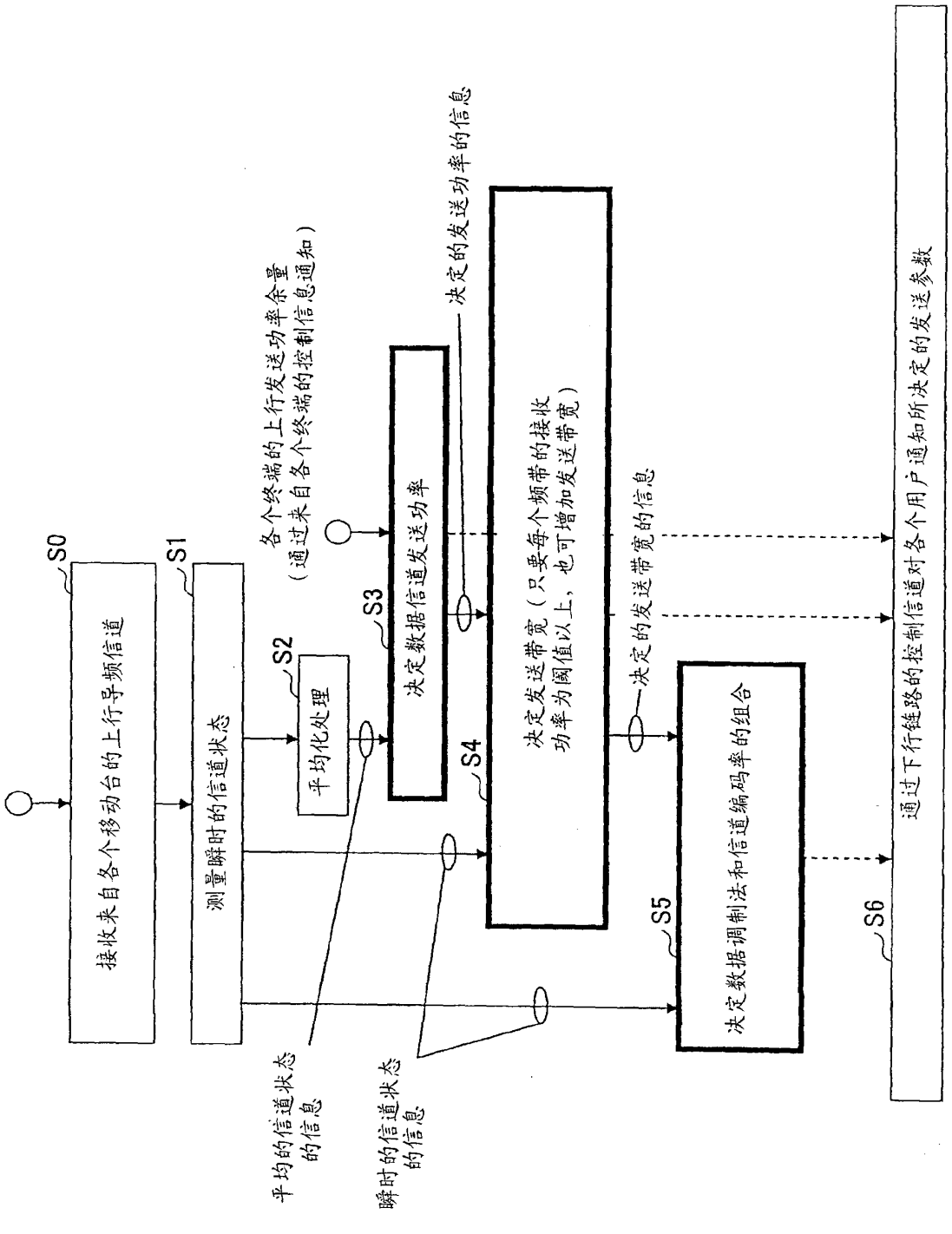


图 3

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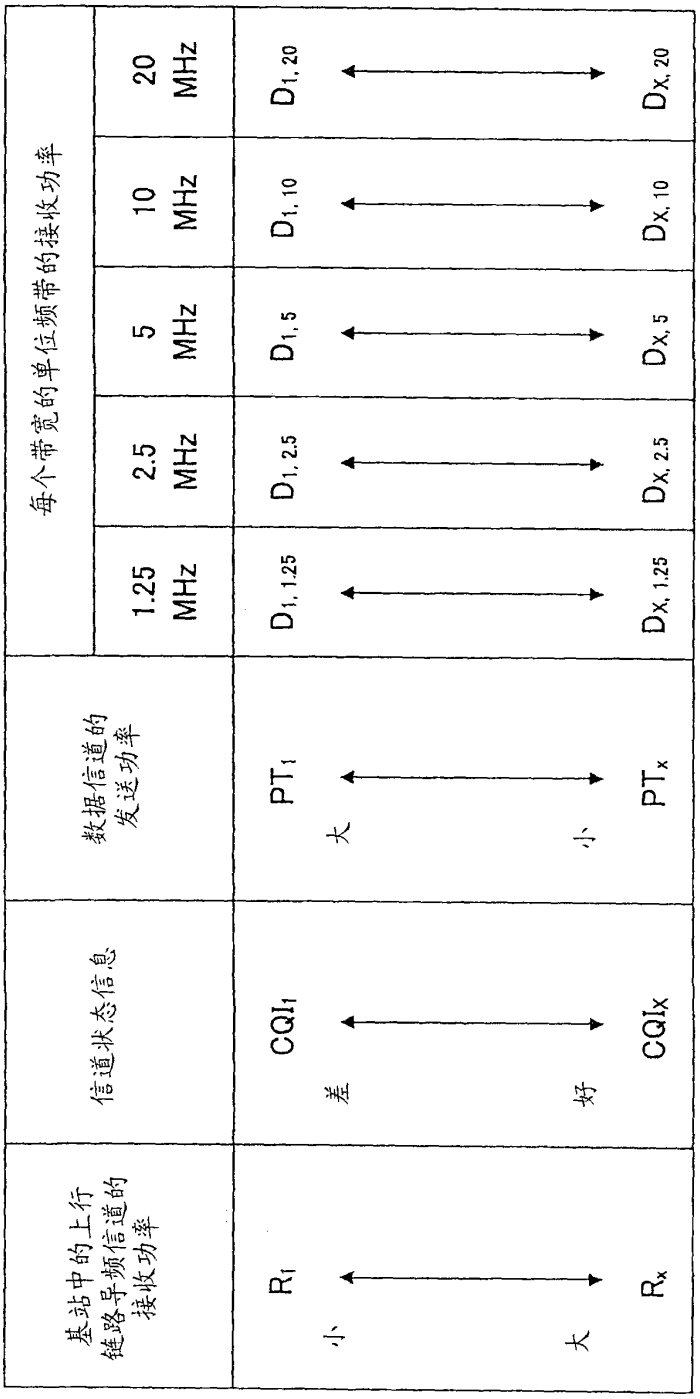


图 4

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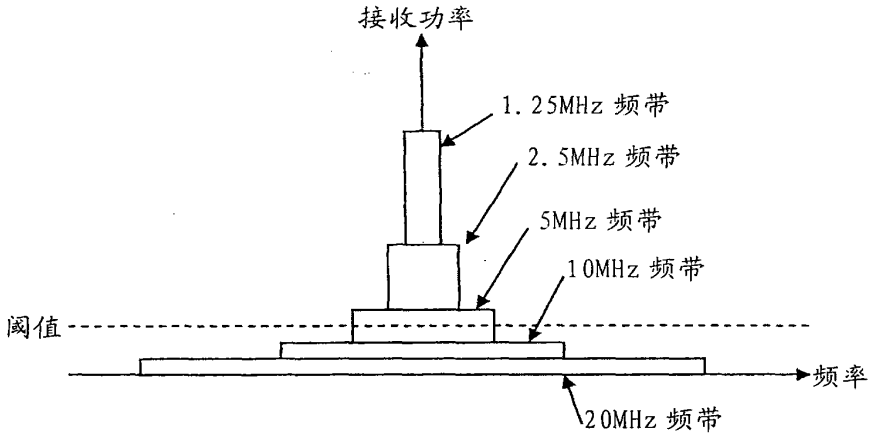
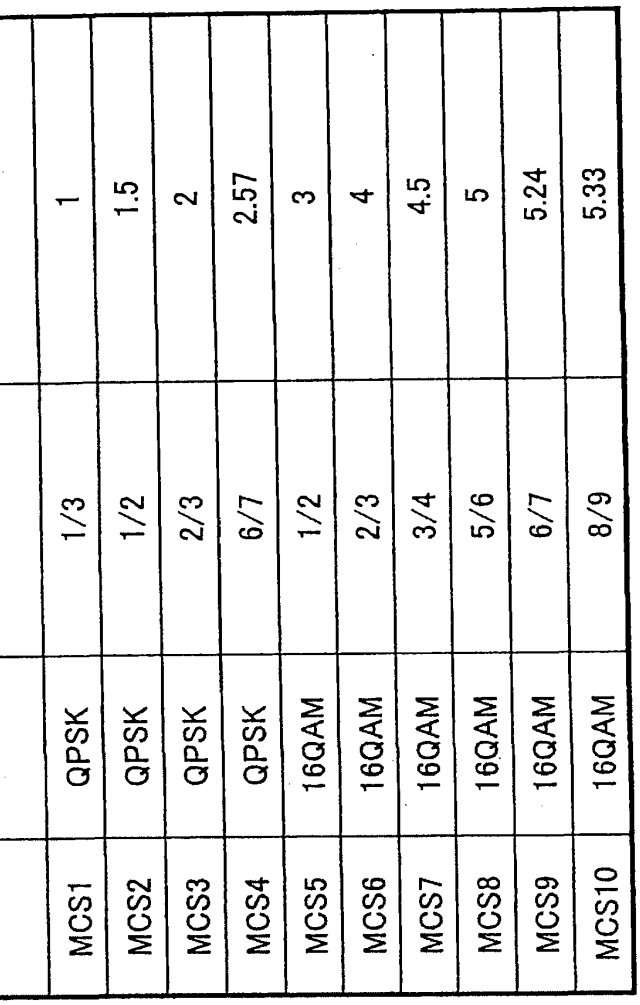


图 5

考虑了发送带宽的瞬时的信道状态	数据调制法和信道编码率的组合
CQI'_1 差 好 CQI'_X	MCS_1 低速 高速 MCS_x

图 6

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MCS 序号	数据调制	信道编码率	相对的信息比特速率
MCS1	QPSK	1/3	1
MCS2	QPSK	1/2	1.5
MCS3	QPSK	2/3	2
MCS4	QPSK	6/7	2.57
MCS5	16QAM	1/2	3
MCS6	16QAM	2/3	4
MCS7	16QAM	3/4	4.5
MCS8	16QAM	5/6	5
MCS9	16QAM	6/7	5.24
MCS10	16QAM	8/9	5.33

图 7

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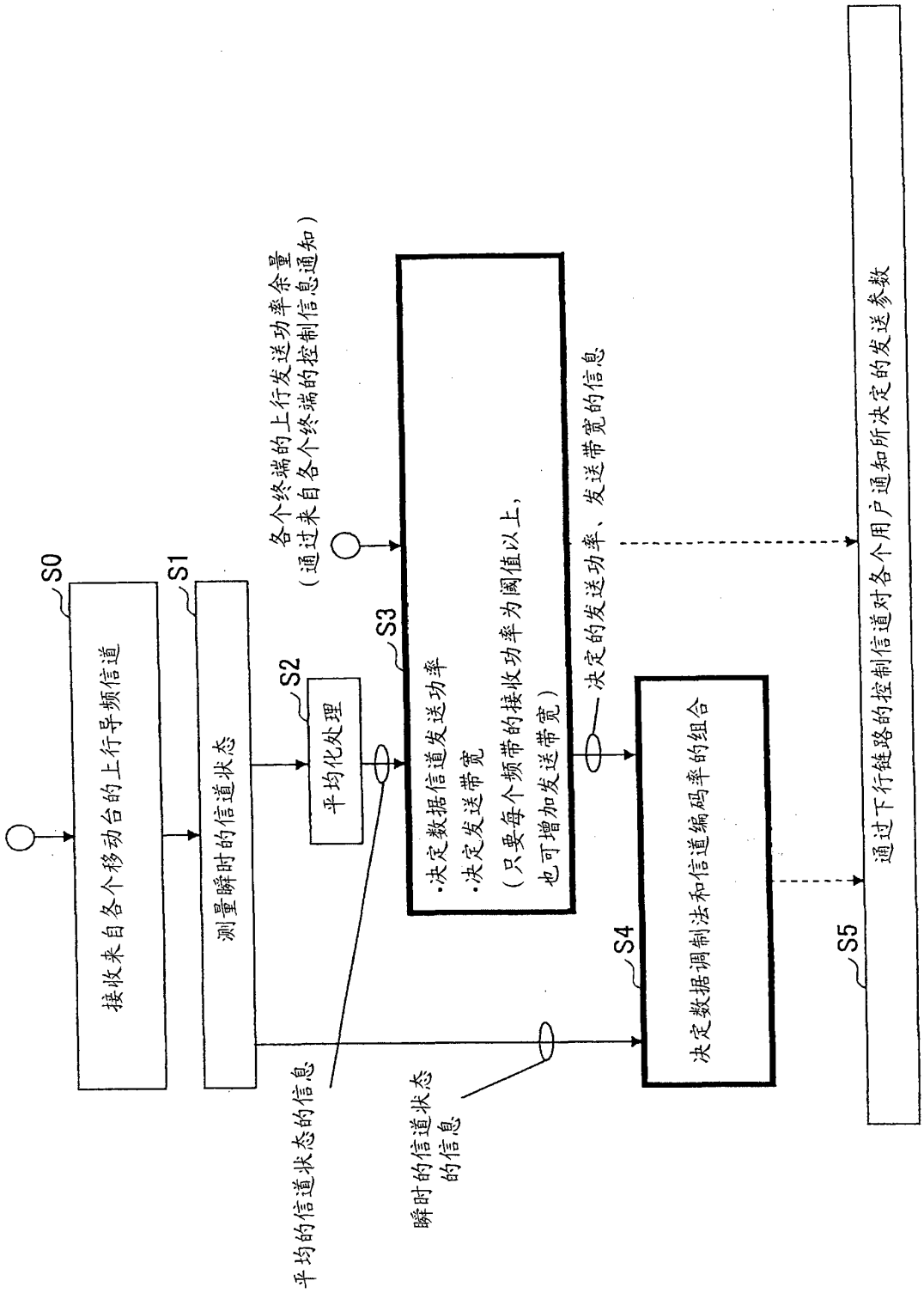


图 8

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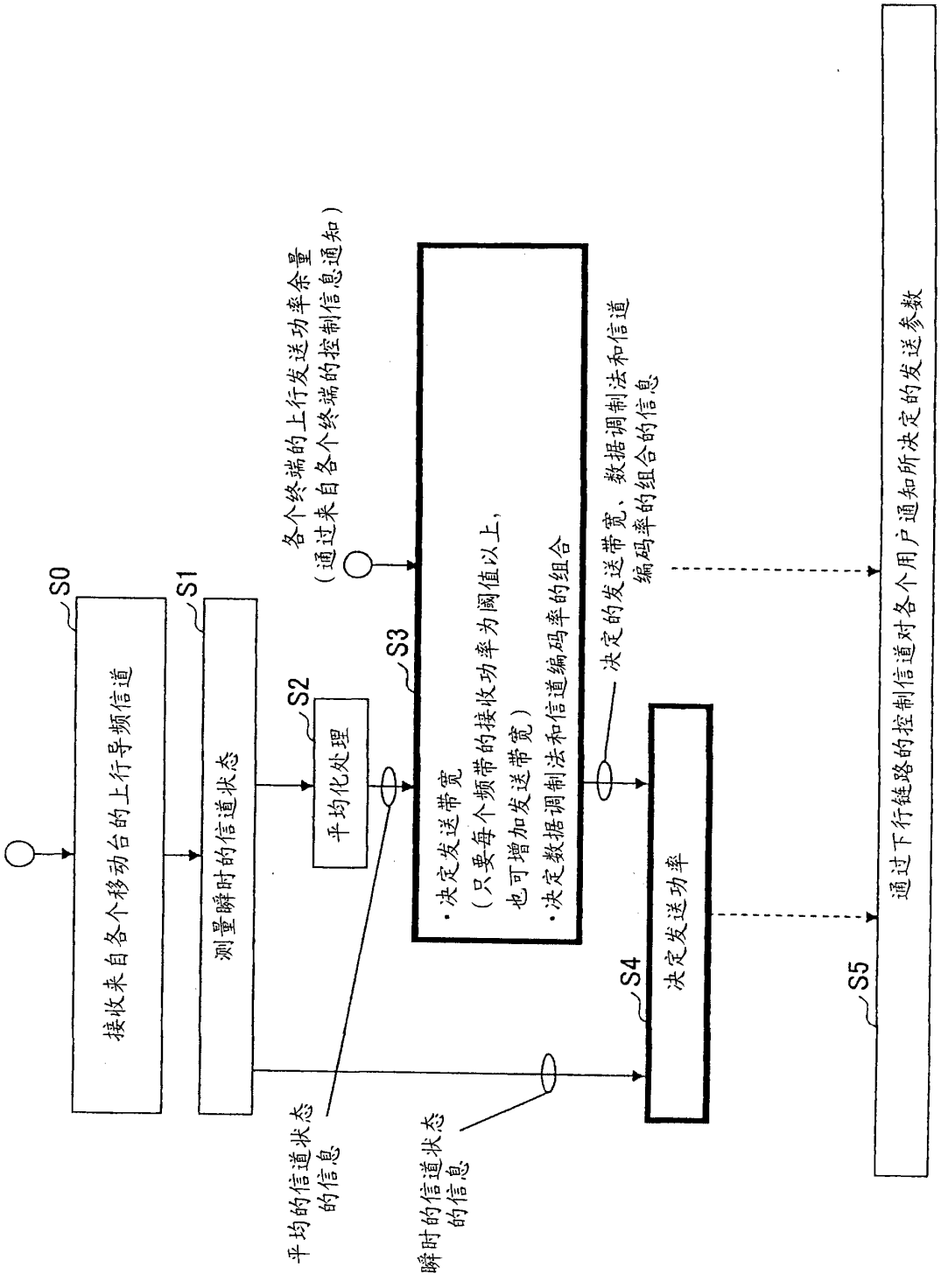


图 9

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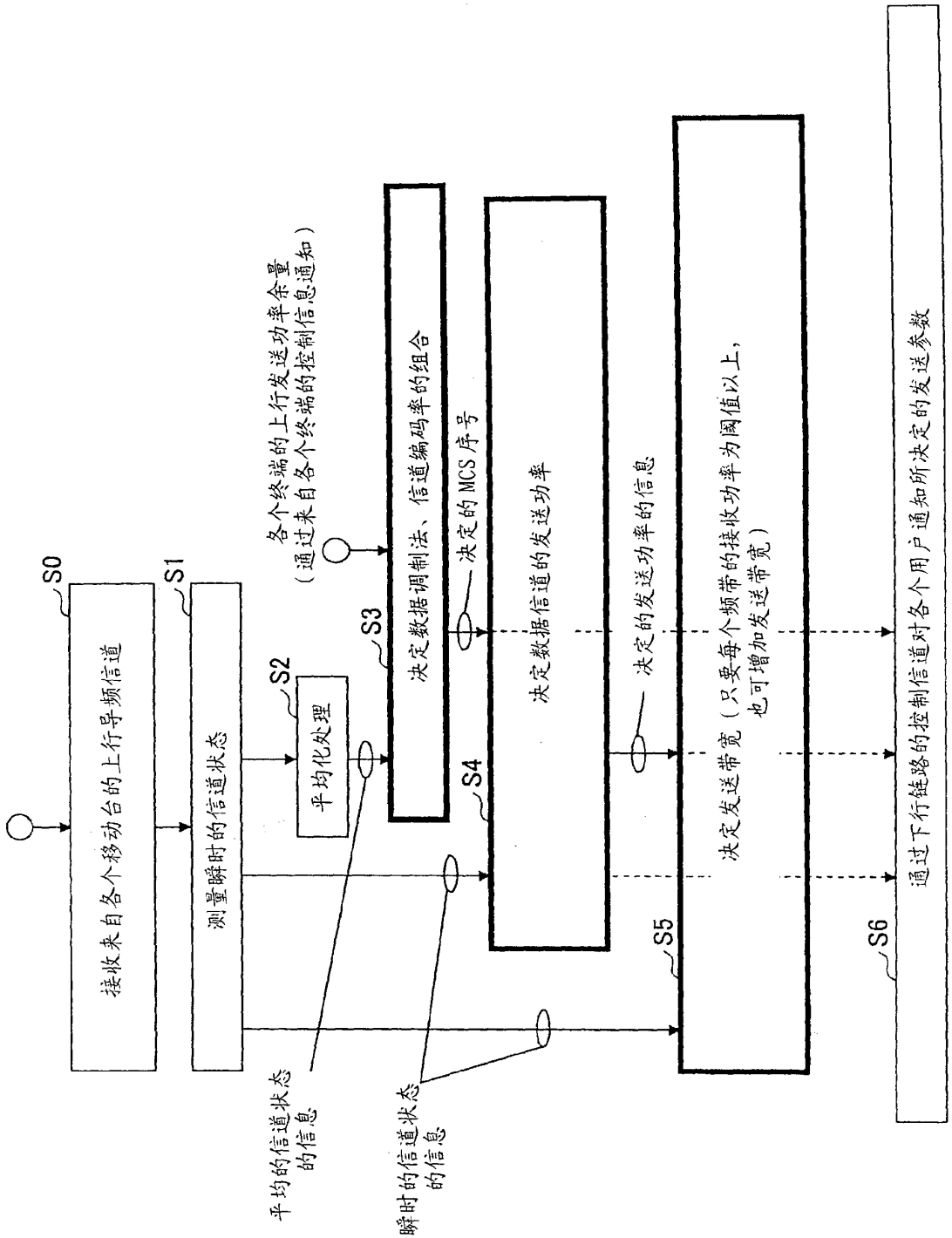


图 10

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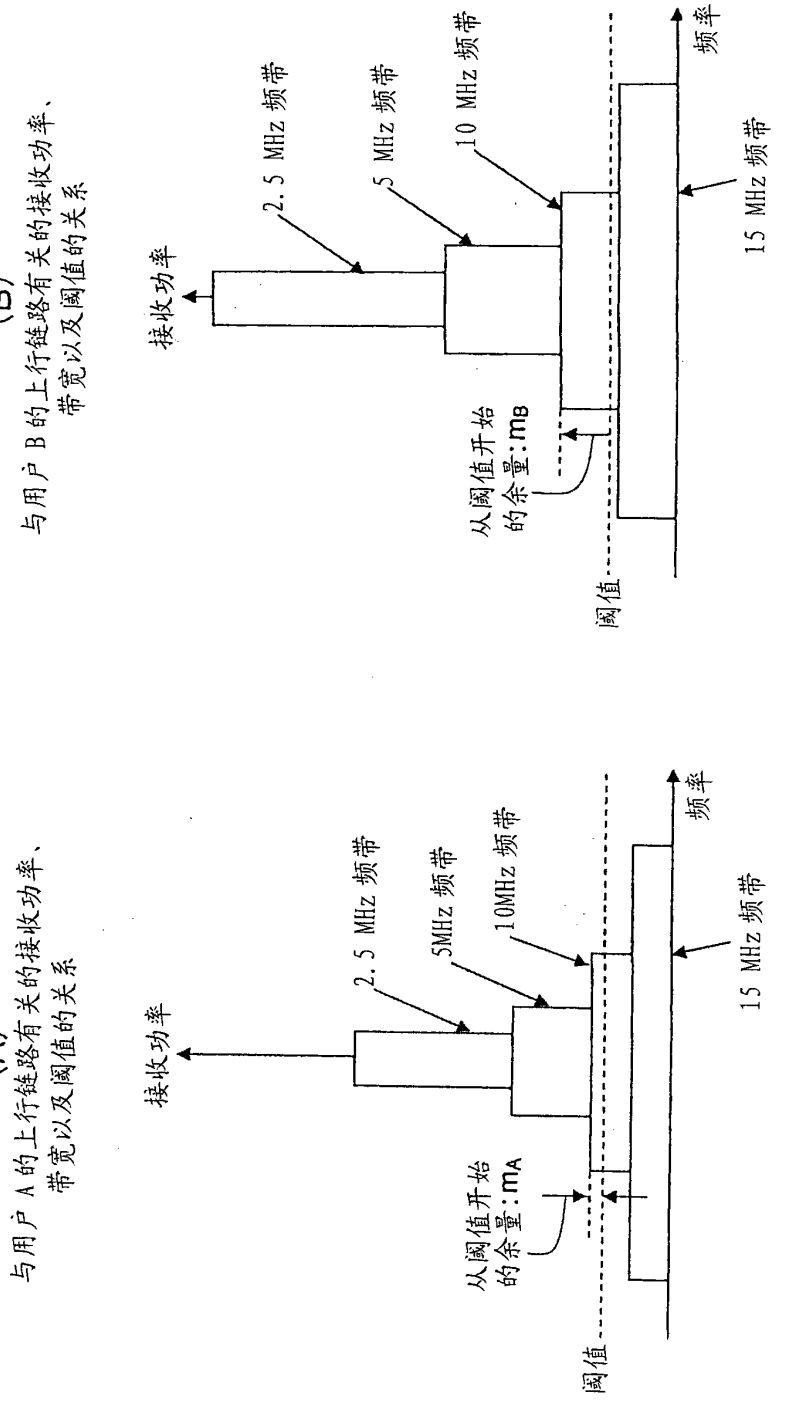


图 11

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	发送功率的控制	发送带宽的控制	AMC 控制
实施例 1（图 3）	低	高	高
实施例 2（图 8）	低	低	高
实施例 3（图 9）	高	低	低
实施例 4（图 10）	高	高	低

图 12

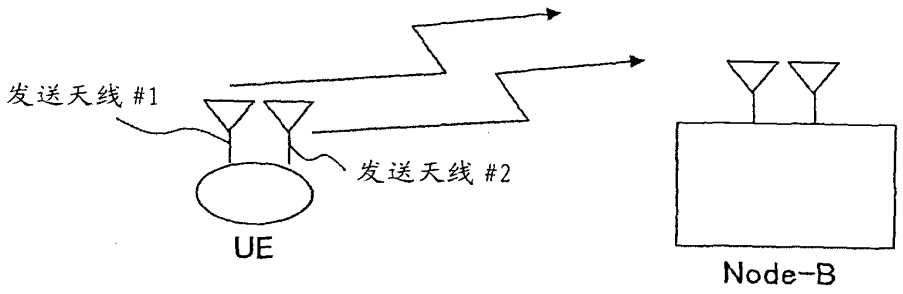


图 13

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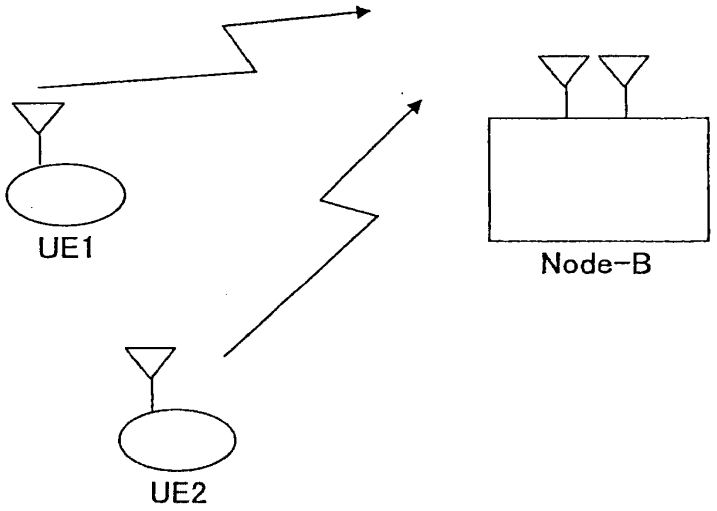


图 14

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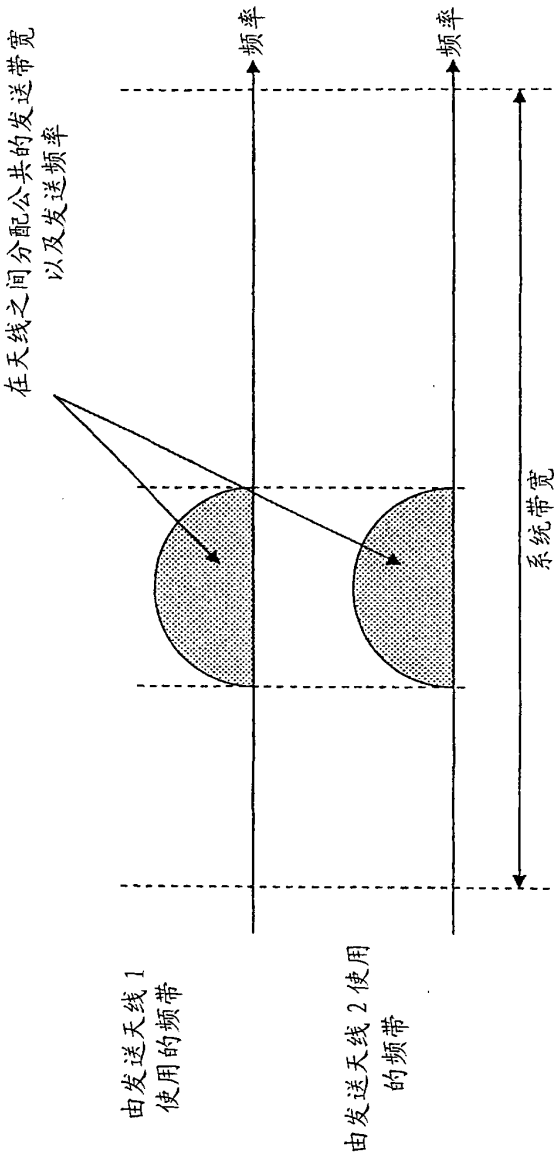


图 15

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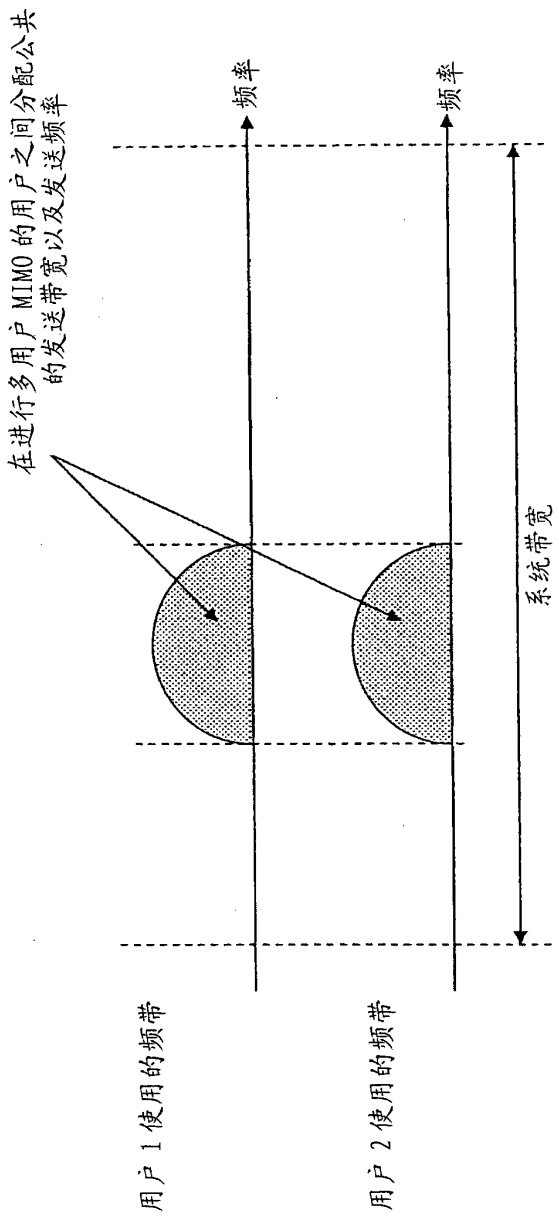


图 16

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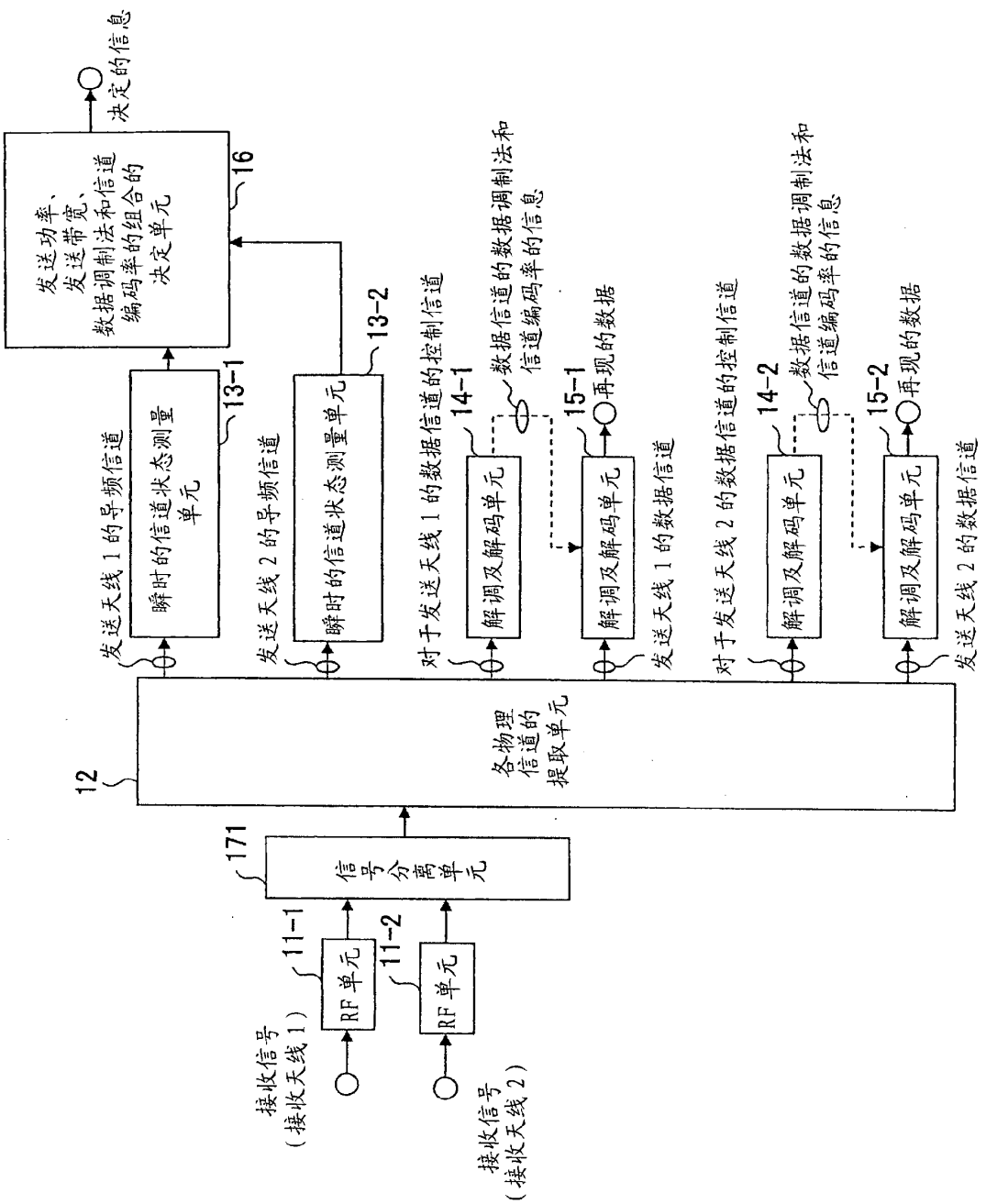


图 17

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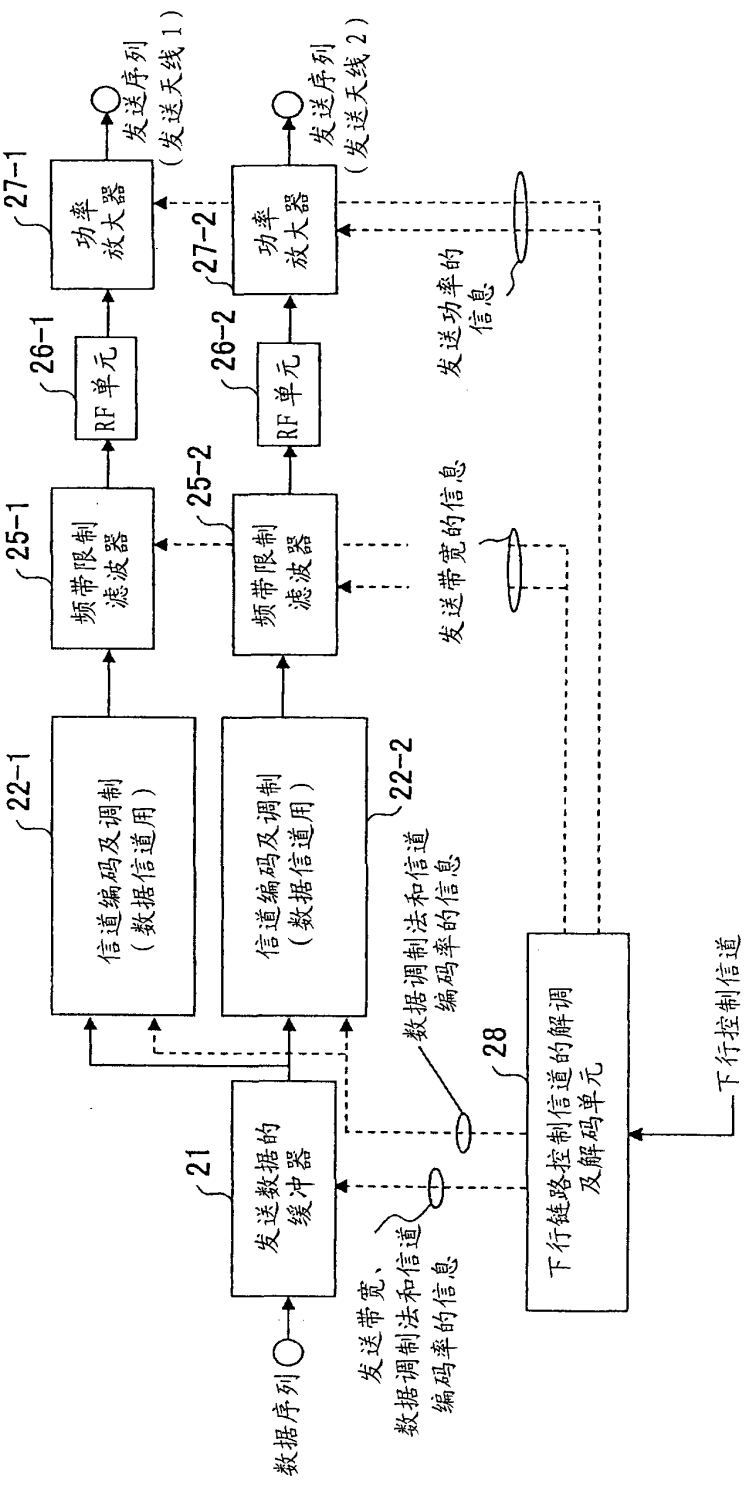


图 18

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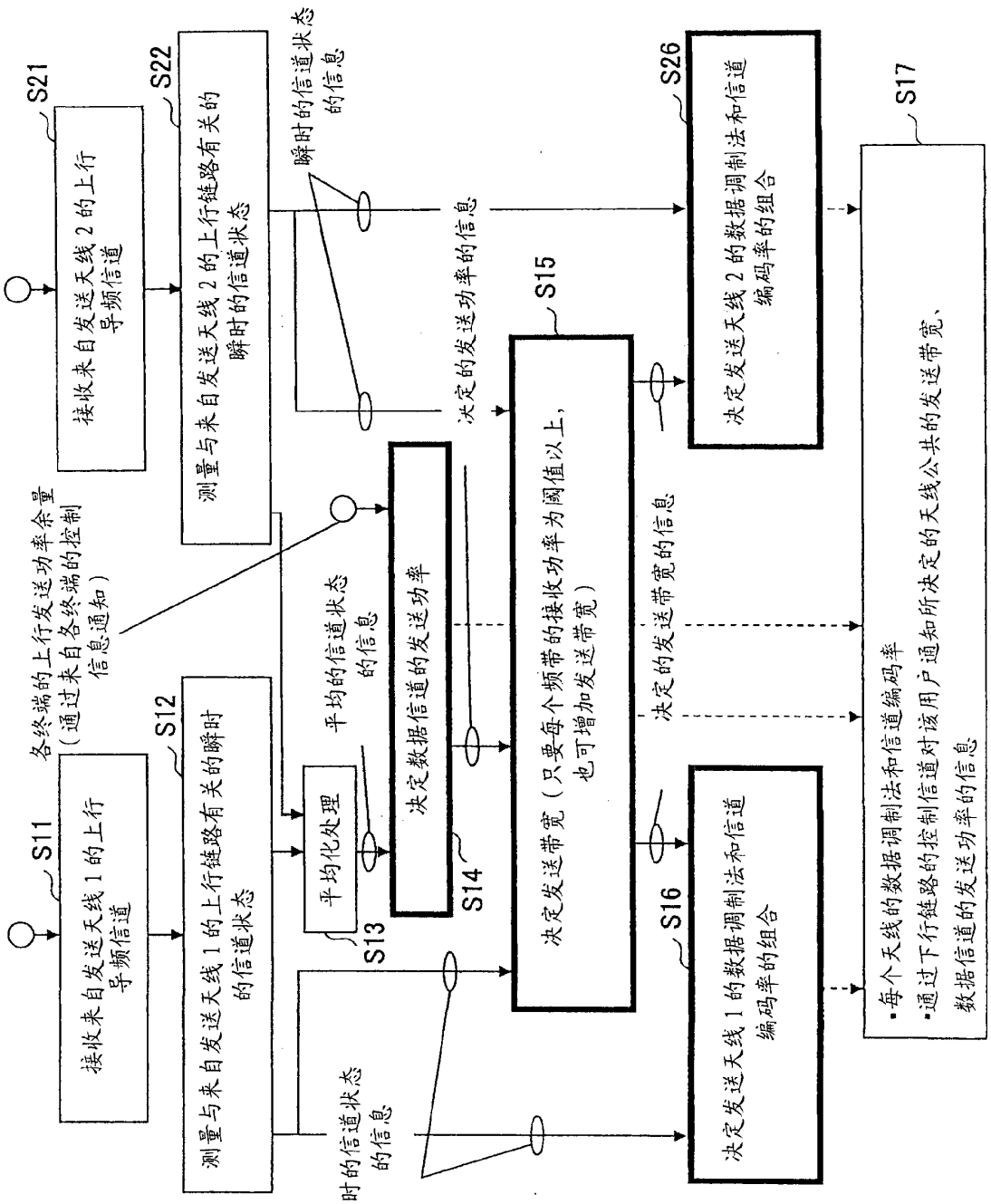


图 19

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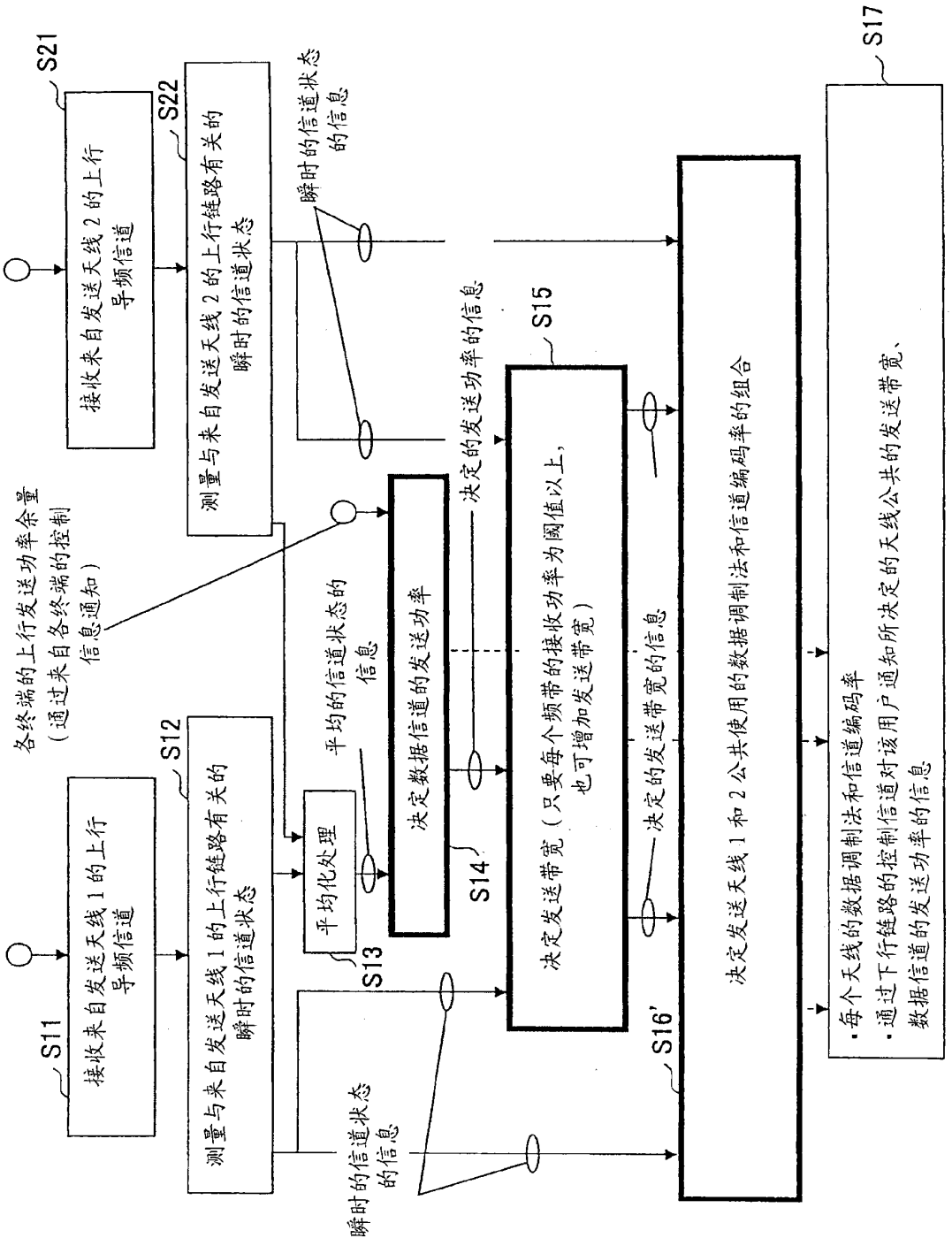


图 20

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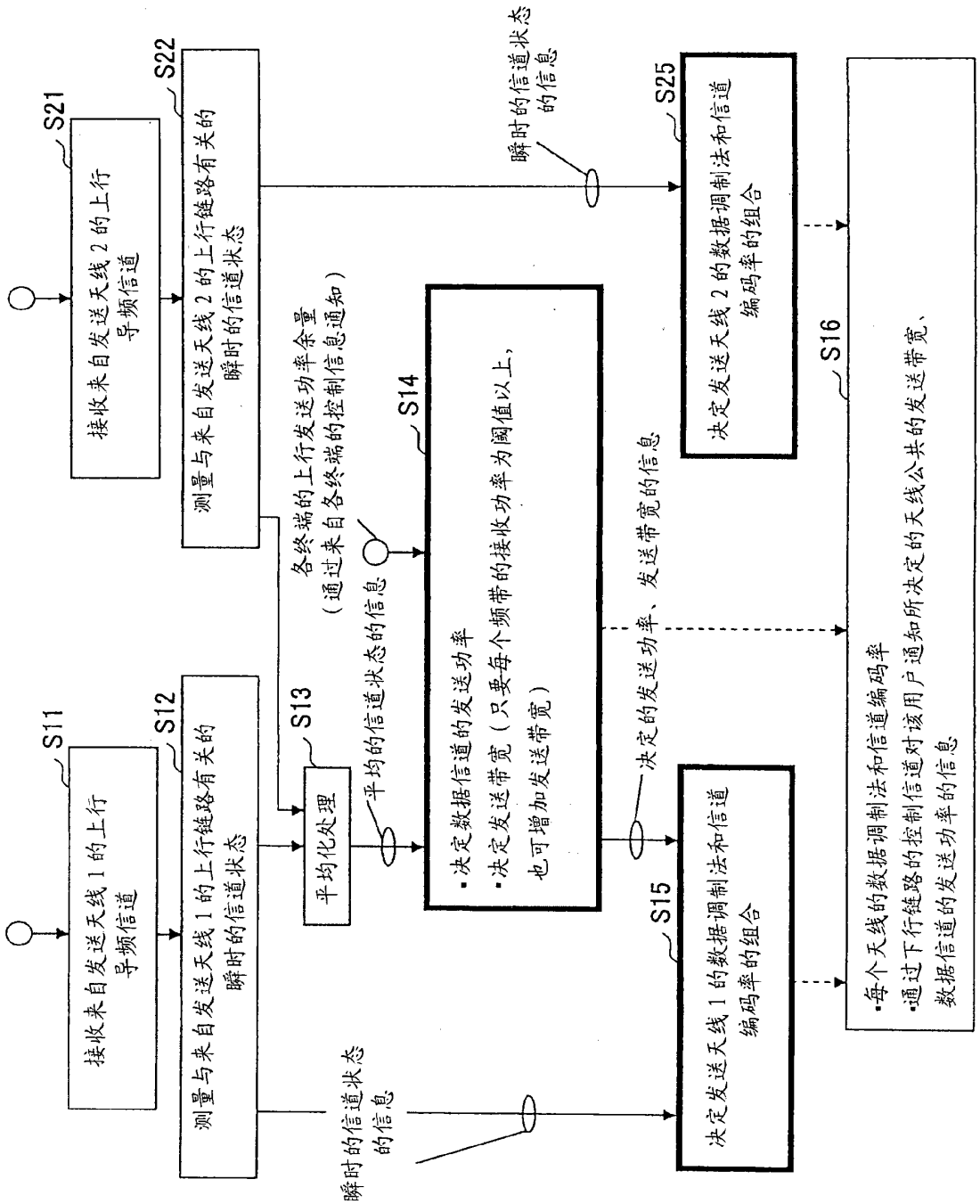


图 21

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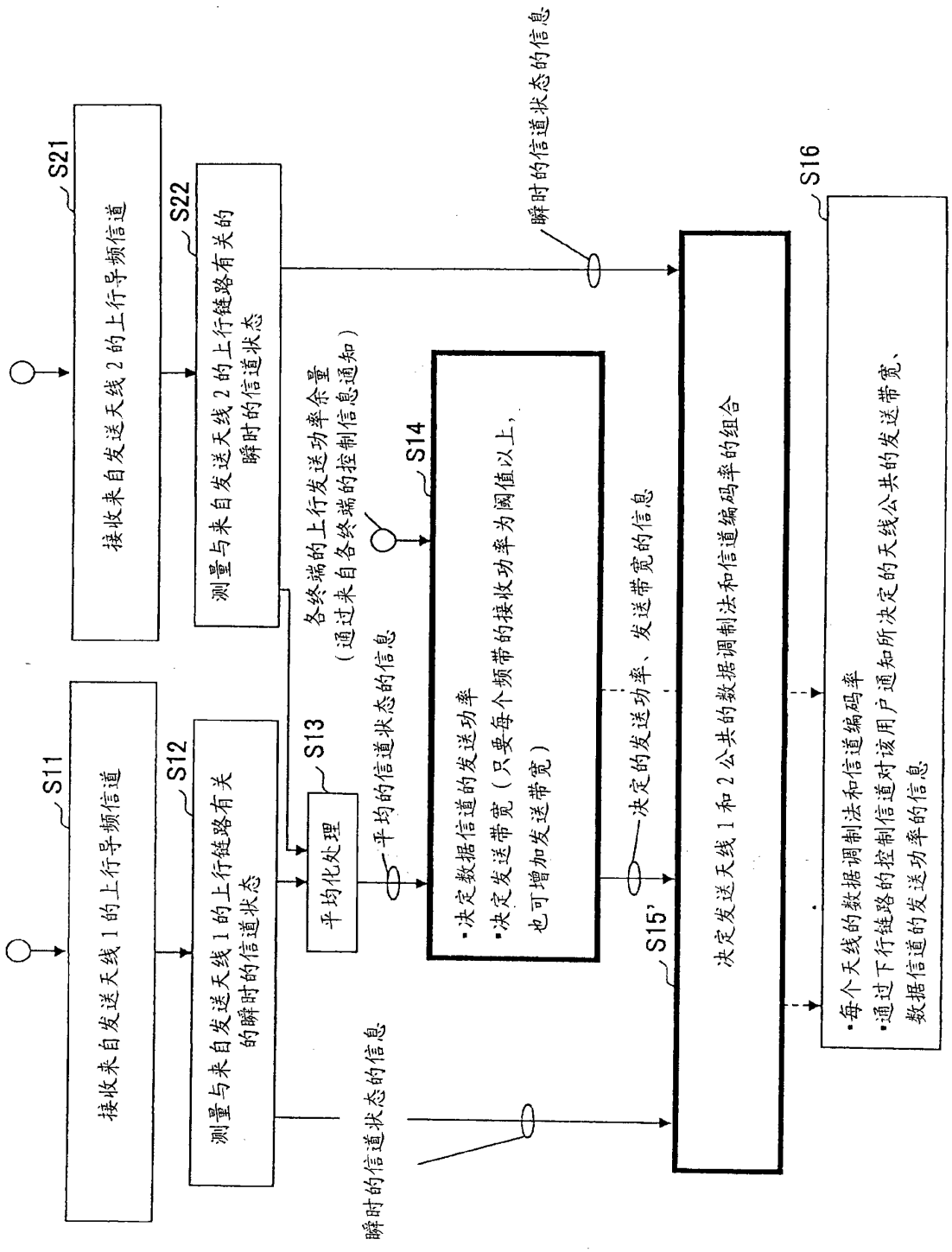


图 22

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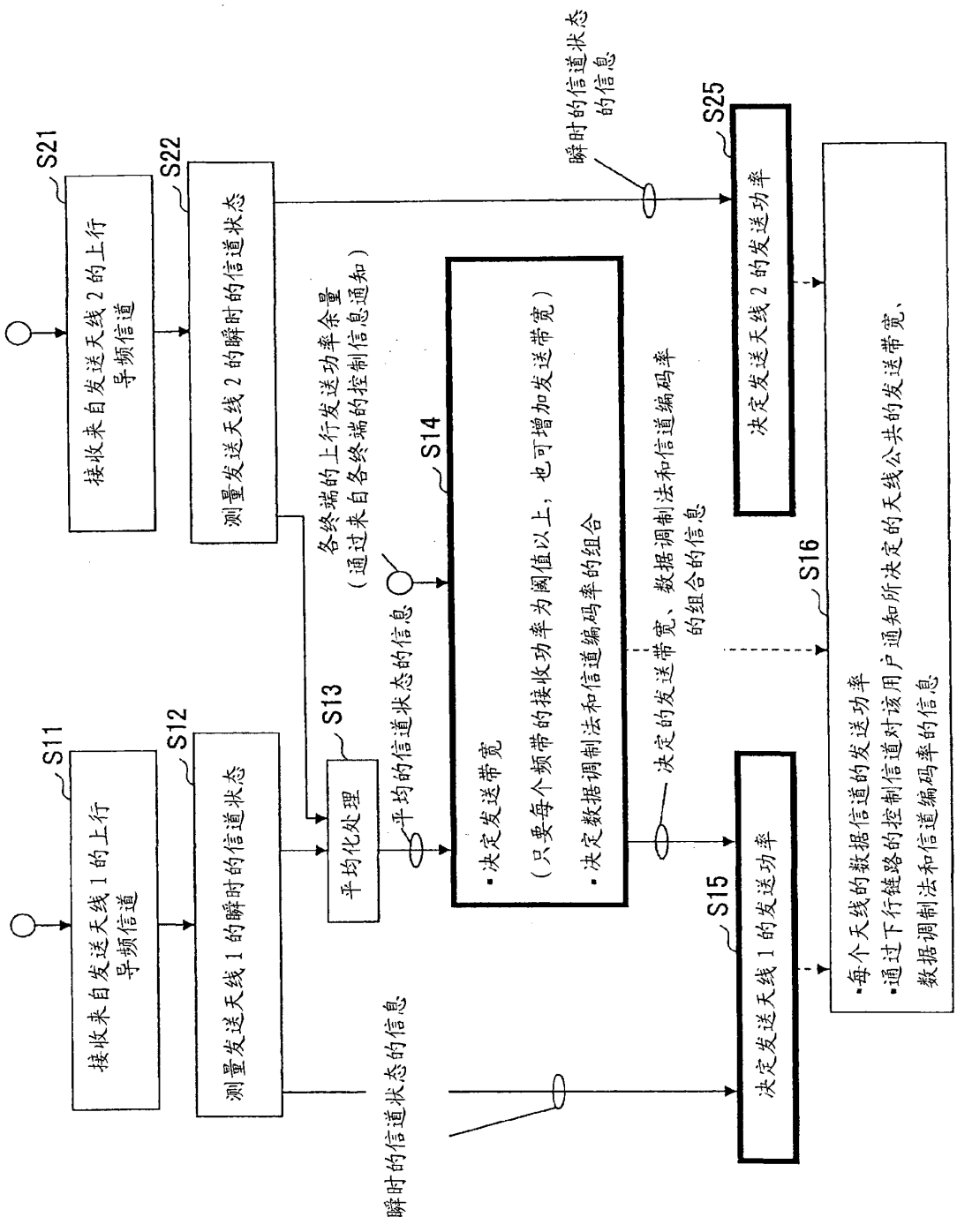


图 23

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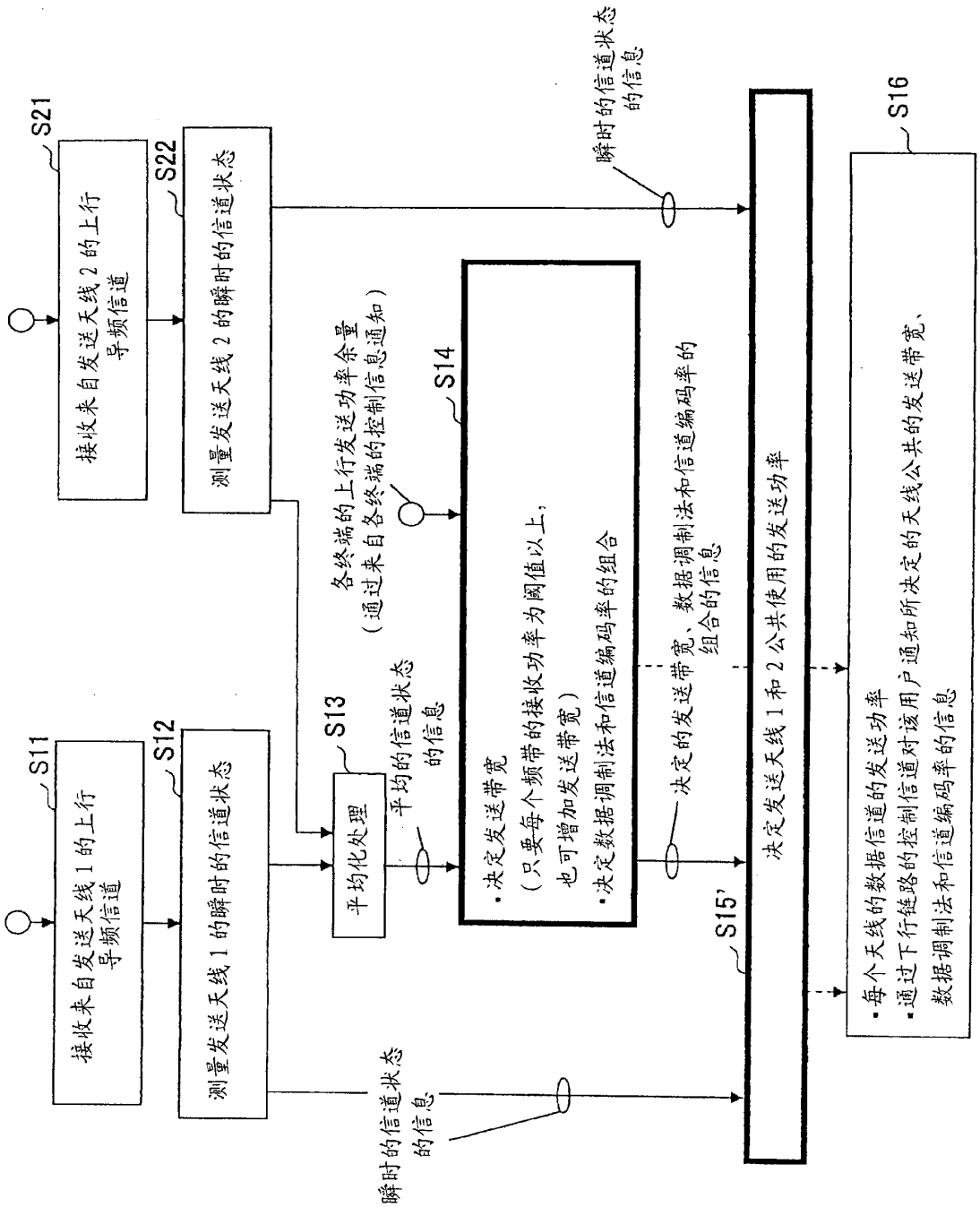


图 24

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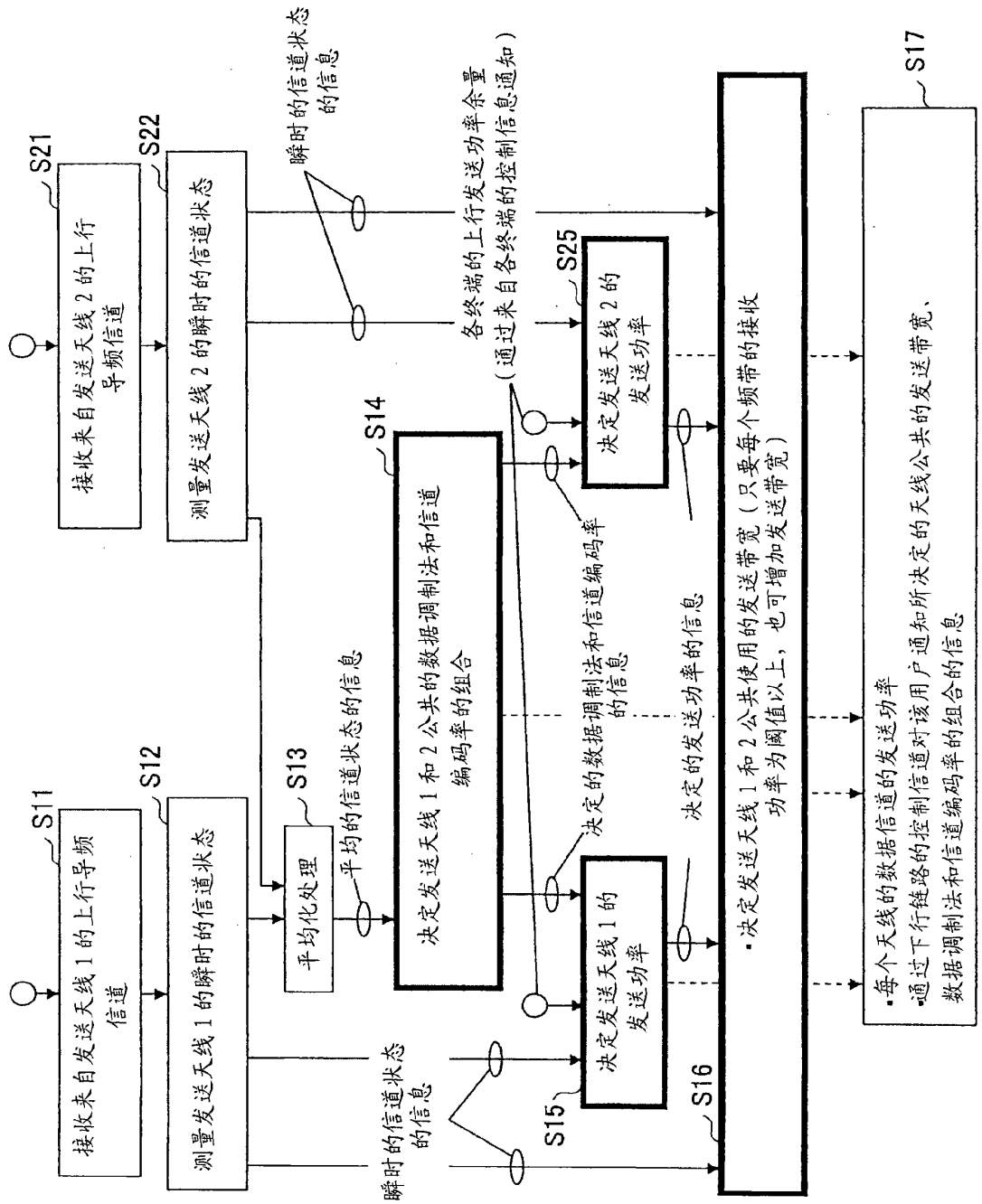


图 25

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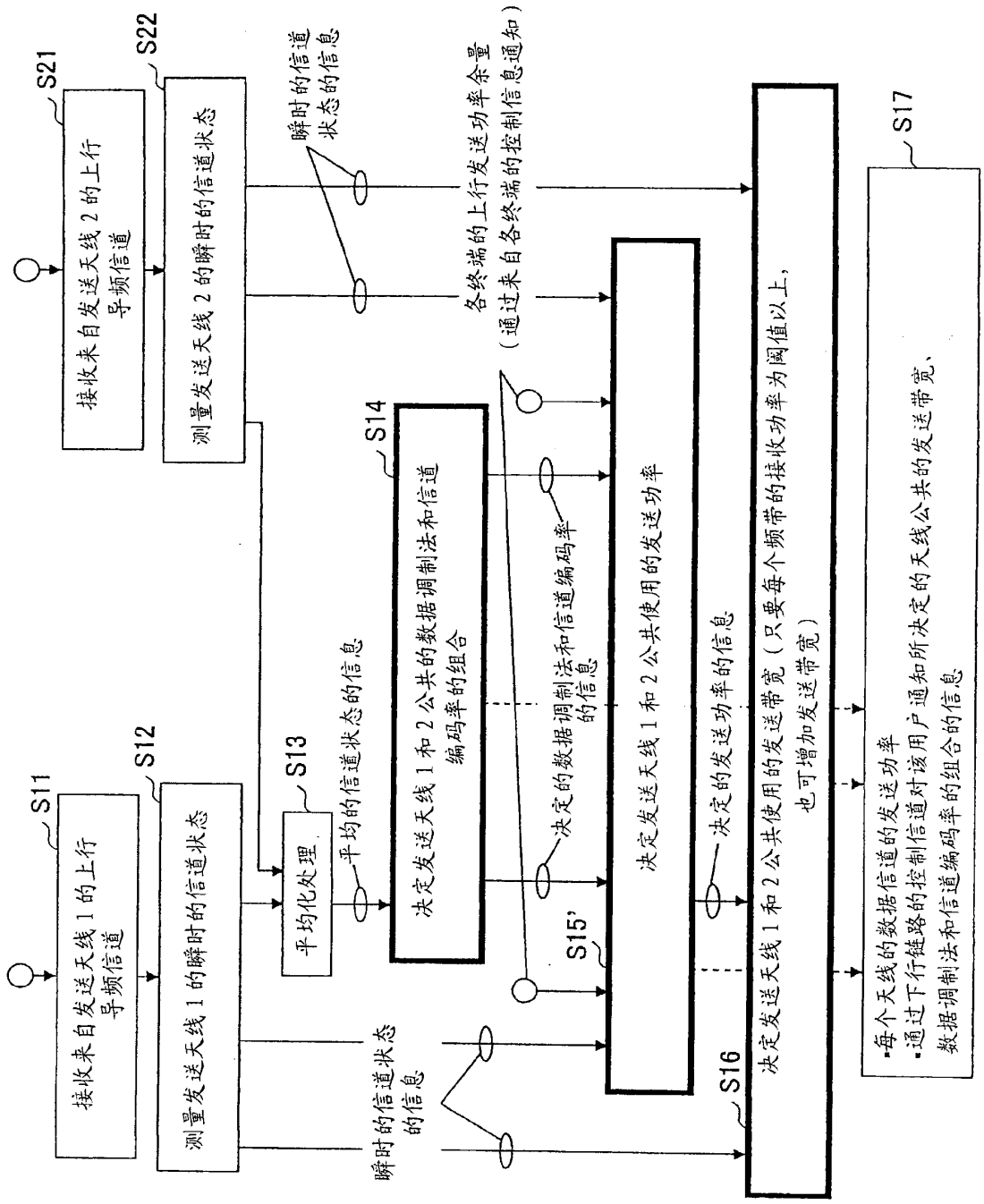


图 26

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	发送功率的控制	发送带宽的控制	AMC 控制
实施例 7（图 19） （图 20）	低（相同）	高（相同）	高（不同） 高（相同）
实施例 8（图 21） （图 22）	低（相同）	低（相同）	高（不同） 高（相同）
实施例 9（图 23） （图 24）	高（不同） 高（相同）	低（相同）	低（相同）
实施例 10（图 25） （图 26）	高（不同） 高（相同）	高（相同）	低（相同）

图 27

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US 20020051455A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2002/0051455 A1**

Lee et al. (43) **Pub. Date: May 2, 2002**

(54) **MAC PROTOCOL OVER ATM PASSIVE OPTICAL NETWORK**

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(21) Appl. No.: **09/984,743**

(22) Filed: **Oct. 31, 2001**

(30) **Foreign Application Priority Data**

Oct. 31, 2000 (KR) 2000-64268

Publication Classification

(51) **Int. Cl.**[7] **H04L 12/56**

(52) **U.S. Cl.** **370/395.21**; 370/442

(57) **ABSTRACT**

A medium access control (MAC) technique between a group of optical network units (ONU) and an optical line termination (OLT) on an asynchronous transfer mode passive optical network (ATM-PON) is disclosed. The downstream frame from the OLT to the group of ONUs includes PLOAM cells having data grant fields, PLOAM grant fields and divided-slot grant fields whose format, being allocated with different identification bit values, is distinguished one from another. The upstream frame from the group of ONUs to the OLT includes a divided-slot structure of 56-byte size, which is divided into four 14-byte minislots for transmitting cell information on the number of real-time cells and non-real-time cells that have arrived at a corresponding ONU. The data grant field format has a quality of service (QoS) class bit allocated for classifying real-time or non-real-time traffics, thus improving the efficiency of utilization as well as efficient transmission.

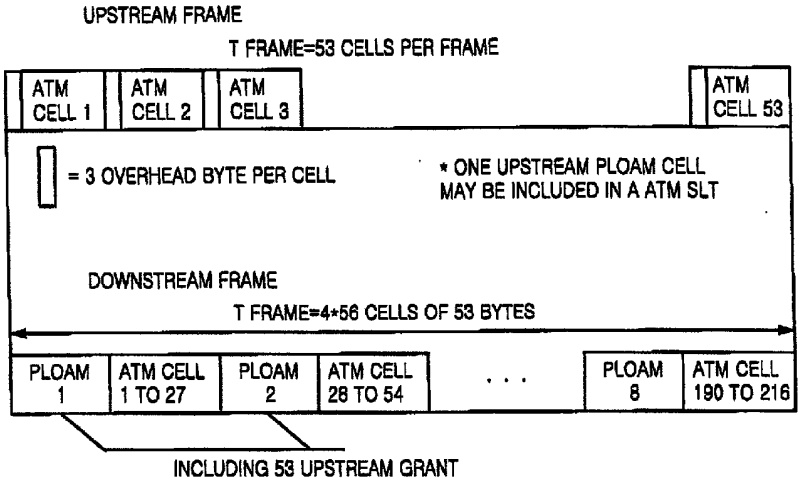


FIG. 1

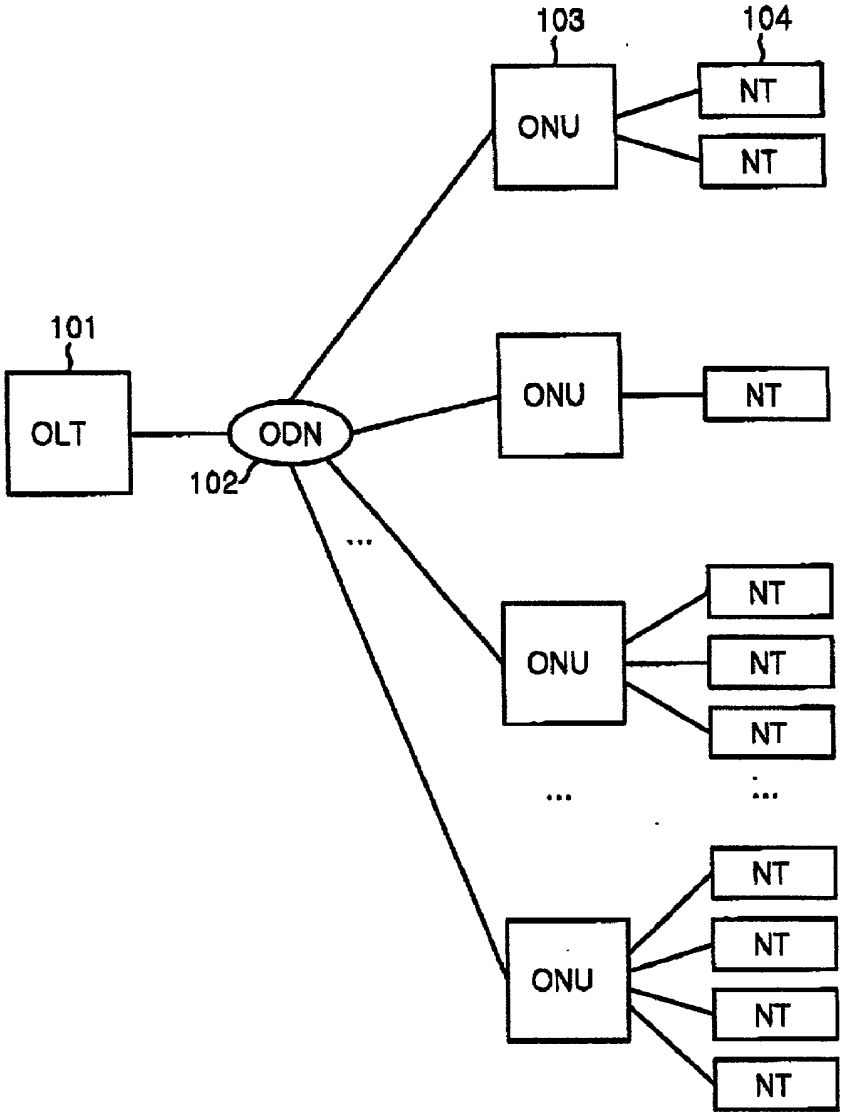

103
104
ONU
NT
NT
101
OLT
ODN
102
ONU
NT
...
NT
ONU
NT
NT
...
...
NT
NT
ONU
NT
NT

FIG. 2

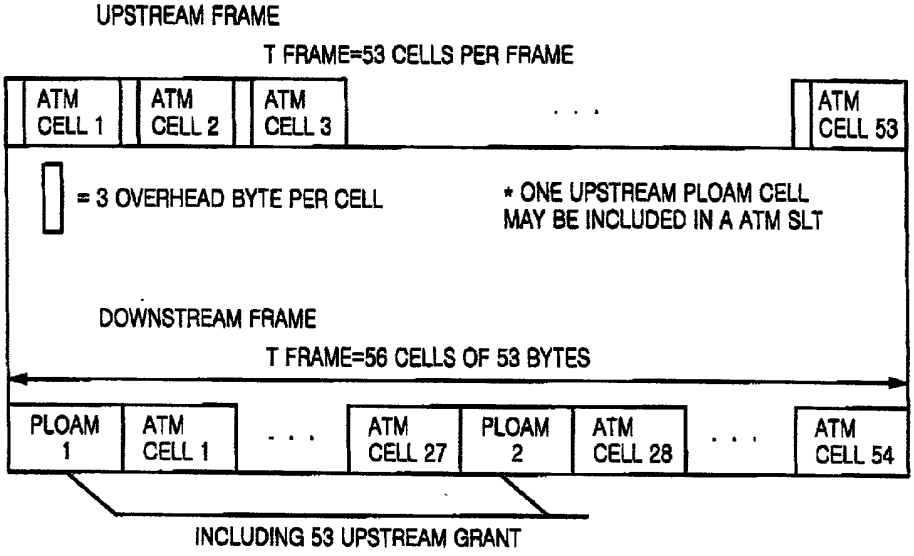

UPSTREAM FRAME
T FRAME=53 CELLS PER FRAME
ATM CELL 1
ATM CELL 2
ATM CELL 3
ATM CELL 53
= 3 OVERHEAD BYTE PER CELL
* ONE UPSTREAM PLOAM CELL MAY BE INCLUDED IN A ATM SLT
DOWNSTREAM FRAME
T FRAME=56 CELLS OF 53 BYTES
PLOAM 1
ATM CELL 1
ATM CELL 27
PLOAM 2
ATM CELL 28
ATM CELL 54
INCLUDING 53 UPSTREAM GRANT

FIG. 3

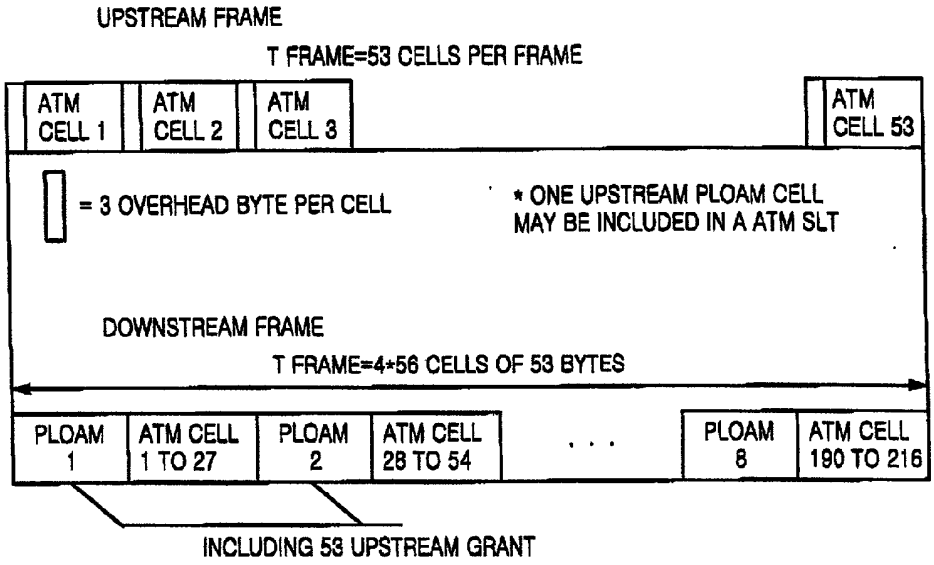

UPSTREAM FRAME
T FRAME=53 CELLS PER FRAME
ATM CELL 1
ATM CELL 2
ATM CELL 3
ATM CELL 53
= 3 OVERHEAD BYTE PER CELL
* ONE UPSTREAM PLOAM CELL MAY BE INCLUDED IN A ATM SLT
DOWNSTREAM FRAME
T FRAME=4*56 CELLS OF 53 BYTES
PLOAM 1
ATM CELL 1 TO 27
PLOAM 2
ATM CELL 28 TO 54
. . .
PLOAM 8
ATM CELL 190 TO 216
INCLUDING 53 UPSTREAM GRANT

FIG. 4

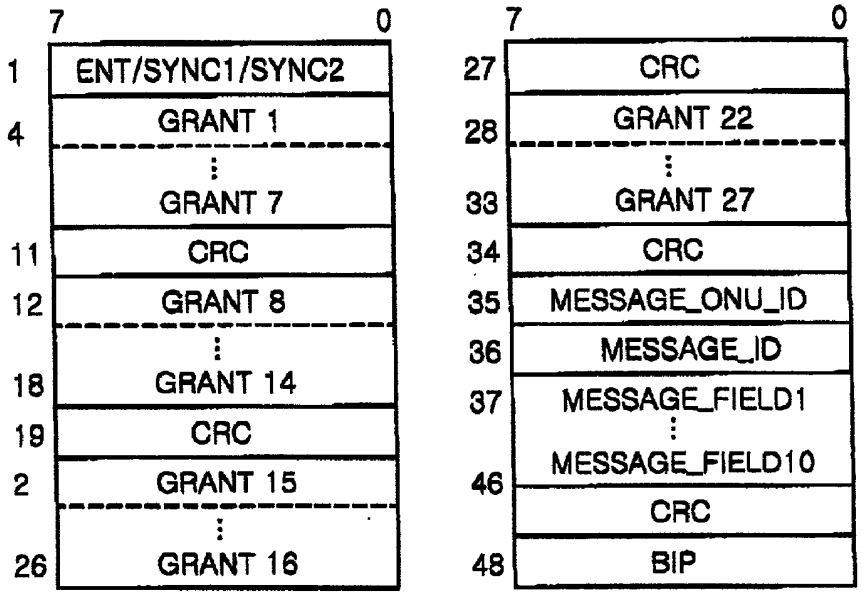

7
0
1
ENT/SYNC1/SYNC2
4
GRANT 1
GRANT 7
11
CRC
12
GRANT 8
18
GRANT 14
19
CRC
2
GRANT 15
26
GRANT 16
7
0
27
CRC
28
GRANT 22
33
GRANT 27
34
CRC
35
MESSAGE_ONU_ID
36
MESSAGE_ID
37
MESSAGE_FIELD1
MESSAGE_FIELD10
46
CRC
48
BIP

FIG. 5A

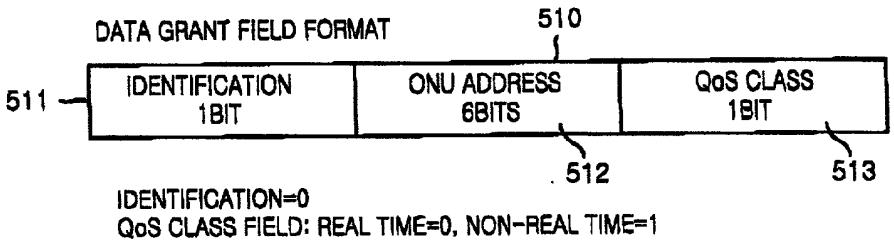


FIG. 5B

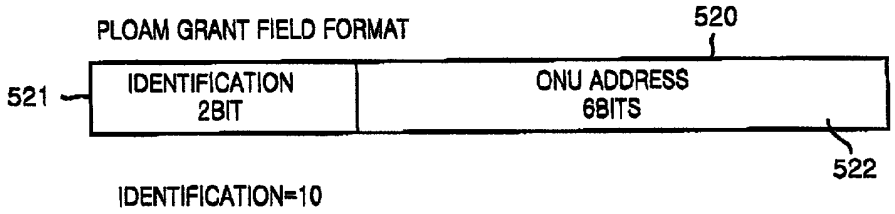


FIG. 5C

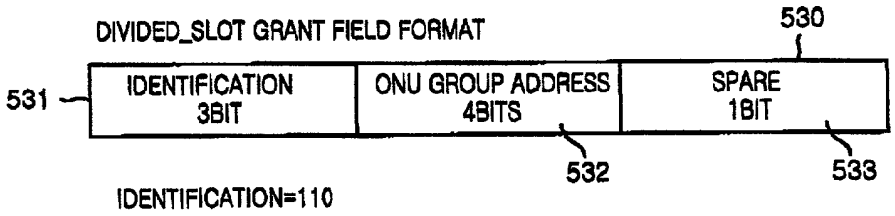


FIG. 6

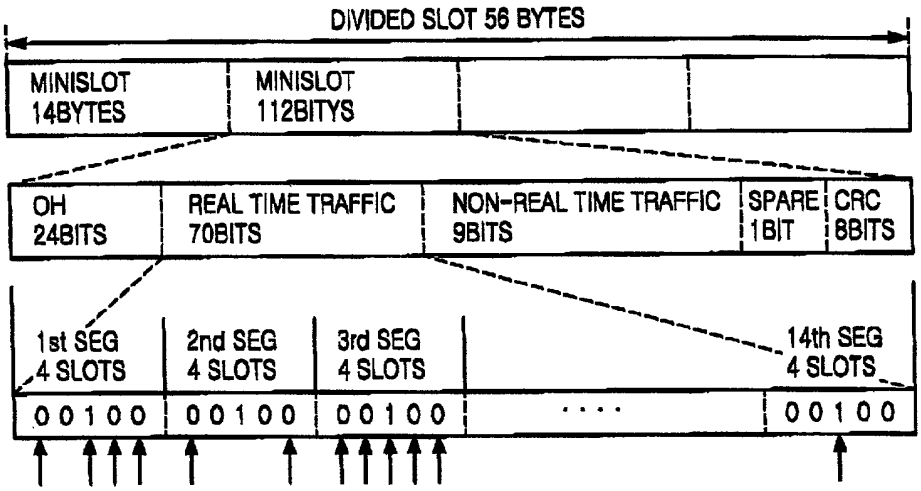

DIVIDED SLOT 56 BYTES
MINISLOT 14BYTES
MINISLOT 112BITYS
OH 24BITS
REAL TIME TRAFFIC 70BITS
NON-REAL TIME TRAFFIC 9BITS
SPARE 1BIT
CRC 8BITS
1st SEG 4 SLOTS
2nd SEG 4 SLOTS
3rd SEG 4 SLOTS
14th SEG 4 SLOTS
0 0 1 0 0
0 0 1 0 0
0 0 1 0 0
0 0 1 0 0

FIG. 7

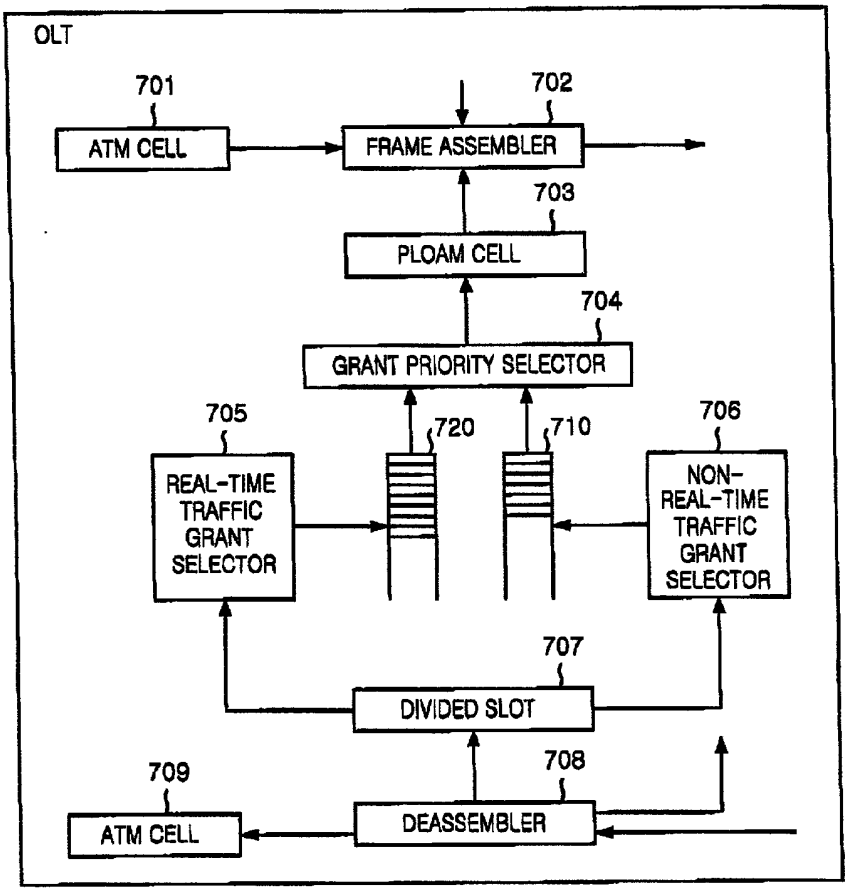

OLT
701
ATM CELL
702
FRAME ASSEMBLER
703
PLOAM CELL
704
GRANT PRIORITY SELECTOR
705
REAL-TIME TRAFFIC GRANT SELECTOR
720
710
706
NON-REAL-TIME TRAFFIC GRANT SELECTOR
707
DIVIDED SLOT
708
DEASSEMBLER
709
ATM CELL

FIG. 8

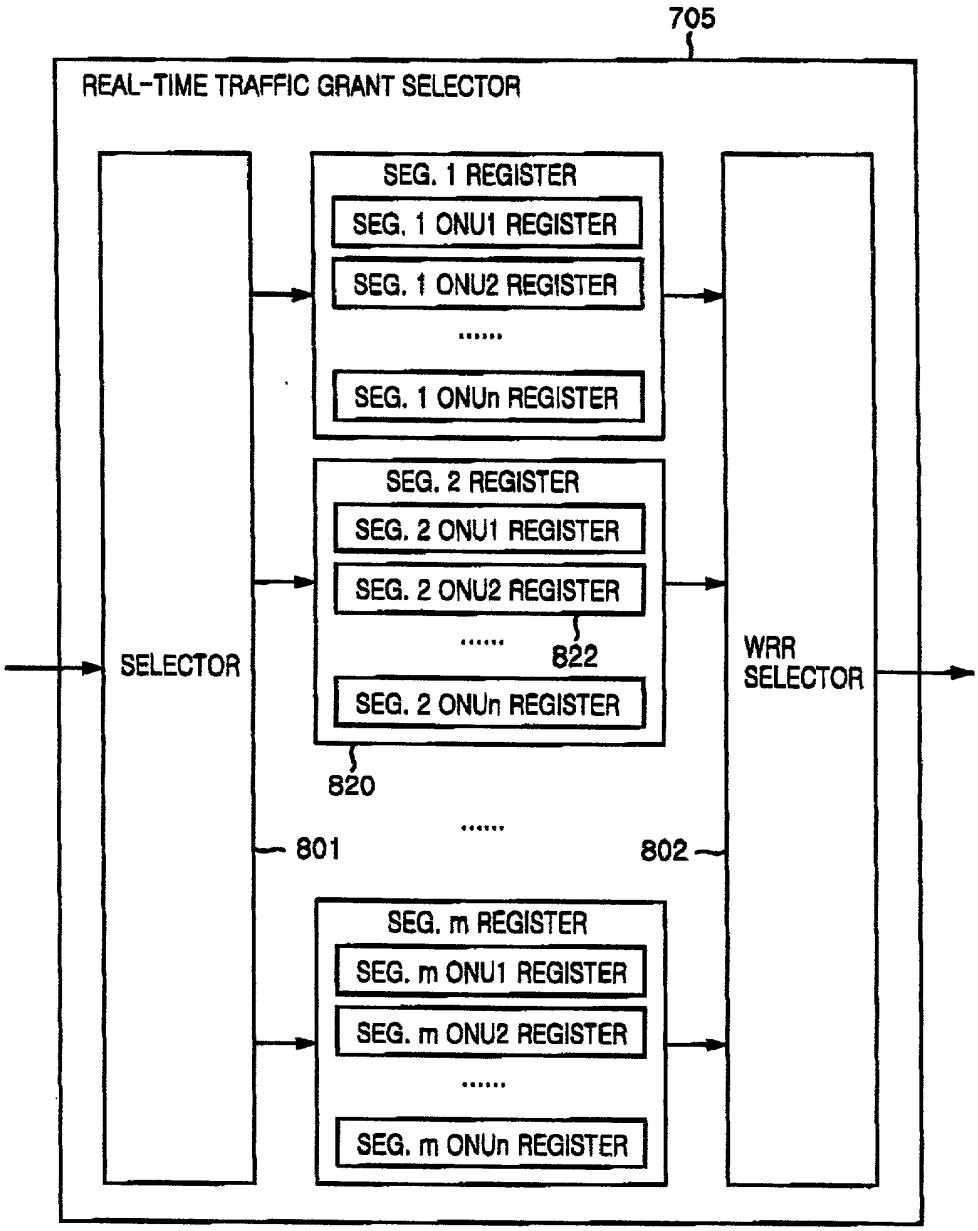

705
REAL-TIME TRAFFIC GRANT SELECTOR
SELECTOR
SEG. 1 REGISTER
SEG. 1 ONU1 REGISTER
SEG. 1 ONU2 REGISTER
.....
SEG. 1 ONUn REGISTER
SEG. 2 REGISTER
SEG. 2 ONU1 REGISTER
SEG. 2 ONU2 REGISTER
.....
822
SEG. 2 ONUn REGISTER
820
.....
801
802
SEG. m REGISTER
SEG. m ONU1 REGISTER
SEG. m ONU2 REGISTER
.....
SEG. m ONUn REGISTER
WRR SELECTOR

FIG. 9

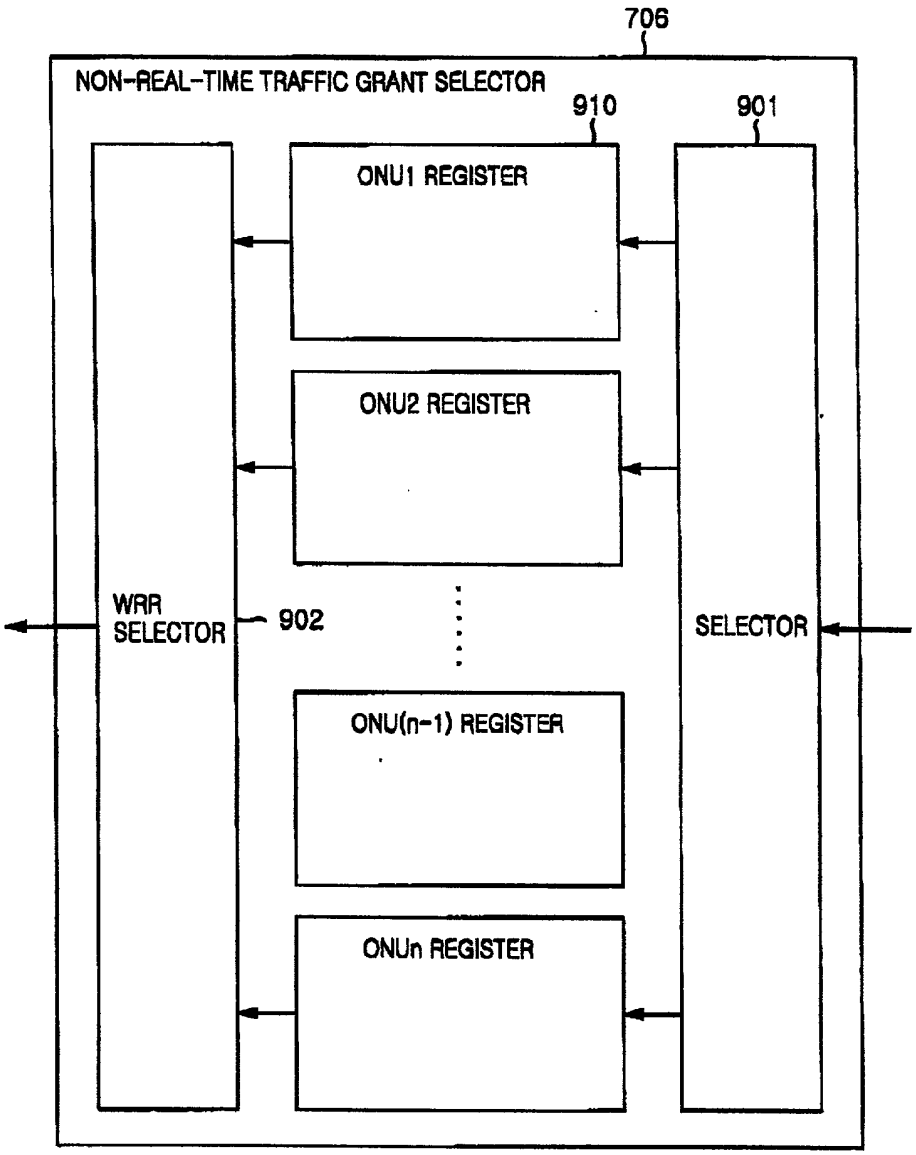

706
NON-REAL-TIME TRAFFIC GRANT SELECTOR
910
901
ONU1 REGISTER
ONU2 REGISTER
WRR SELECTOR
902
SELECTOR
ONU(n-1) REGISTER
ONUn REGISTER

FIG. 10

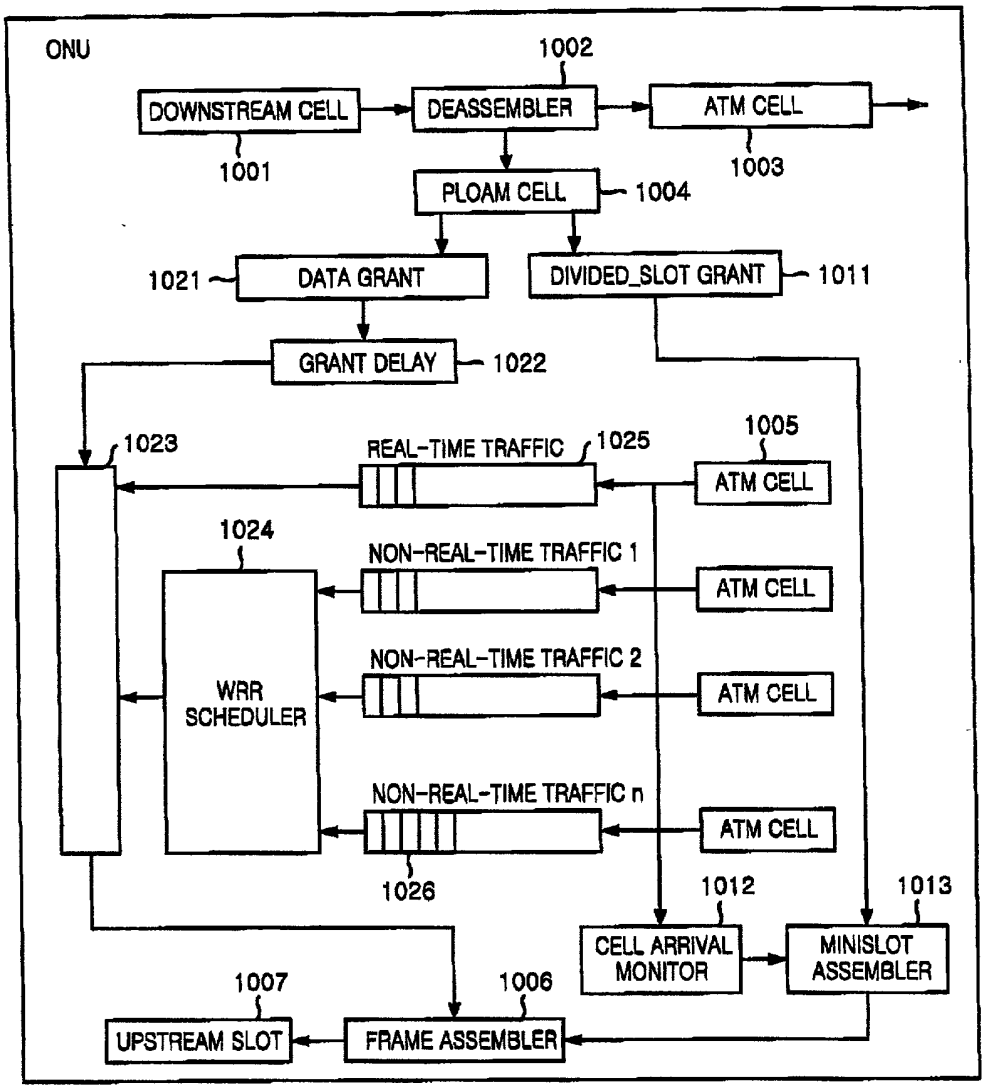
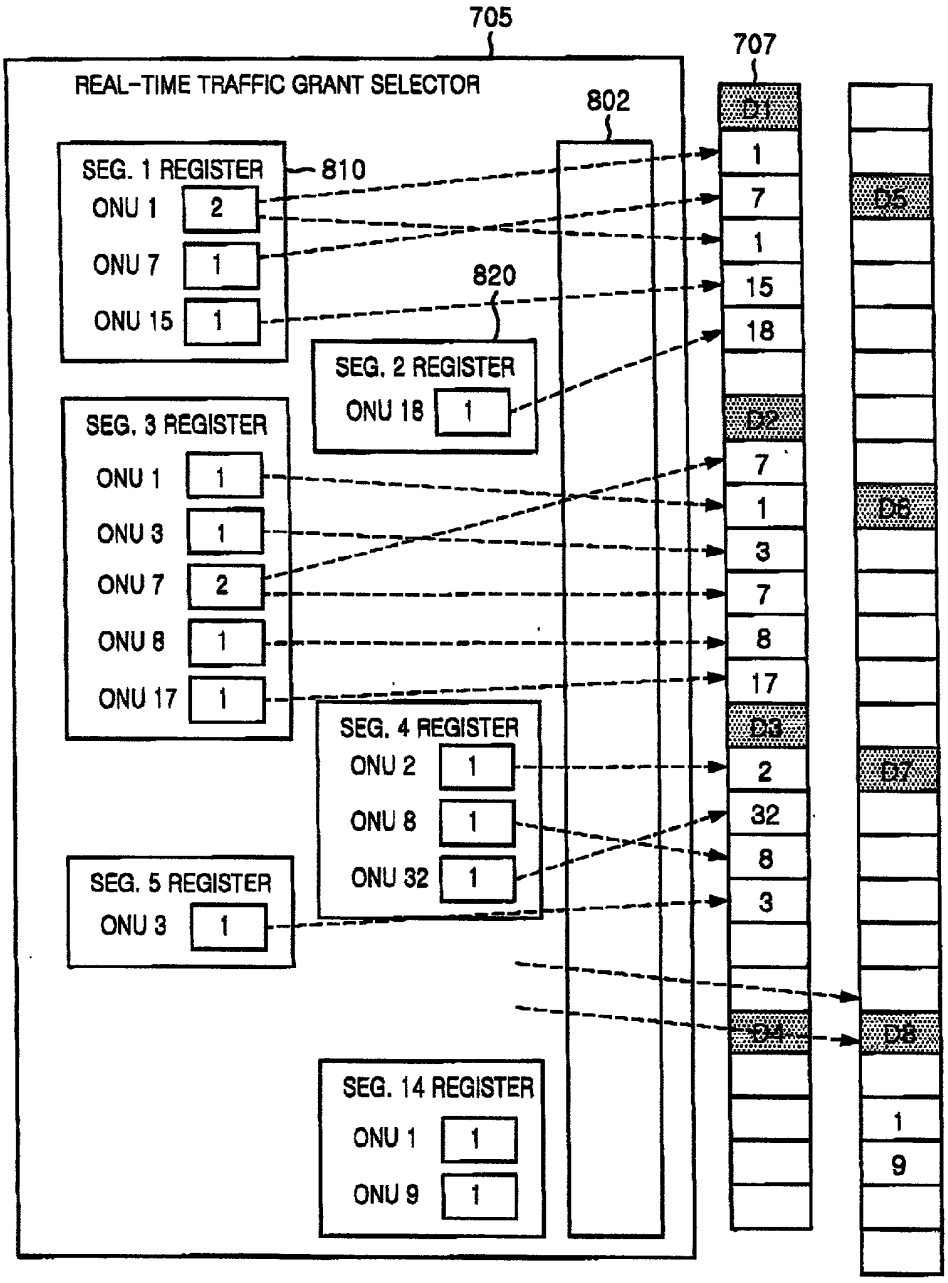

ONU
1002
DOWNSTREAM CELL
DEASSEMBLER
ATM CELL
1001
1003
PLOAM CELL
1004
1021
DATA GRANT
DIVIDED_SLOT GRANT
1011
GRANT DELAY
1022
1023
REAL-TIME TRAFFIC
1025
1005
ATM CELL
1024
NON-REAL-TIME TRAFFIC 1
ATM CELL
WRR SCHEDULER
NON-REAL-TIME TRAFFIC 2
ATM CELL
NON-REAL-TIME TRAFFIC n
ATM CELL
1026
1012
1013
CELL ARRIVAL MONITOR
MINISLOT ASSEMBLER
1007
1006
UPSTREAM SLOT
FRAME ASSEMBLER

FIG. 11


705
707
REAL-TIME TRAFFIC GRANT SELECTOR
802
SEG. 1 REGISTER
810
ONU 1 2
ONU 7 1
ONU 15 1
820
SEG. 2 REGISTER
ONU 18 1
SEG. 3 REGISTER
ONU 1 1
ONU 3 1
ONU 7 2
ONU 8 1
ONU 17 1
SEG. 4 REGISTER
ONU 2 1
ONU 8 1
ONU 32 1
SEG. 5 REGISTER
ONU 3 1
SEG. 14 REGISTER
ONU 1 1
ONU 9 1
D1
1
7
1
15
18
D2
7
1
3
7
8
17
D3
2
32
8
3
34
D5
D6
D7
D8
1
9

MAC PROTOCOL OVER ATM PASSIVE OPTICAL NETWORK

FIELD OF THE INVENTION

[0001] The present invention relates to a medium access control (MAC) protocol in an asynchronous transfer mode (ATM) passive optical network (PON); and more particularly to a transmit frame structure and a method applied to embody the protocol, and an ONU and OLT for embodying the protocol. Also, the present invention refers to a method for designing a medium access control (MAC) scheme that provides an efficient use of network resources and various ATM services in an ATM-based passive optical network (PON).

DESCRIPTION OF THE PRIOR ART

[0002] At present, the ATM-PON system is established and is used as an economical way of establishment adequate for providing wideband service. As a subscriber network structure, the ATM-PON system has multiplexing generated in its upstream. So, MAC protocol should be employed to cope with the multiplexing effect. In fact, there are many MAC protocol propositions suggesting tree algorithm to solve the conflict. However, this algorithm does not perform well enough when time-sensitive traffic in priority is coming in.

[0003] Generally, many telecommunication companies are adopting an applicable wideband PON system. Providing from low-speed synchronization service such as voice to high-speed service like LAN interconnection, the PON system should not affect the performance of service.

[0004] Normally, the PON uses an optical distribution network (ODN), a distribution network, between the Fiber To The Home (FTTH) or Fiber To The Office (FTTC) subscriber access node and optical network unit (ONU), and all nodes are topologies dispersed in the form of bus or tree topology.

[0005] To access to an optical subscriber's network, the PON system includes ONUs established inside homes or companies and Optical Line Terminations (OLT) set up at telephone companies that are connected with each ONU through optical cables. Through each of the OLT, provided is an Internet service, Plain Old Telephone Service (POTS), video on demand (VOD) service and others.

[0006] PON technology has advantages of users capable of sharing exchange equipments and optical resources, low maintenance expenses due to passive optical distribution network, high flexibility of a service provider adding or deleting splits easily, and low per-subscriber cost because of high-level resource-sharing.

[0007] However, the problem of collision arises among users because many users are sharing optical resources in the PON. This collision happens more than often in an ATM-PON environment supporting multi-media traffic environment, which leads to bad performance.

[0008] Therefore, MAC technology transmitting information without any collision among users and using network resources efficiently is in need in the PON system.

SUMMARY OF THE INVENTION

[0009] It is, therefore, an object of the present invention to provide a method of medium access control (MAC) that defines an upstream/downstream transmission frame, sends and reserves local cell arrival information of ONU for information transmission by using the upstream frame and to get a grant for it, utilizes a bandwidth allocation algorithm on a cell basis to secure the QoS of ATM traffic.

[0010] In accordance with an aspect of the present invention, there is provided a method for transmitting a medium access control (MAC) protocol data between multiple groups of optical network units (ONU) and an optical line termination (OLT) in an asynchronous transfer mode passive optical network (ATM-PON), the method comprising the steps of: a) at the group of ONUs, transmitting an upstream frame to the OLT, wherein the upstream frame includes divided-slots having a plurality of minislots and each of the minislots has information on the number of real-time cells and non-real-time cells that have arrived at a corresponding ONU of the group of ONUs; and b) at the OLT, transmitting a downstream frame to the ONU, wherein the downstream frame includes PLOAM cells having a divided-slot grant field, a PLOAM grant field and a data grant field that being allocated with different bits of identifier, which the divided-slot grant field, the PLOAM grant field and the data grant field are distinctive to each other, wherein a quality of service (QoS) class field for distinguishing the real-time from the non-real-time cell is allocated to the data grant field.

[0011] In accordance with another aspect of the present invention, there is provided a method of medium access control (MAC) for reciprocal data transmission between a plurality of optical network unit (ONU) and an optical line termination (OLT) in an asynchronous transfer mode passive optical network (ATM-PON), the method comprising the steps of: a) the ONU determining the kind of a received grant from the identification bit inside a PLOAM cell of the downstream from the OLT; b) if the received grant is a divided-slot grant, calculating information on real-time cells and non-real-time cells that have arrived during the previous frame before receiving the divided-slot grant; c) transmitting the cell information calculated in the step b) to a corresponding slot through a minislot of the divided-slot; and d) if the received grant is a data grant, transmitting cells in a corresponding buffer to a corresponding slot and thus transmitting a corresponding frame to the OLT.

[0012] In accordance with further another aspect of the present invention, there is provided a method of medium access control (MAC) for reciprocal data transmission between a plurality of optical network unit (ONU) and an optical line termination (OLT) in an asynchronous transfer mode passive optical network (ATM-PON), the method comprising the steps of: a) at the OLT, dividing 53 slots to be transmitted for a frame into groups as much as a number of segments; b) allocating data grant on real-time traffic to the remaining slots left after allocation of divided-slot grants to a corresponding group is completed; and c) if there is no slot to be allocated to the data grant in a corresponding group, the grants being allocated in the empty slots of the next group.

[0013] In accordance with still further another aspect of the present invention, there is provided a computer-readable recording medium for recording a program in an optical network unit (ONU) that realizes a medium access control (MAC) protocol with an optical line termination (OLT) in an

asynchronous transfer mode passive optical network (ATM-PON), the method comprising the steps of; g) determining the kind of a received grant from an identification bit in the downstream frame PLOAM cell from the OLT; h) if the received grant is a divided-slot grant, calculating information of the real-time/non-real-time cells that have arrived during the previous frame before receiving the divided-slot grant; i) transmitting the cell information calculated in the step h) to a corresponding slot through a minislot of the divided-slot; and j) if the received grant is a data grant, transmitting a cell in a corresponding buffer to a corresponding slot.

[0014] In accordance with yet another aspect of the present invention, there is provided a computer-readable recording medium for recording a program in an optical line termination (OLT) that realizes a medium access control protocol with a plurality of optical network units (ONU) in an asynchronous transfer mode passive optical network (ATM-PON), the method comprising the steps of: a) at the OLT, dividing 53 slots to be transmitted for a frame into groups as much as a number of segments; b) allocating data grant on real-time traffic to the remaining slots left after allocation of divided-slot grants to a corresponding group is completed; and c) if there is no slot to be allocated to the data grant in a corresponding group, the grants being allocated in the empty slots of the next group.

[0015] In accordance with yet another aspect of the present invention, there is provided an optical network unit (ONU) for realizing a medium access control (MAC) protocol with an optical line termination (OLT) in an asynchronous transfer mode passive optical network (ATM-PON), the ONU comprising: a cell arrival monitor for, if a divided-slot grant in the downstream PLOAM cell from the OLT, calculating information of real-time and non-real-time cells that have arrived during the previous frame before receiving the divided-slot grant; a minislot assembler for making a plurality of minislot formats including each cell information from the respective ONUs calculated at the cell arrival monitor and transmitting them to a frame assembler, and a cell scheduler for, if a data grant in the downstream cell from the OLT is allocated and the grant is of non-real-time traffic, selecting one out of a plurality of non-real-time traffic buffers and transmitting the data cell in the selected buffer to the frame assembler.

[0016] In accordance with yet another aspect of the present invention, there is provided an optical line termination (OLT) for embodying a medium access control protocol with a group of optical network units (ONU) in an asynchronous transfer mode passive optical network (ATM-PON), the OLT comprising: a unit for being transmitted with real-time cell arrival information from the divided-slot received from the group of ONUs, storing it in a corresponding register according to an ONU, and allocating data grant for real-time traffic; a unit for receiving non-real-time cell arrival information from the divided-slot, storing it in a corresponding register according to each ONU, and allocating a data grant for non-real-time traffic; a first grant memory for being allocated with a divided-slot grant and a real-time data grant from the unit for allocating real-time traffic data grant so that the real-time cell corresponding to each segment of the upstream frame through the real-time cell arrival information stored in each register; and a second grant memory for being allocated with a divided-slot grant and a non-real-time data grant from the unit for allocating non-real-time traffic data grant so that the non-real-time cell corresponding to each segment of the upstream frame through the non-real-time cell arrival information stored in each register.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The above and other objects and features of the present invention will become apparent from the following description of the preferred embodiments given in conjunction with the accompanying drawings, in which:

[0018] **FIG. 1** is a block diagram showing a passive optical network (PON) of tree topology in accordance with the present invention;

[0019] **FIG. 2** is a diagram showing a transmit frame of a symmetric PON whose upstream and downstream are 155.52 and 155.52 Mbps respectively in accordance with the PON of **FIG. 1**;

[0020] **FIG. 3** is a diagram showing a transmit frame of an asymmetric PON whose upstream and downstream are 155.52 and 622.08 Mbps respectively in accordance with the PON of **FIG. 1**;

[0021] **FIG. 4** is a diagram illustrating the downstream PLOAM cell payload content of the transmit frame in FIGS. **2** or **3**;

[0022] **FIG. 5** is a diagram depicting the format of a grant field defined in accordance with an embodiment of the present invention;

[0023] **FIG. 6** is a diagram depicting the format of a divided slot defined in accordance with an embodiment of the present invention;

[0024] **FIG. 7** is a block diagram illustrating the function of a medium access controller at an optical line termination (OLT) in an embodiment of the present invention;

[0025] **FIG. 8** is a structural diagram of a grant selector showing real-time traffic in the medium access controller at an OLT in an embodiment of the present invention;

[0026] **FIG. 9** is a structural diagram of a grant selector showing non-real-time traffic of the medium access controller at the OLT in an embodiment of the present invention;

[0027] **FIG. 10** is a block diagram illustrating the function of the medium access controller at an optical network unit (ONU) in an embodiment of the present invention; and

[0028] **FIG. 11** is a diagram showing the operation of the grant selector on the real-time traffic of the medium access controller at an OLT in an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0029] Other objects and aspects of the invention will become apparent from the following description of the embodiments with reference to the accompanying drawings, which is set forth hereinafter.

[0030] **FIG. 1** is a block diagram of a passive optical network (PON) of tree topology in accordance with the present invention. The PON system comprises an OLT **101**

which being situated in the root of the tree topology, plays a pivotal role for providing information to subscribers of an access network, an ONU **103** for connecting a plurality of NTs **104** to the OLT **101**, and an ODN **102** which being situated between the ONU **103** and the OLT **101**, has tree topology,

[**0031**] In the preferred embodiment of the present invention, it is the OLT **101** that implements bandwidth allocation algorithm where a variety of ATM traffics are considered.

[**0032**] To briefly describe the implementation of the protocol embodied in this invention, if a reservation is requested through the upstream frame, grant information which is generated from the cell-unit bandwidth allocation algorithm to secure the QoS of ATM traffic is sent to a corresponding ONU **103** among a plurality of ONUs through the down-stream frame.

[**0033**] Getting grant for that reservation request, the ONU **103** refers to the received grant information and transmits information to the OLT. In the preferred embodiment of the present invention, the one single grant information means that it uses one single slot of the upstream frame in the ONU **103**. The bandwidth for the upstream frame is allocated in priority order to satisfy the QoS considering characteristics of ATM traffic.

[**0034**] Referring to exemplary embodiments, the structure of the upstream/down-stream frame will be described more in detail, hereinafter.

[**0035**] **FIG. 2** is a diagram showing a transmit frame structure of a symmetric PON whose upstream and down-stream are 155.52 and 155.52 Mbps, while **FIG. 3** shows a transmit frame structure of an asymmetric PON whose upstream and downstream are 155.52 and 622.08 Mbps, respectively. As seen in **FIGS. 2 and 3**, the downstream interface structure for both 155.52 Mbps and 62.08 Mbps contains 53 octets of continuous ATM cells or PLOAM cells, and a PLOAM cell is inserted in every 28th time slot. In case of 155.52 Mbps, the downstream frame contains two PLOAM cells in 56 slots and in case of 622.08 Mbps, there are eight PLOAM cells in 224 slots, while the upstream frame contains 53 56-byte time slots. So, we can see that the downstream cell rate of an asymmetric PON is four times as big as that of a symmetric PON.

[**0036**] Capable of transmitting 53 cells in a single upstream frame, the number of grants the OLT should send to the ONU through one downstream frame is 53. The information of 53 grants is carried in the first two PLOAM cells of the downstream frame.

[**0037**] **FIG. 4** is a diagram illustrating the downstream PLOAM cell payload content on a byte basis according to an embodiment of the present invention. The downstream PLOAM cell includes 27 one-byte grant fields. Among the kinds of grants the OLT **101** sends to the ONU **103** are a data grant, PLOAM grant, divided-slot grant, reserved grant, ranging grant, unassigned grant and an idle grant. As the OLT should send 53 grants in one downstream frame, the last grant field of the second PLOAM slot and the grant fields of the following PLOAM cell are all filled up with idle grants.

[**0038**] In accordance with an embodiment of the present invention, the data grant field **510**, PLOAM grant field **520** and divided-slot grant field **530** included in the downstream PLOAM cell are illustrated in **FIG. 5**.

[**0039**] Referring to **FIG. 5**, the data grant field **510** is composed of a one-bit identification field **511**, six-bit ONU address field **512** and one-bit QoS class field **513**.

[**0040**] The one-bit identification field **511** is used to indicate that a certain grant is a data grant, and chooses '0' in the preferred embodiment of the present invention. Also, the six-bit ONU address field **512** is used to show the address of an ONU a grant is allocated to, and up to 64 ONUs largest can be differently indicated according to the preferred embodiment of the present invention. The one-bit QoS class field **513** is used to indicate if a certain data grant is allocated to real-time traffic or non-real-time traffic, and in the preferred embodiment of the present invention, if it's allocated to real-time traffic, the value '0' is given, otherwise being allocated to non-real-time traffic, '1' is given.

[**0041**] The PLOAM grant **520** is composed of a two-bit identification field **521** and a six-bit ONU address field **522**. The two-bit identification field **521** is used to express that a certain grant is a PLOAM grant, and in this preferred embodiment of the present invention, its value is set to be '10.' The six-bit ONU address field **522** is used to express the address of an ONU a grant is allocated to, and in this preferred embodiment of the present invention, up to 64 ONUs largest can be differently indicated.

[**0042**] The divided-slot grant field **530** is composed of a three-bit identification field **531**, four-bit ONU group address field **532** and one-bit spare bit **533**. The three-bit identification field **531** is used to indicate that a grant is a divided-slot grant, and in this preferred embodiment of the present invention, its value is set to be '110.' Also, the six-bit ONU group address field **532** is used to express the address of an ONU group a corresponding grant is allocated to, and in this preferred embodiment of the present invention, up to 16 ONU groups at largest can be differently indicated. Also, according to the preferred embodiment of the present invention, one ONU group consists of four ONUs.

[**0043**] The ONU group that has received a divided-slot grant **530** expresses on the upstream frame divided-slot the information on the number of cells, which have arrived in a corresponding ONU, and transmits it to the OLT. In accordance with the preferred embodiment of the present invention, the divided-slot is composed of a plurality of minislots, each minislot expressed with the information on the number of cells that have arrived at each ONU.

[**0044**] An embodiment of a divided-slot format is illustrated in **FIG. 6**. In the preferred embodiment of the present invention, a single divided-slot includes four minislots, each minislot being formed of 14 bytes, that is, 112 bits. The minislot is composed of a 24-bit overhead field, 70-bit real-time cell arrival number field, 9-bit non-real-time cell arrival number field, one-bit spare field and eight-bit CRC field.

[**0045**] In case of real-time service, to express cell arrival information more precisely, each ONU divides a frame into 14 segments. Then each segment gets to have four time slot resolutions, which expresses the number of real-time traffic cells having arrived during each segment in five bits. Therefore, the 70-bit real-time cell arrival number field shows cell arrival information from all the 14 segments. In case of

non-real-time service, the nine-bit non-real-time cell arrival number field is used to indicate the number of non-real-time cells that have arrived.

[0046] The bandwidth allocation method will be described more in detail, hereinafter, applying such a frame format as above and considering the ATM traffic characteristics.

[0047] The internal structure of an optical network unit (ONU) in accordance with the preferred embodiment of the present invention is illustrated in detail in **FIG. 10**. Referring to **FIG. 10**, each ONU of a group of ONUs where the divided-slot grant **1011** in the downstream PLOAM cell **1004** from the OLT is allocated to includes a cell arrival monitor **1012** for calculating real-time cells and non-real-time cells that have arrived in a corresponding ONU during the previous frame before receiving the divided-slot grant **1011**, and the calculated number of cells is made into a minislot format at a minislot assembler **1013** and transmitted to the OLT through a frame assembler **1006** and an upstream slot **1007**.

[0048] Meanwhile, the internal structure of the OLT in accordance with the preferred embodiment of the present invention is shown in detail in **FIG. 7**. The OLT receives information on the number of cells arrived for a certain frame from all ONUs via the divided-slot **707**, sends the number of real-time arrival cells and the number of non-real-time arrival cells to grant selectors **705**, **706** respectively and stores it in a corresponding register according to each ONU. Each grant selector **705**, **706** allocates a divided-slot grant and data grant to grant memories **710**, **720**. This invention makes the bandwidth of the upstream frame allocated dynamically by endowing priority to grants stored in the grant memories **710**, **720** through the grant priority selector **704** so that the QoS should be satisfied.

[0049] **FIG. 8** is a detailed figure of the real-time grant selector **705** and **FIG. 9**, of the non-real-time grant selector **706**.

[0050] Referring to **FIG. 8**, the real-time grant selector **705** classifies at the selector **801** the number of real-time arrival cells of the ONU transmitted through the divided-slot **707**, stores it in the corresponding register **822** of a segment according to each segment **820**, and the OLT allocates data grants to a divided-slot grant and real-time data grant memory **720** so that real-time cells can be transmitted to each segment of the upstream frame with the help of the real-time cell arrival information stored according to a segment. Here, the allocation procedure in each segment is implemented at the WRR selector **802**, which conducts spacing treatment. The selector **802** adopts a WRR method which has the number of cells as weight, and keeps grants allocated according to each ONU at regular interval in a segment to reduce cell delay variance (CDV). The number of non-real-time cell arrivals is stored in the corresponding register **910** of each ONU.

[0051] Meanwhile, the grants of non-real-time cells of each ONUs are allocated to a non-real-time data grant memory **710** according to the WRR method having the number of cells as weight. The non-real-time data grants are not allocated to real-time cells but to slots left in each segment. **FIG. 9** illustrates a detailed figure of the non-real-time grant selector **706**. As **FIG. 9** has a similar constitute to that of **FIG. 8**, some details have been omitted to present a simple figure.

[0052] Referring to **FIG. 10** again, when an ONU receives a data grant **1021**, if the data grant is of real-time traffic, the ONU transmits a cell in the waiting row **1025** of real-time traffic, otherwise, the ONU selects one from a plurality of non-real-time traffic waiting row **1026** and transmits it to the OLT through the cell scheduler **1024** that has a WRR method.

[0053] Referring to **FIG. 11**, the operation of grant allocation algorithm for real-time traffic will be described hereinafter.

[0054] As seen in **FIG. 11**, in the first place, a divided-slot and real-time data grant memory **707** is divided into 14 memory segments of **4**,**3**, **4**,**3**, **4**,**3**, **4**,**3**, **4**,**3**, **4**,**4**, **5**, **5**,**4** slots, and the divided-slot grants are allocated to empty slots of the memory **707** to D**1**, D**2**, D**3**, D**4**, DS, D**6**, D**7** and D**8**. Then the data grant that has arrived at an ONU during each segment is allocated at as regular intervals as possible. In case there is no empty slot in a corresponding memory segment to allocate data grants that have arrived during each segment, the rest of the grants should be allocated to the empty slots of the next segment continuously.

[0055] For instance, as shown in **FIG. 11**, it is assumed that two cells have arrived at the ONU**1**, a cell at the ONU**7** and a cell at the ONU**15** during a first segment **810**, and during a second segment **820** a cell is to arrive at the ONU**18**, and for the rest segments have cells arrived at each ONU as described in **FIG. 11**. Then, the number of cells that have arrived during the first segment is four, larger than the number of empty slots of the first memory segment of the divided-slot and real-time data grant memory **707**, which is three. So, the data grant for the cells that have arrived during the first segment **810** is allocated to the first slot of the second memory segment. The two cells that have arrived at the ONU**1** during the first segment **810** is allocated into the second and fourth slots of the four slots between the second slot of the memory **707** and its fifth slot so that they are arrayed at regular intervals.

[0056] Using the MAC scheme of the present invention, there are advantages of raising the utility rate of the upstream transmit channel and efficient transmission as well as providing diverse multi-media services. Since a plurality of users can use high-cost optical resources in the form of sharing efficiently, it also brings economical effect.

[0057] While the present invention has been described with respect to certain preferred embodiments, it will be apparent to those skilled in the art that various changes and modifications may be made without departing from the scope of the invention as defined in the following claims.

What is claimed is:

1. A method for transmitting a medium access control (MAC) protocol data between multiple groups of optical network units (ONU) and an optical line termination (OLT) in an asynchronous transfer mode passive optical network (ATM-PON), the method comprising the steps of:

a) at the group of ONUs, transmitting an upstream frame to the OLT, wherein the upstream frame includes divided-slots having a plurality of minislots and each of the minislots has information on the number of real-time cells and non-real-time cells that have arrived at a corresponding ONU of the group of ONUs; and

b) at the OLT, transmitting a downstream frame to the ONU, wherein the downstream frame includes PLOAM cells having a divided-slot grant field, a PLOAM grant field and a data grant field that being allocated with different bits of identifier, which the divided-slot grant field, the PLOAM grant field and the data grant field are distinctive to each other,

wherein a quality of service (QoS) class field for distinguishing the real-time from the non-real-time cell is allocated to the data grant field.

2. The method as recited in claim 1, wherein the divided-slot includes 56 bytes, which is divided into four 14-byte minislots.

3. The method as recited in claim 1, wherein one bit is allocated to the identification field of the data grant field, two bits to the identification field of the PLOAM grant field, and three bits to the identification field of the divided-slot grant field.

4. The method as recited in claim 3, wherein the data grant field includes the one-bit identification field, an ONU address field for indicating an address of the ONU to which a grant is allocated, and the QoS class field.

5. The method as recited in claim 3 , wherein the PLOAM grant field includes the two-bit identification field and an ONU address field for indicating an address of the ONU to which a grant is allocated.

6. The method as recited in claim 3, wherein the divided-slot grant field includes the three-bit identification field, an ONU address field for indicating an address of the group of ONUs to which a grant is allocated, and a spare bit.

7. The method as recited in claim 2, wherein each minislot of the upstream frame includes 24 bits of an overhead field 70 bits of a real-time cell arrival number field which indicates the number of real-time cell arrivals, nine bits of a non-real-time call arrival number field which indicates the number of non-real-time cell arrivals, one bit of a spare field and eight bits of a CRC field.

8. The method as recited in claim 7, wherein the real-time cell arrival number field is divided into 14 5-bit segments, the number of real-time cells arrived for every four slots is transmitted to the OLT, such that cell delay variance (CDV) of the real-time cells can be reduced.

9. A method of medium access control (MAC) for reciprocal data transmission between a plurality of optical network unit (ONU) and an optical line termination (OLT) in an asynchronous transfer mode passive optical network (ATM-PON), the method comprising the steps of:

a) at the ONU, determining a kind of a received grant from the identification bit inside a PLOAM cell of the downstream from the OLT;

b) if the received grant is a divided-slot grant, calculating information on real-time cells and non-real-time cells that have arrived during the previous frame before receiving the divided-slot grant;

c) transmitting the cell information calculated in the step b) to a corresponding slot through a minislot of the divided-slots; and

d) if the received grant is a data grant, transmitting cells in a corresponding buffer to a corresponding slot and thus transmitting a corresponding frame to the OLT.

10. The method as recited in claim 9, further comprising the steps of;

e) if the received grant is a data grant, the ONU analyzing the allocated QoS class field to classify real-time traffics and non-real-time traffics in the data grant field format; and

f) if the grant of the step e) is one allocated to real-time traffic, transmitting the cell in the real-time traffic buffer to a corresponding slot, or if the grant is one allocated to non-real-time traffic, transmitting the non-real-time cell to a corresponding slot.

11. The method as recited in claim 10, wherein the non-real-time cell selection is performed through an algorithm in order of weight.

12. The method as recited in claim 9, wherein if a divided-slot is received from the ONU, the OLT performs the steps of:

a) dividing the number of cell arrivals in each minislot of the divided-slot received above by the number of real-time cells and non-real-time cells when receiving a divided-slot;

b) storing the number of real-time and non-real-time cells in corresponding registers according to each ONU; and

c) allocating the divided-slot grant and real-time/non-real-time data grant so that corresponding real-time cells are transmitted to the upstream frame to be transmitted according to the number of the real-time and non-real-time cells stored in the registers, and the non-real-time data grant being allocated in the slots left after the divided-slot grant allocation of a corresponding group is completed.

13. The method as recited in claim 12, wherein the data grant allocation is conducted through a weight priority algorithm using the number displayed on the register of each ONU as weight.

14. A method of medium access control (MAC) for reciprocal data transmission between a plurality of optical network unit (ONU) and an optical line termination (OLT) in an asynchronous transfer mode passive optical network (ATM-PON), the method comprising the steps of:

a) at the OLT, dividing 53 slots to be transmitted for a frame into groups as much as a number of segments;

b) allocating data grant on real-time traffic to the remaining slots left after allocation of divided-slot grants to a corresponding group is completed; and

c) if there is no slot to be allocated to the data grant in a corresponding group, the grants being allocated in the empty slots of the next group.

15. The method as recited in claim 14, wherein the OLT allocates data grant on non-real-time traffic into the slots left after the allocation of divided-slot grant and data grant on real-time traffics are completed.

16. The method as recited in claim 14, wherein the allocation to the above slots employs a weight priority algorithm having the number displayed on the register of each ONU as weight.

17. A computer-readable recording medium recording instructions for executing a method of medium access control (MAC) protocol between an optical line termination (OLT) and a plurality of optical network units (ONU) in an

asynchronous transfer mode passive optical network (ATM-PON), the method comprising the steps of:

a) determining the kind of a received grant from an identification bit in the downtown frame PLOAM cell from the OLT;

b) if the received grant is a divided-slot grant, calculating information of the real-time/non-real-time cells that have arrived during the previous frame before receiving the divided-slot grant;

c) transmitting the cell information calculated in the step b) to a corresponding slot through a minislot of the divided-slots; and

d) if the received grant is a data grant, transmitting a cell in a corresponding buffer to a corresponding slot.

18. A computer-readable recording medium recording instructions for executing a method of a medium access control protocol between an optical line termination (OLT) and a plurality of optical network units (ONU) in an asynchronous transfer mode passive optical network (ATM-PON), the method comprising the steps of:

a) at the OLT, dividing 53 slots to be transmitted for a frame into groups as much as a number of segments;

b) allocating data grant on real-time traffic to the remaining slots left after allocation of divided-slot grants to a corresponding group is completed; and

c) if there is no slot to be allocated to the data grant in a corresponding group, the grants being allocated in the empty slots of the next group.

19. An optical network unit (ONU) for realizing a medium access control (MAC) protocol with an optical line termination (OLT) in an asynchronous transfer mode passive optical network (ATM-PON), the ONU comprising:

a cell arrival monitor for, if a divided-slot grant in the downstream PLOAM cell from the OLT, calculating information of real-time and non-real-time cells that have arrived during the previous frame before receiving the divided-slot grant;

a minislot assembler for making a plurality of minislot formats including each cell information from the respective ONUs calculated at the cell arrival monitor and transmitting them to a frame assembler; and

a cell scheduler for, if a data grant in the downstream cell from the OLT is allocated and the grant is of non-real-time traffic, selecting one out of a plurality of non-real-time traffic waiting rows and transmitting it to the frame assembler.

20. The optical network unit (ONU) as recited in claim 19, wherein in case a data grant in the downstream cell from the OLT is allocated and the grant is of real-time traffic, the cell of real-time traffic waiting rows is transmitted to the OLT through the frame assembler.

21. The optical network unit (ONU) as recited in claim 19, wherein the cell scheduler selects a non-real-time cell through a weight priority algorithm.

22. An optical line termination (OLT) for embodying a medium access control protocol with a group of optical network units (ONU) in an asynchronous transfer mode passive optical network (ATM-PON), the OLT comprising:

means for receiving real-time cell arrival information from the divided-slot from the group of ONUs, storing it in a corresponding register according to an ONU, and allocating data grant for real-time traffic;

means for receiving non-real-time cell arrival information from the divided-slot, storing it in a corresponding register according to each ONU, and allocating a data grant for non-real-time traffic;

a first grant memory for being allocated with a divided-slot grant and a real-time data grant from the means for allocating real-time traffic data grant so that the real-time cell corresponding to each segment of the upstream frame through the real-time cell arrival information stored in each register; and

a second grant memory for being allocated with a divided-slot grant and a non-real-time data grant from the means for allocating non-real-time traffic data grant so that the non-real-time cell corresponding to each segment of the upstream frame through the non-real-time cell arrival information stored in each register.

23. The optical line termination (OLT) as recited in claim 22, further including a grant priority selection means for giving priority to the frame allocated to the first and the second grant memories.

24. The optical line termination (OLT) as recited in claim 22, wherein the data grant allocation to the first grant memory is performed by a selector that allocates grants to each segment according to each ONU of the first grant memory through a weight priority algorithm using the number of cells as weight.

25. The optical line termination (OLT) as recited in claim 22, wherein the data grant allocation to the second grant memory is conducted by a selector that allocates grants to the remaining slot of each segment, which real-time cell are not allocated to, according to each ONU of the second grant memory through a weight priority algorithm using the number of cells as weight.

* * * * *

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First Named Inventor/Applicant Name:	Dezhi ZHANG
Customer Number:	95957
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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Oath or Declaration filed	Joint_Declaration_and_POA.pdf	88772 418de58e2696412b5defc3548bbc6dd74cc024b1	no	3

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	Specification		2	35	
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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.

Docket No.: AFD111101442-US

JOINT DECLARATION FOR PATENT APPLICATION (37 CFR 1.63) AND POWER OF ATTORNEY

As the below named inventors, we hereby declare that:

Our residence, mailing address and citizenship are as stated below next to our names;

We believe we are the original, first and joint inventors of the subject matter which is claimed and for which a patent is sought on the invention entitled "Method and Passive Optical Network System for Managing Uplink Burst Overhead Parameters", the specification of which

☐ is attached hereto.
☒ was filed on 9/20/2011 as Application Serial Number 13/257,621 and was amended on ___ (if applicable)..
☐ was filed under the Patent Cooperation Treaty (PCT) and accorded International Application No. _____, filed _____, and amended on _____ (if any).

We hereby state that we have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

We hereby acknowledge the duty to disclose information which is material to patentability in accordance with Title 37, Code of Federal Regulations, §1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

Prior Foreign Application(s)

We hereby claim foreign priority benefits under Title 35, United States Code, §119(a)-(d) or (f), or 365(b) of any foreign application(s) for patent or inventor's or plant breeder's rights certificate(s) or 365(a) of any PCT international application which designated at least country other than the United States of America, listed below and have also identified below any foreign application(s) for patent, inventor's or plant breeder's rights certificate(s), or any PCT international application having a filing date before that of the application on which priority is claimed:

Country	Application No.	Date of Filing	Date of Issue	Priority Claimed Under 35 U.S.C. §119
China	200910212093.3	2009-11-04	N/A	Yes
PCT	PCT/CN2010/073773	2010-06-10	N/A	Yes

Prior United States Provisional Application(s)

We hereby claim priority benefits under Title 35, United States Code, §119(e)(1) of any U.S. provisional application listed below:

U.S. Provisional Application No.	Date of Filing (day month year)	Priority Claimed Under 35 U.S.C. §119(e)(1)

Prior United States Application(s)

We hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, we acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

Docket No.: AFD111101442-US

Application Serial No.	Date of Filing (Day, Month, Year)	Status — Patented, Pending, Abandoned

Power of Attorney

And we hereby appoint, both jointly and severally, as our attorneys or agents with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith the practitioners at:

Customer Number: 95957

Please address all correspondence and telephone communications to the address and telephone number for this Customer Number.

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

Signature Zhang De Zhi Date 2011. 11. 16

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Docket No.: AFD111101442-US

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ABSTRACT

A method for managing upstream burst overhead parameters includes: an Optical Line Terminal (OLT) or an Optical Network Unit (ONU) detects transmission quality of a downlink between the OLT and the ONU; the OLT or the ONU determines the upstream burst overhead parameters suitable for the ONU according to the transmission quality; and the ONU starts to use the upstream burst overhead parameters suitable for the ONU after the switching time determined by the ONU itself or indicated by the OLT. The present invention also provides an ONU and an OLT for managing the upstream burst overhead parameters. The present invention can improve the bandwidth utilization rate and decrease the complexity of indicating the upstream burst overhead parameters in PON system, so that the ONU and the OLT are enabled to flexibly and simply select the upstream burst overhead parameters.

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Method and Passive Optical Network System for Managing Uplink Burst Overhead Parameters

Technical Field

The present invention relates to the field of optical communication technology, and more particularly, to a method for assigning and managing upstream burst overhead parameters used between an optical line terminal (OLT) and an Optical Network Unit (ONU) in a passive optical network (PON) system and the passive optical network system.

Background of the Related Art

In the PON technology, it needs consistent upstream burst overhead parameters (i.e., parameters of upstream burst overhead) in the OLT and the ONU: the ONU sends upstream frames according to the determined upstream burst overhead parameters; the OLT correctly receives the upstream frames also according to the determined upstream burst overhead parameters. Based on this premise, the PON can work properly. Generally, the upstream burst overhead parameters include:

(1) State (on or off) of Forward Error Correction (FEC);

(2) Delimiter, which has a variable length and can be suitable to different optical fiber link quality;

(3) Preamble, which typically is a constant, but also may be several constants for selecting, and relates to different optical fiber link quality and performance of the optical module; and

(4) Guard band (Guard time), which is the number of bits of the guard band, and generally has a constant length.

In the existing ITU G.984.3 GPON technology standard, these upstream burst overhead parameters are determined between the OLT and the ONU according to the following method: in a register process which starts up periodically, the OLT broadcasts a part of the upstream burst overhead parameters required by the OLT, including the parameters (2), (3) and (4) in the above-mentioned upstream burst overhead parameters, to all ONUs which communicate with the OLT. As shown in FIG. 1, after the ONU acquires downstream physical layer

synchronization and enters into a waiting state (i.e., O2 state), it continuously monitors a message carrying the part of the upstream burst overhead parameters broadcasted by the OLT in the downlink; once the message is received successfully, the ONU records the carried upstream burst overhead parameters, and then transfers to a serial number state (i.e., O3 state); and the ONU uses these received upstream burst overhead parameters in the subsequent working process without modification.

In addition, in the existing Gigabit Passive Optical Network (GPON) standards, state notification mechanism of the parameter (1) FEC in the upstream burst overhead parameters is independent from communication mechanism of the above-mentioned parameters (2), (3) and (4). The on/off notification of the parameter (1) FEC is indicated in real time by a fixed indication bit in a tag field assigned for each upstream burst bandwidth of each ONU in a bandwidth assignment field of the downstream frame.

Content of the Invention

The actual implementation in the prior art has two problems:

Complexity problem: indications of the upstream burst overhead parameters in the GPON system are performed separately, thus it has high complexity.

Efficiency problem: Once the ONU in the GPON system determines the upstream burst overhead parameters such as preamble and delimiter, these parameters are not updated any more; after the quality of some links is improved, and at the time relatively short preamble is allowed to be used for upstream communication, there is no corresponding mechanism provided for negotiation, and the original upstream burst overhead parameters are forced to be used for upstream communication, which is not flexible and cannot improve bandwidth efficiency along with quality improvement of the link.

The present invention provides a method for managing upstream burst overhead parameters between optical access nodes to improve the bandwidth utilization.

In order to solve the above problem, the present invention provides a method for managing the upstream burst overhead parameters, comprising:

an optical line terminal (OLT) or an optical network unit (ONU) detecting transmission quality of a downlink between the OLT and the ONU;

The OLT or the ONU determining upstream burst overhead parameters suitable for the ONU according to the transmission quality; and

The ONU starting to use the upstream burst overhead parameters suitable for the ONU after the switching time determined by the ONU itself or indicated by the OLT.

Before the step of the OLT or the ONU detecting the transmission quality of the downlink between the OLT and the ONU, the method further comprises:

the OLT determining and identifying N kinds of upstream burst overhead parameter sets according to different levels of link quality; wherein, N is an integer and is larger than zero; and

the OLT sending a parameter value or an identification of one default upstream burst overhead parameter set to the ONU, and the ONU receiving the parameter value or the identification of the upstream burst overhead parameter set in a waiting state and using the upstream burst overhead parameter set; or,

the OLT sending parameter values or identifications of more than one upstream burst overhead parameter set to the ONU, and the ONU receiving the parameter values or the identifications of the more than one upstream burst overhead parameter set in a waiting state and using one of the more than one upstream burst overhead parameter set.

After the step of the ONU receiving the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s), the method further comprises: the ONU entering into a serial number state;

the step of the ONU detecting the transmission quality of the downlink between the OLT and the ONU comprises: in the serial number state of the ONU, the OLT detecting the downlink between the ONU and the OLT to acquire the quality information of the downlink;

the step of the OLT determining the upstream burst overhead parameters suitable for the ONU according to the transmission quality comprises: the OLT determining the upstream burst overhead parameter set(s) suitable for the ONU according to the quality information of the downlink, and notifying the parameter value(s) or the identification(s) of the upstream burst

overhead parameter set(s) suitable for the ONU to the ONU via a unicast message or a broadcast message.

After the step of the ONU receiving the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s), the method further comprises: the ONU entering into a serial number state;

the step of the ONU detecting the transmission quality of the downlink between the OLT and the ONU comprises: in the serial number state of the ONU, the ONU detects the downlink between the ONU and the OLT to acquire the quality information of the downlink;

after the step of acquiring the quality information of the downlink, the method further comprises: the ONU notifying the quality information of the downlink to the OLT;

the step of the OLT determining the upstream burst overhead parameters suitable for the ONU according to the transmission quality comprises: the OLT determining the upstream burst overhead parameter set(s) suitable for the ONU according to the quality information of the downlink, and notifying the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) suitable for the ONU to the ONU via a unicast message or a broadcast message.

After the step of the ONU receiving the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s), the method further comprises: the ONU entering into a serial number state;

the step of the ONU detecting the transmission quality of the downlink between the OLT and the ONU comprises: in the serial number state of the ONU, the ONU detecting the downlink between the ONU and the OLT to acquire the quality information of the downlink;

the step of the ONU determining the upstream burst overhead parameters suitable for the ONU according to the transmission quality comprises: the ONU determining the upstream burst overhead parameter set(s) suitable for the ONU according to the quality information of the downlink, and notifying the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) suitable for the ONU to the OLT via a unicast message or a broadcast message.

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While or after the OLT notifies the ONU the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s), or while or after the ONU notifies the OLT the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s), the method further comprises: the OLT setting a switching index value of the upstream burst overhead parameters in the tag field assigned for the bandwidth of the ONU and sending it to the ONU via a downstream frame; the step of the ONU starting to use the upstream burst overhead parameters after the switching time indicated by the OLT comprises: after the ONU receives the switching index value, it using the upstream burst overhead parameters suitable for the ONU in the next frame; or

while or after the OLT notifies the ONU the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s), or while or after the ONU notifies the OLT the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s), the method further comprises: the OLT notifying the ONU a hyper frame number; the step of the ONU starting to use the upstream burst overhead parameters after the switching time indicated by the OLT comprises: after the ONU receives the hyper frame number, it starting to use the upstream burst overhead parameters suitable for the ONU after the frame indicated by the hyper frame number arrives; or

while or after the OLT notifies the ONU the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s), or while or after the ONU notifies the OLT the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set, the method further comprises: the ONU notifying the ONU a hyper frame number; the step of the ONU starting to use the upstream burst overhead parameters after the switching time determined by the ONU itself comprises: after the frame indicated by the hyper frame number arrives, the ONU starting to use the upstream burst overhead parameters suitable for the ONU.

The upstream burst overhead parameter set comprises: state of forward error correction, delimiter, preamble, and guard band.

In the step of the OLT sending the parameter values or the identifications of more than one upstream burst overhead parameter set to the ONU, the OLT sends the parameter values or

identifications of one or more upstream burst overhead parameter sets to all ONUs or one or more ONUs which communicate with the OLT.

In order to solve the above technical problem, the present invention also provides a PON system for managing the upstream burst overhead parameters, comprising an OLT or an ONU. The OLT is used to detect the transmission quality of the downlink between the OLT and the ONU, determine the upstream burst overhead parameters suitable for the ONU according to the transmission quality and notify the parameters to the ONU; and the OLT is further used to indicate the switching time to the ONU. The ONU is used to detect the transmission quality of the downlink between the OLT and the ONU and determine the upstream burst overhead parameters suitable for the ONU according to the transmission quality; or, the ONU directly receives from the OLT the transmission quality of the downlink determined by the OLT; and the ONU is further used to start to use the upstream burst overhead parameters after the switching time determined by the ONU itself or indicated by the OLT.

In order to solve the above problem, the present invention also provides an ONU for managing the upstream burst overhead parameters, and the ONU comprises a first parameter acquisition module and a switching module; wherein:

the first parameter acquisition module is configured to:

detect transmission quality of a downlink between the OLT and the ONU or receive the transmission quality of the downlink detected and sent by the OLT, determine upstream burst overhead parameters suitable for the ONU according to the transmission quality, and send the upstream burst overhead parameters suitable for the ONU to the OLT; or,

detect transmission quality of a downlink between an OLT and the ONU, send the transmission quality to the OLT, and receive from the OLT the upstream burst overhead parameters suitable for the ONU determined according to the transmission quality; or,

directly receive from the OLT the upstream burst overhead parameters suitable for the ONU determined by the OLT; and,

while or after notifying the OLT the upstream burst overhead parameters suitable

for the ONU, or while or after receiving the upstream burst overhead parameters suitable for the ONU sent by the OLT, indicate the switching module;

the switching module is configured to:

while or after receiving an indication from the first parameter acquisition module, determine a switching event or receive switching time indicated by the OLT, and start to use the upstream burst overhead parameters suitable for the ONU after the switching time determined by the ONU itself or indicated by the OLT.

The ONU also comprises a burst overhead parameter set receiving module.

The burst overhead parameter set receiving module is configured to: receive, in a waiting state, a parameter value or an identification of one default upstream burst overhead parameter set sent by the OLT to the ONU after the OLT determines and identifies N kinds of upstream burst overhead parameter sets according to different levels of link quality, and use this upstream burst overhead parameter set; or,

receive, in a waiting state, parameter values or identifications of more than one upstream burst overhead parameter set sent by the OLT to the ONU after the OLT determines and identifies N kinds of upstream burst overhead parameter sets according to different levels of link quality, and use one of the upstream burst overhead parameter sets;

Wherein, N is an integer and is larger than zero.

the switching module is further configured to: while or after receiving the indication from the first parameter acquisition module, receive a switching index value of the upstream burst overhead parameters which is sent from the OLT to the ONU via a downstream frame and are set in a tag field assigned for a bandwidth of the ONU by the optical line terminal; and, the switching module is configured to start to use the upstream burst overhead parameters after the switching time indicated by the OLT according to the following manner: after receiving the switching index value, using the upstream burst overhead parameters in a next frame; or

the switching module is further configured to: while or after receiving the indication from the first parameter acquisition module, receive a hyper frame number notified by the OLT to the

ONU; and, the switching module is configured to start to use the upstream burst overhead parameters after the switching time indicated by the OLT according to the following manner: after a frame indicated by the hyper frame number arrives, starting to use the upstream burst overhead parameters; or

the switching module is further configured to: while or after receiving the indication from the first parameter acquisition module, notify a hyper frame number to the ONU; and, the ONU is configured to start to use the upstream burst overhead parameters after the switching time determined by the ONU itself according to the following method: after a frame indicated by the hyper frame number arrives, start to use the upstream burst overhead parameters.

In order to solve the above-mentioned method, the present invention also provides an optical line terminal (OLT) for managing the upstream burst overhead parameters, and the OLT comprises: a second parameter acquisition module and a switching time transceiving module, wherein:

The second parameter acquisition module is configured to:

detect transmission quality of a downlink between the OLT and an ONU, send the transmission quality to the ONU, and receive upstream burst overhead parameters suitable for the ONU determined by the ONU according to the transmission quality sent by the OLT; or,

detect transmission quality of a downlink between the OLT and an ONU, determine upstream burst overhead parameters suitable for the ONU according to the transmission quality, and notify the determined upstream burst overhead parameters suitable for the ONU to the ONU; or,

receive transmission quality of a downlink detected and sent by an ONU, determine the upstream burst overhead parameters suitable for the ONU according to the transmission quality, and notify the determined upstream burst overhead parameters suitable for the ONU to the ONU; or,

receive upstream burst overhead parameters suitable for an ONU which are sent and determined by the ONU according to transmission quality of a downlink detected and acquired by the ONU itself; and

while or after notifying the determined upstream burst overhead parameters suitable for the ONU to the ONU, or while or after receiving the upstream burst overhead parameters suitable for the ONU sent by the ONU, indicate switching time transceiving module;

The switching time transceiving module is configured to:

while or after receiving an indication from the second parameter acquisition module, indicate the switching time to the ONU or receive the switching time sent by the ONU, so that the ONU start to use the upstream burst overhead parameters after the switching time.

A upstream burst overhead parameter set acquisition module, configured to: determine and identify N kinds of upstream burst overhead parameter sets according to different levels of link quality; wherein, N is an integer and is larger than zero; and send a parameter value or an identification of one default upstream burst overhead parameter set to the ONU, or, send the parameter values or the identifications of more than one upstream burst overhead parameter set to the ONU,

so that the ONU can receive the parameter value or the identification of one upstream burst overhead parameter set in a waiting state and use this upstream burst overhead parameter set; or, the ONU can receive the parameter values or the identifications of more than one upstream burst overhead parameter set in a waiting state and use one of them.

The switching time transceiving module is configured to indicate the switching time to the ONU according to the following manner: setting a switching index value of the upstream burst overhead parameters in a tag field assigned for a bandwidth of the ONU, and sending the switching index value to the ONU via a downstream frame, so that after the ONU receives the switching index value, the ONU uses the upstream burst overhead parameters in a next frame; or,

the switching time transceiving module is configured to indicate the switching time to the ONU according to the following manner: notifying a hyper frame number to the ONU, so that the ONU starts to use the upstream burst overhead parameters after a frame indicated by the hyper frame number arrives; or,

the switching time transceiving module is configured to receive the switching time sent by the ONU according to the following method: receiving a hyper frame number notified by the ONT, so that the ONU starts to use the upstream burst overhead parameters after a frame indicated by the hyper frame number arrives.

The present invention is able to improve the bandwidth utilization and decrease the complexity of indicating the upstream burst overhead parameters in the PON system, thereby the ONU and the OLT can flexibly and simply select the upstream burst overhead parameters.

Brief Description of Drawings

FIG. 1 is a schematic diagram of an OLT periodically broadcasting upstream burst overhead parameters in a GPON system in the prior art;

FIG. 2 is a schematic diagram of a method for managing upstream burst overhead parameters between optical access nodes in accordance with an embodiment of the present invention;

FIG. 3 is a schematic diagram of a method for managing upstream burst overhead parameters in accordance with the first embodiment;

FIG. 4 is a schematic diagram of a method for managing upstream burst overhead parameters in accordance with the second embodiment;

FIG. 5 is a schematic diagram of a method for managing upstream burst overhead parameters in accordance with the third embodiment;

FIG. 6 is a schematic diagram of a method for managing upstream burst overhead parameters in accordance with the fourth embodiment;

FIG. 7 is a schematic diagram of a method for managing upstream burst overhead parameters in accordance with the fifth embodiment;

FIG. 8 is a schematic diagram of a method for managing upstream burst overhead parameters in accordance with the sixth embodiment; and

FIG. 9 is a schematic diagram of a method for managing upstream burst overhead parameters in accordance with the seventh embodiment.

Preferred Embodiments of the Present Invention

As shown in FIG. 2, a method for managing upstream burst overhead parameters between optical access nodes includes the following steps:

Step 201, an OLT or an ONU detects transmission quality of a downlink between the OLT and the ONU when the ONU is at a serial number state (i.e., O3 state);

Step 202, the OLT or the ONU determines upstream burst overhead parameters suitable for using by the ONU according to the transmission quality; and

Step 203, the ONU starts to use the upstream burst overhead parameters after switching time is indicated by the OLT or determined by the ONU itself.

The method of the present invention will be described in detail in the following.

In the method of the present invention, when the ONU is at an initial state (i.e., O1 state), the OLT determines and identifies N kinds of upstream burst overhead parameter sets according to different levels of the link quality, wherein N is an integer and is larger than zero. Each upstream burst overhead parameter set includes the following parameters: state of forward error correction, delimiter, preamble and guard band.

The OLT sends a parameter value or an identification of one default upstream burst overhead parameter set to the ONU, and the ONU receives the parameter value or the identification of the upstream burst overhead parameter set in a waiting state (i.e., O2 state) and uses that upstream burst overhead parameter set; or, the OLT sends parameter values or identifications of more than one upstream burst overhead parameter set to the ONU, and after the ONU receives the parameter values or the identifications of more than one upstream burst overhead parameter set in the O2 state, it uses one of the upstream burst overhead parameter sets. When there is a plurality of the upstream burst overhead parameter sets, one of them can be set as a default set. After the ONU receives parameters of more than one upstream burst overhead parameter set, it can select the default set or any one from the more than one upstream burst overhead parameter set to use.

The OLT can unicast the upstream burst overhead parameter set to a specific ONU or

broadcast to all ONUs.

In steps 201 and 202, in the case that the OLT detects the downlink between the OLT and the ONU, the OLT acquires the quality information of that downlink by detecting the downlink, determines the upstream burst overhead parameter set used by the ONU according to the quality information of that downlink, and notifies the parameter value in the upstream burst overhead parameter set or the identification of the upstream burst overhead parameter set to the ONU via a unicast message or a broadcast message;

Or, in steps 201 and 202, in the case that the ONU detects the downlink between the OLT and the ONU, the ONU acquires the quality information of that downlink by detecting the downlink, and notifies the quality information of the downlink to the OLT; the OLT determines the upstream burst overhead parameter set used by the ONU according to the quality information of the downlink, and notifies the parameter value in the upstream burst overhead parameter set or the identification of the upstream burst overhead parameter set to the ONU via a unicast message or a broadcast message;

Or, in steps 201 and 202, in the case that the ONU detects the downlink between the OLT and the ONU, the upstream burst overhead parameter set used by the ONU also can be determined by the ONU itself. The ONU acquires the quality information of that downlink by detecting the downlink, determines the upstream burst overhead parameter set used by the ONU according to the quality information of the downlink, and notifies the parameter value in the upstream burst overhead parameter set or the identification of the upstream burst overhead parameter set to the OLT via a unicast message or a broadcast message.

In step 203, the OLT can notify the ONU to switch by a switching index value. Specifically, while or after the OLT notifies the determined upstream burst overhead parameter set to the ONU, the OLT sets the switching index value of the upstream burst overhead parameters in the tag field assigned for the bandwidth of the ONU and sends to the ONU via a downstream frame. After the ONU receives the switching index value, it uses the upstream burst overhead parameters in the next frame;

Or, in step 203, the OLT also can notify the ONU to switch by indicating a hyper frame number. Specifically, while or after the OLT notifies the determined upstream burst overhead

parameter set to the ONU, the OLT notifies the hyper frame number to the ONU, and after the ONU receives the hyper frame number, it starts to use the upstream burst overhead parameters after a hyper frame indicated by the hyper frame number arrives;

In step 203, the ONU can also determine the hyper frame number and notify it to the OLT. While or after the ONU notifies the determined upstream burst overhead parameter set to the OLT, the ONU notifies the hyper frame number to the OLT, and the ONU starts to use the upstream burst overhead parameters after the hyper frame indicated by the hyper frame number arrives.

The method of the present invention will be described below with embodiments. In the following embodiments, suppose the OLT determines three kinds of upstream burst overhead parameter sets according to the link quality, wherein, set 1 includes the general upstream burst overhead parameters which are parameters used in default and also correspond to parameters required by the typical link quality, and the index value is set as 0b00; set 2 includes the enhanced upstream burst overhead parameters which correspond to parameters used in situations that the link quality is worse than the typical link quality, and the index value is set as 0b01; and set 3 includes the weakened upstream burst overhead parameters which correspond to parameters used in situations that the link quality is better than the typical link quality, and the index value is set as 0b10. Only three kinds of sets are illustrated herein, however, more than thee corresponding parameter levels can be defined according to the practical condition of the link quality, so as to set various one–to-one correspondence upstream burst overhead parameter sets. Configuration of parameter sets in the subsequent embodiments can use the same method.

The first embodiment

In the first embodiment, the OLT broadcasts the default upstream burst overhead parameter set to the ONU, and after the ONU enters into the O3 state, it detects the quality of the downlink between the ONU and the OLT, and notifies the detected link quality signal to the OLT; the OLT determines the upstream burst overhead parameter set suitable for using by the ONU according to that quality signal, notifies the upstream burst overhead parameter set to the ONU via a unicast message, and also indicates for switching in the tag field assigned for the

bandwidth of the ONU; and after the ONU receives the above message, it uses the parameters in that received upstream burst overhead parameter set in the subsequent upstream frame.

As shown in FIG. 3, the first embodiment specifically includes the following steps.

Step 1001, the OLT determines each upstream burst overhead parameter set.

Step 1002, the OLT broadcasts an Upstream_overhead message carrying the parameters in the general upstream burst overhead parameter set (i.e., set 1) in a downstream direction.

The Upstream_overhead message may carry the parameters or the identification of that set 1.

That message can be sent once or time after time, which is not limited in the present invention.

Step 1003, the ONU is powered up, receives the Upstream_overhead message sent by the OLT in the O2 state, and transfers to the O3 state after successfully acquiring the carried upstream burst overhead parameters.

Step 1004, from the O3 state, the ONU starts to analyze the transmission quality of the downlink, acquiring result by using a currently general bit interleaved parity (BIP) detection method or a frequently used FEC result and the number of correction bits. In the present invention, the ONU may use other similar detection methods to acquire the transmission quality information of the downlink. Suppose that the result of the quality of the link detected by the ONU is good.

Step 1005, the ONU carries the result of quality detection (or evaluation) for the downlink by the ONU in the subsequent upstream frame (here the upstream frame uses the general upstream burst overhead parameters received in the step 1003) and reports the result to the OLT.

For example, when the ONU responds the serial number request bandwidth assignment (SN_Request) sent by the OLT in the O3 state, the link quality information – “good” acquired in step 1004 is carried in the upstream message “Serial_Number_ONU”, as shown in Table 1.

Table 1

Serial_Number_ONU

ONU serial number information		
Octet	Content	Description
1	11111111 ONU-ID	=11111111: ONU-ID is not assigned, broadcast message ONU-ID is assigned, filled with value of ONU-ID, unicast message
2	00000001	Message type: "ONU serial number information"
3-6	VID1-VID4	Equipment provider identification: bit1- bit4
7-10	VID2	Serial number information bit1- bit4 defined by equipment provider
11	RRRRRRRR	High 8 bits of random experiment
12	RRRRAATT	RRRR = low 4 bits of random experiment AA: link quality measurement result notified to OLT by ONU, where it is set as "01" corresponding to "good" (00 - OLT neglects 01 - link quality is good 10 - link quality is OK 11 - link quality is poor) TT = ONU transmission power TT = 00 – Low Power TT = 01 – Medium Power TT = 10 – High Power TT = 11 – Reserved
13-20	Reserve	Reserved

Using the Serial_number_ONU message to carry that information is only an example. Idle bits in other upstream frame message can also be used to be endowed with the similar definition of the "AA" in the above table for notifying the OLT the link detection result, or a specifically defined message is used to transmit that detection result.

Step 1006, after the OLT receives that upstream frame, it records the link quality information corresponding to the ONU and determines the upstream burst overhead parameter set (e.g., set 3 in this embodiment) suitable for using by the ONU.

Step 1007, after the ONU is assigned with the ONU_ID, the OLT sends the parameter set to be used by the ONU and the corresponding index value to the ONU via a unicast Upstream_overhead message, as shown in Table 2:

Table 2

Upstream_Overhead message upstream burst overhead parameters		
Octet	Content	Description
1	ONU-ID	ONU identification
2	00000001	Message identification “upstream burst overhead parameters”
3	000000ss	ss is the index value of the parameter set included in the message 00: parameter set 1 01: parameter set 2 10: parameter set 3 11: Reserved
4	Gggggggg	The number of guard band bits
5	Xxxxxxxx	The number of preamble bits
6-8	Bbbbbbbb bbbbbbbb Bbbbbbbb	Delimiter bit1- bit3
9-10	Xxxxxxxx xxxxxxxx Xxxxxxxx	xx = reserved:
11-12	Ddddddddd Ddddddddd	Pre-assigned delay parameters
13-20	Reserve	Reserved

Step 1008, after the ONU receives the unicast Upstream_overhead message sent by the OLT, the ONU records the physical layer parameters and the index value 0b10 of the set 3 carried by the message.

Step 1009, the OLT sets a switching index value of the upstream burst overhead parameters in the tag field assigned for the bandwidth of the ONU and sends the switching index value to the ONU via the downstream frame.

Step 1010, once the ONU receives the switching indication from step 1009, it immediately performs switching of the upstream burst overhead parameters in the next frame according to the indicated index value, and then uses the switched upstream burst overhead parameters in the subsequent upstream transmission.

The second embodiment

In the second embodiment, the OLT broadcasts the default upstream burst overhead parameter set to the ONU; and after the ONU enters into the O3 state, the OLT detects the quality of the downlink between the ONU and the OLT, determines the upstream burst overhead parameter set suitable for using by the ONU according to that quality signal, and notifies it to the ONU via the unicast message; the OLT also indicates to switch in the tag field assigned for the bandwidth of the ONU; and after the ONU receives the message, it uses the parameters in the received upstream burst overhead parameter set in the subsequent upstream frames.

As shown in FIG. 4, the second embodiment specifically includes the following steps.

Step 2001, the OLT determines each upstream burst overhead parameter set.

Step 2002, the OLT broadcasts the Upstream_overhead message carrying the parameters in the general upstream burst overhead parameter set (i.e., set 1) in a downstream direction.

The Upstream_overhead message can carry the parameters or the identification of that set 1. That message can be sent once or time after time, which is not limited in the present invention.

Step 2003, the ONU is powered up, receives the Upstream_overhead message sent by the OLT in the O2 state, and after the ONU successfully acquires the upstream physical layer burst overhead parameters carried by the message, it transfers to the O3 state. The ONU performs normally data communication with the OLT in accordance with the specification constituted by standard (in the prior art).

Step 2004, the OLT starts to detect a link corresponding to a certain ONU to acquire its link quality information, and the detection result is “poor”, which corresponds to the upstream burst overhead parameter set 2.

In this step, the conditions of starting to detect can be various, and the conditions can be: increasing of upstream frame error codes, losing of the upstream frames or detecting required actively by an operator. The detection method by the OLT can adopt the currently general BIP or the frequently used FEC, or any other similar detection method that can acquire the related

information.

Step 2005, the OLT transmits the upstream burst overhead parameter set 2 to be used by the ONU to the ONU via the unicast Upstream_overhead message, as shown in Table 3:

Table 3

Upstream_Overhead message upstream burst overhead parameters		
Octet	Content	Description
1	ONU-ID	ONU identification
2	00000001	Message identification “upstream burst overhead parameters”
3	gggggggg	The number of guard band bits
4	xxxxxxxx	The number of preamble bits
5-7	bbbbbbbb bbbbbbbb bbbbbbbb	Delimiter bit1- bit3
8-10	xxxxxxxx xxxxxxxx xxxxxxxx	xx = reserved:
11-12	dddddddd dddddddd	Pre-assigned delay parameters
13-20	Reserve	Reserved

Step 2006, after the ONU receives the unicast Upstream_overhead message sent by the OLT, the ONU records the physical layer parameters carried by the message, so that the physical layer parameters are to be used in the subsequent switching.

The subsequent switching indication and operation can be the same as those in the first embodiment.

The third embodiment

The difference between the third embodiment and the second embodiment is that the OLT broadcasts all parameter sets to the ONU in advance in the third embodiment.

As shown in FIG. 5, the third embodiment specifically includes the following steps.

Step 3001, it is the same as step 2001;

Step 3002, the OLT broadcasts the Upstream_overhead message carrying all the upstream burst overhead parameters (i.e., sets 1, 2 and 3 are sent in one message) in a downstream direction. As shown in Table 4, that message can be sent once or time after time, which is not limited in the present invention.

Table 4

Upstream_Overhead message upstream burst overhead parameters		
Octet	Content	Description
1	11111111	broadcast message type
2	00000001	Message identification: “upstream burst overhead parameters”
3-7	gggggggg gggggggg gggggggg gggggggg gggggggg	Upstream burst overhead parameters -- set 1, which is also the default parameter set
8-12	xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx	Upstream burst overhead parameters -- set 2, which is to be used corresponding to the link having poor transmission quality
13-17	bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb	Upstream burst overhead parameters -- set 3, which is to be used corresponding to the link having good transmission quality
18-19	dddddddd dddddddd	Pre-assigned delay parameters
20	Reserve	Reserved

Step 3003, the ONU is powered up, receives the Upstream_overhead message sent by the OLT in the O2 state, and after the ONU successfully acquires all the upstream physical layer burst overhead parameter sets carried by the message, it transfers to the O3 state. Without any definite indication, the ONU uses the parameter set 1 by default. The ONU performs normal data communication in accordance with the specification constituted by standard (in the prior art).

Step 3004, it is the same as step 2004;

Step 3005, the OLT transmits the upstream burst overhead parameter set 2 to be used by the ONU to the ONU via the unicast message Upstream_overhead. The message format is shown as Table 5, wherein "BB" should be valued as "01".

Table 5

Overhead_ONU_Indication message upstream burst overhead parameter indication message		
Octet	Content	Description
1	ONU-ID	ONU identification
2	00000001	Message identification "upstream burst overhead parameter indication"
3	000000BB	BB: which upstream burst overhead parameter set adopted by the ONU indicated by the OLT 00: set 1 01: set 2 10: set 3 11: Reserved
4-20	Reserve	Reserved

Step 3006, after the ONU receives the unicast ONU overhead indication (Overhead_ONU_Indication) message sent by the OLT, it records the physical layer parameter BB(01) carried by the message and performs parameter switching subsequently according to the indication. The subsequent switching indication and operation are the same as those in the first embodiment.

The fourth embodiment

The difference between the third embodiment and the second embodiment is that the OLT broadcasts all parameter sets to the ONU in advance in the third embodiment.

As shown in FIG. 6, the fourth embodiment specifically includes the following steps.

Step 4001, it is the same as step 1001;

Step 4002, the OLT broadcasts the Upstream_overhead message carrying all the upstream burst overhead parameter sets (i.e., sets 1, 2 and 3 are sent in one message) in a downstream direction, and the message, as shown in Table 6. The message can be sent once or time after time, which is not limited in the present invention.

Table 6

Upstream_Overhead message upstream burst overhead parameters		
Octet	Content	Description
1	11111111 ONU-ID	=11111111: ONU-ID is not assigned, broadcast message ONU-ID is assigned, filled with ONU-ID value, unicast message
2	00000001	Message identification: “Upstream burst overhead parameters”
3	000000xx	xx: when this message is a unicast message, which upstream burst overhead parameter set adopted by ONU indicated by OLT 00: set 1 01: set 2 10: set 3 11: Reserved When this message is a broadcast message, xx is invalid and the ONU neglects it
4-8	gggggggg gggggggg gggggggg gggggggg gggggggg	Upstream burst overhead parameters -- set 1, which is also the default parameter set
9-13	xxxxxxxx xxxxxxxx xxxxxxxx	Upstream burst overhead parameters -- set 2, which is to be used corresponding to the link having poor transmission quality

	xxxxxxxx xxxxxxxx	
14-18	bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb	Upstream burst overhead parameters -- set 3, which is to be used corresponding to the link having good transmission quality
19-20	dddddddd dddddddd	Pre-assigned delay parameters

Step 4003, it is the same as step 1003;

Step 4004, it is the same as step 1004;

Step 4005, it is the same as step 1005; When the ONU responds the serial number request bandwidth assignment (SN_request) sent by the OLT in the O3 state, the ONU carries, in the Serial_Number_ONU, the link quality information - "good" acquired in step 1004, as shown in Table 7.

Table 7

Serial_Number_ONU ONU serial number information		
Octet	Content	Description
1	11111111 ONU-ID	=11111111: ONU-ID is not assigned ONU-ID is assigned, filled with value of ONU-ID
2	00000001	Message type: "ONU serial number information"
3-6	VID1-VID4	Equipment provider identification: bit1- bit4
7-10	VID2	Serial number information bit1- bit4 defined by equipment provider
11	RRRRRRRR	High 8 bits of random experiment
12	RRRRAATT	RRRR = low 4 bits of random experiment AA: link quality measurement result notified to OLT by ONU, where it sets as "01" corresponding to "good" (00 - OLT neglects 01 - link quality is good 10 - link quality is OK

		11 - link quality is poor) TT = ONU transmission power TT = 00 – Low Power TT = 01 – Medium Power TT = 10 – High Power TT = 11 – Reserved
13-20	Reserve	Reserved

(Using the Serial_number_ONU message to carry that information is only an example. Idle bits in other upstream frame message can also be used to be endowed with the similar definition of the "AA" in the above table for notifying the OLT the link detection result, or a specifically defined message is used to transmit that detection result.)

Step 4006, it is the same as step 1006;

Step 4007, after the ONU is assigned with the ONU-ID, the OLT indicates via the unicast Upstream_overhead message ("xx" in the unicast message is set as "10") that the upstream burst overhead parameters to be used by the ONU is the set 3, as shown in Table 8.

Table 8

Upstream_Overhead message upstream burst overhead parameters		
Octet	Content	Description
1	11111111 ONU-ID	=11111111: ONU-ID is not assigned, broadcast message ONU-ID is assigned, filled with value of ONU-ID, unicast message
2	00000001	Message identification: "Upstream burst overhead parameters"
3	000000xx	xx: when this message is a unicast message, which upstream burst overhead parameter set adopted by ONU indicated by OLT 00: set 1 01: set 2 10: set 3 11: Reserved When this message is a broadcast message, xx is invalid and the ONU neglects it
4-8	gggggggg	Upstream burst overhead parameters -- set 1, which is also the default

	gggggggg gggggggg gggggggg gggggggg	parameter set
9-13	xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx	Upstream burst overhead parameters -- set 2, which is to be used corresponding to the link having poor transmission quality
14-18	bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb	Upstream burst overhead parameters -- set 3, which is to be used corresponding to the link having good transmission quality
19-20	dddddddd dddddddd	Pre-assigned delay parameters

Step 4008, after the ONU receives the Upstream_overhead unicast message sent by the OLT, the ONU records the upstream burst overhead parameter indication carried by the message, and uses in the subsequent switching. The subsequent switching indication and operation are the same as those in the first embodiment.

The fifth embodiment

The difference between the fifth embodiment and the third embodiment is that, in the fifth embodiment, after the OLT detects the quality of the downlink, it notifies the ONU to record the upstream burst overhead parameters to be switched to and the switching hyper frame number via broadcast channel message Overhead_ONU_indication; and after the frame corresponding to the hyper frame number arrives, all ONUs switch to use the upstream burst overhead parameters indicated by the OLT to perform upstream transmission.

As shown in FIG. 7, the fifth embodiment specifically includes the following steps.

Steps 5001-5004, they are the same as steps 3001-3004.

Step 5005, the OLT transmits the upstream burst overhead parameter set 2 to be switched used by all ONUs as well as the hyper frame number which is used to perform the parameter switching, via the broadcast Overhead_ONU_Indication message. The message has the following message format, wherein BB should be valued as "01". The hyper frame number field (4-7) is filled with the value of the hyper frame number that needs to be switched, as shown in Table 9.

Table 9

Overhead_ONU_Indication message upstream burst overhead parameter indication message		
Octet	Content	Description
1	11111111	Broadcast message type
2	00000001	Message ID "Upstream burst overhead parameter indication"
3	000000BB	BB: which kind of upstream burst overhead parameter set adopted by ONU indicated by OLT 00: set 1 01: set 2 10: set 3 11: Reserved
4-7	ssssssss ssssssss ssssssss ssssssss	The hyper frame number that the OLT requires all ONUs to switch, wherein, before the hyper frame arrives, all ONUs switch to use the upstream burst overhead parameters indicated by the OLT to perform upstream transmission
8-20	Reserve	Reserved

Step 5006, after all ONUs receive the Overhead_ONU_Indication message broadcasted by the OLT, all ONUs record the physical layer parameter BB(01) and the hyper frame number that indicates the switching time carried in the message, and the parameter switching is performed subsequently according to the indication.

Step 5007, after the downstream frame corresponding to the subsequent hyper frame number arrives, the ONU performs switching operation of the upstream burst overhead parameter, and the parameters after the switching is used in upstream transmission.

This embodiment can be simply modified, that is, the message in steps 5005-5006 is

designed as a unicast message to support the switching of a single ONU rather than all ONUs.

The sixth embodiment

The difference between the sixth embodiment and the fifth embodiment is that: in the sixth embodiment, after the OLT detects the quality of the downlink, it notifies the ONUs to record the upstream burst overhead parameters to be switched and the switching hyper frame number, via the broadcast channel message Overhead_ONU_indication; the OLT sets the switching index values of the upstream burst overhead parameters in the tag fields assigned for the bandwidths of all ONUs; and after the ONUs receive this switching indication, they perform the upstream burst overhead parameter switching in the next frame according to the indicated index value.

As shown in FIG. 8, the sixth embodiment specifically includes the following steps.

Steps 6001-6006, they are the same as steps 5001-5006.

Step 6007, the OLT sets the switching index values of the upstream burst overhead parameters in the tag fields assigned for the bandwidths of all ONUs and sends them to all ONUs via a downstream frame.

Once all ONUs receive the switching indication in step 6007, they perform the upstream burst overhead parameter switching immediately in the next frame according to the indicated index values, so that the switched parameters can be used in the subsequent upstream transmission.

This embodiment can be modified simply, that is, the message in steps 6005/6006/6007 is designed as a unicast message and is set according to a certain ONU, to support the switching of a single ONU rather than all ONUs.

The seventh embodiment

In the seventh embodiment, the ONU tests the quality of the link and determines the upstream burst overhead parameters used by the ONU itself according to the quality of the link, and the ONU notifies the OLT the upstream burst overhead parameters and indicates the

switching hyper frame number.

As shown in FIG. 9, the seventh embodiment specifically includes the following steps.

Steps 7001-7002, they are the same as steps 6001-6002.

Step 7003, the ONU is powered up, and receives the Upstream_overhead message sent by the OLT in the O2 state, and after successfully acquiring the upstream physical layer burst overhead parameters carried in the message, the ONU transfers to the O3 state.

Step 7004, from the O3 state, the ONU starts to analyze the transmission quality of the downlink, acquiring result by using the currently general BIP detection method or the frequently used FEC result and the number of correction bits. (The ONU can also use other similar detection method to acquire the transmission quality information of the downlink, as long as the method works). Suppose the result of the measurement is good.

Step 7005, after the ONU acquires the transmission quality information in step 7004, the subsequent upstream frame carries the detection result "good" by the ONU detecting the quality of the downlink; and the ONU determines the upstream burst overhead parameter set (i.e., set 3) according to the link quality, and then the ONU reports the determined upstream burst overhead parameter set 3 and the hyper frame number which represents the set 3 ready for switching to be used. For example, when the ONU responds the serial number request bandwidth assignment (SN_Request) sent by the OLT in the O3 state, the link quality information – "good" acquired in step 7004 is carried in the upstream message "Serial_Number_ONU", as shown in Table 10.

Table 10

Serial_Number_ONU ONU serial number information		
Octet	Content	Description
1	11111111 ONU-ID	=11111111: ONU-ID is not assigned, broadcast message ONU-ID is assigned, filled with value of ONU-ID, unicast message
2	00000001	Message type: "ONU serial number information"
3-6	VID1-VID4	Equipment provider ID: bit1- bit4
7-10	VID2	Serial number information bit1- bit4 defined by equipment provider
11	RRRRRRRR	High 8 bits of random experiment
12	RRRRAATT	RRRR = low 4 bits of random experiment

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		AA: link quality measurement result notified to OLT by ONU, where it is set as "01" corresponding to "good" (00 - OLT neglects 01 - link quality is good 10 - link quality is OK 11 - link quality is poor) TT = ONU transmission power TT = 00 – Low Power TT = 01 – Medium Power TT = 10 – High Power TT = 11 – Reserved
13-16	ssssssss ssssssss ssssssss ssssssss	Hyper frame number of downstream frame which represents the parameter set 3 switched to be used by ONU. After the OLT sends the downstream frame corresponding to the hyper frame number, it uses new upstream burst overhead parameters to receive the upstream frames of the ONU.
17-20	Reserve	Reserved

Using the Serial_number_ONU message to carry the information is only an example. Idle bits in other upstream frame message can also be used to be endowed with the similar definition of the related field in the above table to notify the OLT the link detection result and the hyper frame number of the downstream frame related to the switching, or a specifically defined message is used to transmit the detection result.

Step 7006, after the OLT receives the message, it records the link quality information corresponding to that ONU and the hyper frame number of the downstream frame related to the switching, and determines the upstream burst overhead parameter set 3 suitable for used by the ONU.

Step 7007, after the OLT sends the downstream frame corresponding to the hyper frame number at a certain time, the ONU switches to use the parameter set 3 to send the upstream frame here, and the OLT uses the parameter set 3 to receive the upstream frames of that ONU.

The above methods can improve the bandwidth utilization and decrease the complexity of indicating the upstream burst overhead parameters in the PON system, so that the OLT and the ONU can flexibly and simply select the upstream burst overhead parameters.

The PON system for managing the upstream burst overhead parameters in the present invention comprises an OLT or an ONU, wherein, the functions of these two entities are the same as those described in the above methods. The detail description is as follows:

The OLT is configured to: detect the transmission quality of the downlink between the OLT and the ONU, determine the upstream burst overhead parameters suitable for the ONU according to the transmission quality and notify the parameters to the ONU; and indicate the switching time to the ONU; and

The ONU is configured to: detect the transmission quality of the downlink between the OLT and the ONU, determine the suitable upstream burst overhead parameters according to the transmission quality, or, directly receive, from the OLT, the transmission quality of the downlink determined by the OLT; and start to use the upstream burst overhead parameters after the switching time determined by the ONU itself or indicated by the OLT.

The OLT is further configured to determine and identify N kinds of upstream burst overhead parameter sets according to different levels of link quality, wherein N is an integer and is larger than zero. The OLT further used to send the parameter value or the identification of one default upstream burst overhead parameter set to the ONU, or, to send the parameter values or the identifications of more than one upstream burst overhead parameter set to the ONU. The ONU is further configured to: receive the parameter value or the identification of one upstream burst overhead parameter set in the waiting state and use this upstream burst overhead parameter set; or, after receiving the parameter values or the identifications of more than one upstream burst overhead parameter set in the waiting state, use one of the upstream burst overhead parameter sets.

The OLT is further configured to: while or after notifying the determined upstream burst overhead parameter set to the ONU, set the switching index value of the upstream burst

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overhead parameters in the tag field assigned for the bandwidth of the ONU and sending it to the ONU via a downstream frame. The ONU is further used to use the upstream burst overhead parameters in the next frame after receiving the switching index value.

The OLT is further configured to: while or after notifying the determined upstream burst overhead parameter set to the ONU, notify the ONU the hyper frame number. The ONU is further configured to start to use the upstream burst overhead parameters after the frame indicated by the hyper frame number arrives.

The ONU is further configured to: while or after notifying the determined upstream burst overhead parameter set to the OLT, notify the OLT the hyper frame number, and start to use the upstream burst overhead parameters after the frame indicated by the hyper frame number arrives.

Based on the above system, the present invention also provides an optical network unit (ONU) for managing the upstream burst overhead parameters, and the ONU comprises a first parameter acquisition module and a switching module; wherein:

the first parameter acquisition module is configured to:

detect the transmission quality of the downlink between the OLT and the ONU or receive the transmission quality of the downlink detected and sent by the OLT, determine the upstream burst overhead parameters suitable for the ONU according to the transmission quality, and send the upstream burst overhead parameters suitable for the ONU to the OLT; or

detect the transmission quality of the downlink between the OLT and the ONU, send the transmission quality to the OLT, and receive the upstream burst overhead parameters suitable for the ONU which are determined according to the transmission quality and sent by the OLT; or,

directly receive, from the OLT, the upstream burst overhead parameters suitable for the ONU determined by the OLT; and

while or after notifying the determined upstream burst overhead parameters suitable

for the ONU to the OLT, or, while or after receiving the upstream burst overhead parameters suitable for the ONU sent by the OLT, indicate the switching module; and

the switching module is configured to:

while or after receiving an indication from the first parameter acquisition module, determine the switching time or receive the switching time indicated by the OLT, and start to use the upstream burst overhead parameters suitable for the ONU after the switching time determined by the ONU itself or indicated by the OLT.

The ONU further comprises a burst overhead parameter set receiving module; wherein:

the burst overhead parameter set receiving module is configured to:

receive, in the waiting state, the parameter value or the identification of one default upstream burst overhead parameter set sent by the OLT to the ONU, wherein the default upstream burst overhead parameter set is one of N kinds of upstream burst overhead parameter sets determined and identified by the OLT according to different levels of link quality, and use this upstream burst overhead parameter set; or,

receive, in the waiting state, the parameter values or the identifications of more than one upstream burst overhead parameter set sent by the OLT to the ONU, wherein the upstream burst overhead parameter sets is one or more of N kinds of upstream burst overhead parameter sets determined and identified by the OLT according to different levels of link quality, and use one of the upstream burst overhead parameter sets;

wherein N is an integer and is larger than zero.

The switching module is further configured to: while or after receiving the indication from the first parameter acquisition module, receive the switching index value of the upstream burst overhead parameters which is set in the tag field assigned for the bandwidth of the ONU by the OLT and is sent by the OLT to the ONU via a downstream frame; and the switching module is configured to start to use the upstream burst overhead parameters after the switching time

indicated by the OLT according to the following manner: after receiving the switching index value, using the upstream burst overhead parameters in the next frame; or

The switching module is further configured to: while or after receiving the indication from the first parameter acquisition module, receive the hyper frame number notified to the ONU by the OLT; and the switching module is configured to start to use the upstream burst overhead parameters after the switching time indicated by the OLT according to the following manner: starting to use the upstream burst overhead parameters after the frame indicated by the hyper frame number arrives; or,

The switching module is further configured to: while or after receiving the indication from the first parameter acquisition module, notify the OLT the hyper frame number; and the ONU is configured to start to use the upstream burst overhead parameters after the switching time determined by the ONU itself according to the following manner: starting to use the upstream burst overhead parameters after the frame indicated by the hyper frame number arrives.

Based on the above-mentioned system, the present invention also provides an optical line terminal (OLT) for managing the upstream burst overhead parameters, and the OLT comprises a second parameter acquisition module and a switching time transceiving module, wherein:

the second parameter acquisition module is configured to:

detect the transmission quality of the downlink between the OLT and an optical network unit (ONU), send the transmission quality to the ONU, and receive the upstream burst overhead parameters suitable for the ONU determined by the ONU according to the transmission quality sent by the OLT; or,

detect the transmission quality of the downlink between the OLT and the ONU, determine the upstream burst overhead parameters suitable for the ONU according to the transmission quality, and notify the ONU the determined upstream burst overhead parameters suitable for the ONU; or,

receive the transmission quality of the downlink detected and sent by the ONU, determine the upstream burst overhead parameters suitable for the ONU according

to the transmission quality, and notify the ONU the determined upstream burst overhead parameters suitable for the ONU; or,

receive from the ONU the upstream burst overhead parameters suitable for the ONU determined according to the transmission quality of the downlink detected and acquired by the ONU itself; and

while or after notifying the ONU the determined upstream burst overhead parameters suitable for the ONU, or, while or after receiving from the ONU the upstream burst overhead parameters suitable for the ONU, indicate the switching time transceiving module; and

the switching time transceiving module is configured to:

while or after receiving an indication from the second parameter acquisition module, indicate the switching time to the ONU or receive the switching time sent by the ONU, so that the ONU starts to use the upstream burst overhead parameters after the switching time.

The OLT further comprises:

an upstream burst overhead parameter set acquisition module, which is configured to: determine and identify N kinds of upstream burst overhead parameter sets according to different levels of link quality, wherein, N is an integer and is larger than zero; and send the parameter value or the identification of one default upstream burst overhead parameter set to the ONU, or, send the parameter values or the identifications of more than one upstream burst overhead parameter set to the ONU,

so that the ONU receives the parameter value or the identification of one upstream burst overhead parameter set in the waiting state and uses this upstream burst overhead parameter set; or, the ONU receives the parameter values or the identifications of more than one upstream burst overhead parameter set in the waiting state and uses one of them.

The switching time transceiving module is configured to indicate the switching time to the ONU according to the following manner: setting the switching index value of the upstream burst overhead parameters in the tag field assigned for the bandwidth of the ONU, and sending

it to the ONU via a downstream frame, so that after the ONU receives the switching index value, it uses the upstream burst overhead parameters in the next frame; or,

the switching time transceiving module is configured to indicate the switching time to the ONU according to the following manner: notify the ONU the hyper frame number, so that the ONU starts to use the upstream burst overhead parameters after the frame indicated by the hyper frame number arrives; or,

the switching time transceiving module is configured to receive the switching time sent by the ONU according to the following manner: receiving the hyper frame number notified by the ONT, so that the ONU starts to use the upstream burst overhead parameters after the frame indicated by the hyper frame number arrives.

The above description is only the preferred embodiments of the present invention and is not intended to limit the present invention. For those skilled in the art, the description of the above scheme in the present invention can be modified or changed. Without departing from the spirit and essence of the present invention, all these kinds of modification, equivalent or variations should belong to the scope of the appending claims of the present invention.

Industrial Applicability

The present invention can improve the bandwidth utilization, decrease the complexity of indicating the upstream burst overhead parameters in the PON system, thereby the ONU and the OLT can flexibly and simply select the upstream burst overhead parameters.

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What is claimed is:

1. A method for managing upstream burst overhead parameters, comprising:

an optical line terminal or an optical network unit detecting transmission quality of a downlink between the optical line terminal and the optical network unit;

the optical line terminal or the optical network unit determining the upstream burst overhead parameters suitable for the optical network unit according to the transmission quality; and

the optical network unit starting to use the upstream burst overhead parameters suitable for the optical network unit after switching time determined by the optical network unit itself or indicated by the optical line terminal.

2. The method of claim 1, wherein, before the step of the optical line terminal or the optical network unit detecting the transmission quality of the downlink between the optical line terminal and the optical network unit, the method further comprises:

the optical line terminal determining and identifying N kinds of upstream burst overhead parameter sets according to different levels of link quality, wherein N is an integer and is larger than zero; and

the optical line terminal sending a parameter value or an identification of one default upstream burst overhead parameter set to the optical network unit; and the optical network unit receiving the parameter value or the identification of the upstream burst overhead parameter set in a waiting state and using the upstream burst overhead parameter set; or,

the optical line terminal sending parameter values or identifications of more than one upstream burst overhead parameter set to the optical network unit; and the optical network unit receiving the parameter values or the identifications of the upstream burst overhead parameter sets in a waiting state and using one of the received upstream burst overhead parameter sets.

3. The method of claim 2, wherein:

after the step of the optical network unit receiving the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s), the method further comprises: the optical network unit entering into a serial number state;

the step of the optical network unit detecting the transmission quality of the downlink between the optical line terminal and the optical network unit comprises: in the serial number state of the optical network unit, the optical line terminal detecting the downlink between the optical network unit and the optical line terminal to acquire quality information of the downlink;

the step of the optical line terminal determining the upstream burst overhead parameters suitable for the optical network unit according to the transmission quality comprises: the optical line terminal determining the upstream burst overhead parameter set suitable for the optical network unit according to the quality information of the downlink, and notifying the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) suitable for the optical network unit to the optical network unit via a unicast message or a broadcast message.

4. The method of claim 2, wherein:

after the step of the optical network unit receiving the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s), the method further comprises: the optical network unit entering into a serial number state;

the step of the optical network unit detecting the transmission quality of the downlink between the optical line terminal and the optical network unit comprises: in the serial number state of the optical network unit, the optical network unit detecting the downlink between the optical network unit and the optical line terminal to acquire quality information of the downlink;

after the step of acquiring the quality information of the downlink, the method further comprises: the optical network unit notifying the quality information of the downlink to the optical line terminal;

the step of the optical line terminal determining the upstream burst overhead parameters suitable for the optical network unit according to the transmission quality comprises: the optical line terminal determining the upstream burst overhead parameter set suitable for the optical network unit according to the quality information of the downlink, and notifying the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) suitable for the optical network unit to the optical network unit via a unicast message or a broadcast message.

5. The method of claim 2, wherein:

after the step of the optical network unit receiving the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s), the method further comprises: the optical network unit entering into a serial number state;

the step of the optical network unit detecting the transmission quality of the downlink between the optical line terminal and the optical network unit comprises: in the serial number state of the optical network unit, the optical network unit detecting the downlink between the optical network unit and the optical line terminal to acquire quality information of the downlink;

The step of the optical network unit determining the upstream burst overhead parameters suitable for the optical network unit according to the transmission quality comprises: the optical network unit determining the upstream burst overhead parameter set suitable for the optical network unit according to the quality information of the downlink, and notifying the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) suitable for the optical network unit to the optical line terminal via a unicast message or a broadcast message.

6. The method of claim 3, 4 or 5, wherein:

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical line terminal setting a switching index value of the upstream burst overhead parameters in a tag field assigned for a bandwidth of the optical network unit, and sending the switching index value to the optical network unit via a downstream frame; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal comprises: after the optical network unit receives the switching index value, the optical network unit using the upstream burst overhead parameters suitable for the optical network unit in a next frame; or,

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical

network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical line terminal notifying a hyper frame number to the optical network unit; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal comprises: after the optical network unit receives the hyper frame number and after a frame indicated by the hyper frame number arrives, the optical network unit starting to use the upstream burst overhead parameters suitable for the optical network unit; or,

while or after the optical line terminal notifies the parameter value(s) or the identification(s) of the determined upstream burst overhead parameter set(s) to the optical network unit, or while or after the optical network unit notifies the parameter value(s) or the identification(s) of the upstream burst overhead parameter set(s) to the optical line terminal, the method further comprises: the optical network unit notifying a hyper frame number to the optical line terminal; the step of the optical network unit starting to use the upstream burst overhead parameters after the switching time determined by the optical network unit itself comprises: after a frame indicated by the hyper frame number arrives, the optical network unit starting to use the upstream burst overhead parameters suitable for the optical network unit.

7. The method of claim 3, 4 or 5, wherein:

the upstream burst overhead parameter set comprises: state of forward error correction, delimiter, preamble and guard band.

8. The method of claim 2, wherein:

in the step of the optical line terminal sending the parameter values or the identifications of more than one upstream burst overhead parameter set to the optical network unit, the optical line terminal sends the parameter values or the identifications of one or more upstream burst overhead parameter sets to all optical network units or one or more optical network units which communicate with the optical line terminal.

9. An optical network unit for managing upstream burst overhead parameters, comprising a first parameter acquisition module and a switching module; wherein:

the first parameter acquisition module is configured to:

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detect transmission quality of a downlink between an optical line terminal and the optical network unit or receive transmission quality of a downlink detected and sent by the optical line terminal, determine upstream burst overhead parameters suitable for the optical network unit according to the transmission quality, and send the upstream burst overhead parameters suitable for the optical network unit to the optical line terminal; or,

detect transmission quality of a downlink between an optical line terminal and the optical network unit, send the transmission quality to the optical line terminal, and receive, from the optical line terminal, upstream burst overhead parameters suitable for the optical network unit determined according to the transmission quality; or,

directly receive, from an optical line terminal, upstream burst overhead parameters suitable for the optical network unit determined by the optical line terminal; and,

while or after notifying the upstream burst overhead parameters suitable for the optical network unit to the optical line terminal, or while or after receiving the upstream burst overhead parameters suitable for the optical network unit sent by the optical line terminal, indicate the switching module;

the switching module is configured to:

while or after receiving an indication from the first parameter acquisition module, determine a switching event or receive switching time indicated by the optical line terminal, and start to use the upstream burst overhead parameters suitable for the optical network unit after the switching time determined by itself or indicated by the optical line terminal.

10. The optical network unit of claim 9, further comprising:

a burst overhead parameter set receiving module, configured to:

receive, in a waiting state, a parameter value or an identification of one default upstream burst overhead parameter set sent by the optical line terminal to the optical network unit after the optical line terminal determines and identifies N kinds of upstream burst overhead parameter sets according to different levels of link quality, and use the upstream burst overhead parameter set; or,

receive, in a waiting state, parameter values or identifications of more than one upstream

burst overhead parameter set sent by the optical line terminal to the optical network unit after the optical line terminal determines and identifies N kinds of upstream burst overhead parameter sets according to different levels of link quality, and use one of the upstream burst overhead parameter sets;

wherein, N is an integer and is larger than zero.

11. The optical network unit of claim 9, wherein:

the switching module is further configured to: while or after receiving the indication from the first parameter acquisition module, receive a switching index value of the upstream burst overhead parameters which is sent from the optical line terminal to the optical network unit via a downstream frame and are set in a tag field assigned for a bandwidth of the optical network unit by the optical line terminal; and, the switching module is configured to start to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal according to the following manner: after receiving the switching index value, using the upstream burst overhead parameters in a next frame; or

the switching module is further configured to: while or after receiving the indication from the first parameter acquisition module, receive a hyper frame number notified by the optical line terminal to the optical network unit; and, the switching module is configured to start to use the upstream burst overhead parameters after the switching time indicated by the optical line terminal according to the following manner: after a frame indicated by the hyper frame number arrives, starting to use the upstream burst overhead parameters; or

the switching module is further configured to: while or after receiving the indication from the first parameter acquisition module, notify a hyper frame number to the optical line terminal; and, the optical network unit is configured to start to use the upstream burst overhead parameters after the switching time determined by the optical network unit itself according to the following method: after a frame indicated by the hyper frame number arrives, start to use the upstream burst overhead parameters.

12. An optical line terminal for managing upstream burst overhead parameters, comprising: a second parameter acquisition module and a switching time transceiving module, wherein:

the second parameter acquisition module is configured to:

detect transmission quality of a downlink between the optical line terminal and an optical network unit, send the transmission quality to the optical network unit, and receive upstream burst overhead parameters suitable for the optical network unit determined by the optical network unit according to the transmission quality sent by the optical line terminal; or,

detect transmission quality of a downlink between the optical line terminal and an optical network unit, determine upstream burst overhead parameters suitable for the optical network unit according to the transmission quality, and notify the determined upstream burst overhead parameters suitable for the optical network unit to the optical network unit; or,

receive transmission quality of a downlink detected and sent by an optical network unit, determine the upstream burst overhead parameters suitable for the optical network unit according to the transmission quality, and notify the determined upstream burst overhead parameters suitable for the optical network unit to the optical network unit; or,

receive upstream burst overhead parameters suitable for an optical network unit which are sent and determined by the optical network unit according to transmission quality of a downlink detected and acquired by the optical network unit itself; and

while or after notifying the determined upstream burst overhead parameters suitable for the optical network unit to the optical network unit, or while or after receiving the upstream burst overhead parameters suitable for the optical network unit sent by the optical network unit, indicate switching time transceiving module;

the switching time transceiving module is configured to:

while or after receiving an indication from the second parameter acquisition module, indicate the switching time to the optical network unit or receive the switching time sent by the optical network unit, so that the optical network unit start to use the upstream burst overhead parameters after the switching time.

13. The optical line terminal of claim 12, further comprising:

a upstream burst overhead parameter set acquisition module, configured to: determine and identify N kinds of upstream burst overhead parameter sets according to different levels of link

quality; wherein N is an integer and is larger than zero; and send a parameter value or an identification of one default upstream burst overhead parameter set to the optical network unit, or, send parameter values or identifications of more than one upstream burst overhead parameter set to the optical network unit,

so that the optical network unit receives the parameter value or the identification of the one upstream burst overhead parameter set in a waiting state and uses the upstream burst overhead parameter set; or, the optical network unit receives the parameter values or the identifications of more than one upstream burst overhead parameter set in a waiting state and uses one of the upstream burst overhead parameter sets.

14. The optical line terminal of claim 12, wherein:

the switching time transceiving module is configured to indicate the switching time to the optical network unit according to the following manner: setting a switching index value of the upstream burst overhead parameters in a tag field assigned for a bandwidth of the optical network unit, and sending the switching index value to the optical network unit via a downstream frame, so that after the optical network unit receives the switching index value, the optical network unit uses the upstream burst overhead parameters in a next frame; or,

the switching time transceiving module is configured to indicate the switching time to the optical network unit according to the following manner: notifying a hyper frame number to the optical network unit, so that the optical network unit starts to use the upstream burst overhead parameters after a frame indicated by the hyper frame number from the optical line terminal arrives; or,

the switching time transceiving module is configured to receive the switching time sent by the optical network unit according to the following method: receiving a hyper frame number notified by the optical network terminal, so that the optical network unit starts to use the upstream burst overhead parameters after a frame indicated by the hyper frame number arrives.

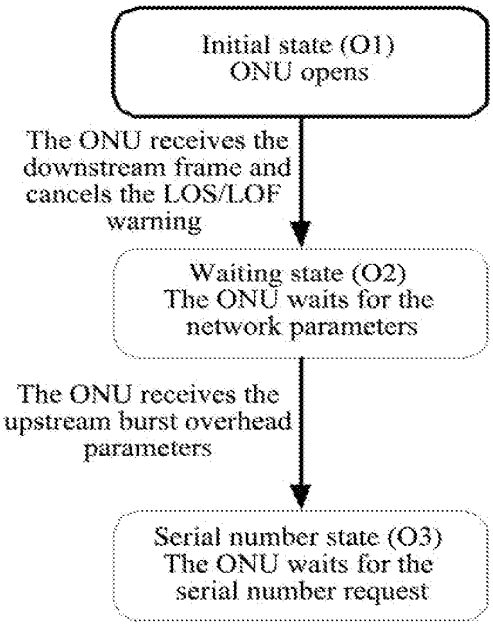

Initial state (O1)
ONU opens
The ONU receives the downstream frame and cancels the LOS/LOF warning
Waiting state (O2)
The ONU waits for the network parameters
The ONU receives the upstream burst overhead parameters
Serial number state (O3)
The ONU waits for the serial number request

FIG. 1

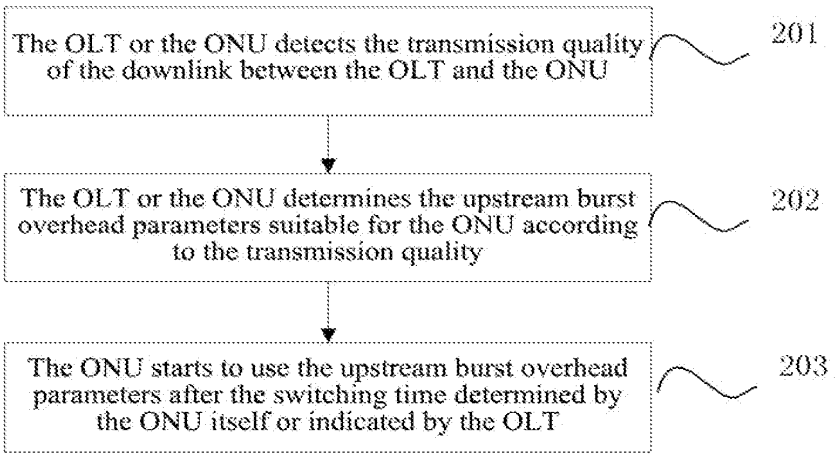

The OLT or the ONU detects the transmission quality of the downlink between the OLT and the ONU
201
The OLT or the ONU determines the upstream burst overhead parameters suitable for the ONU according to the transmission quality
202
The ONU starts to use the upstream burst overhead parameters after the switching time determined by the ONU itself or indicated by the OLT
203

FIG. 2

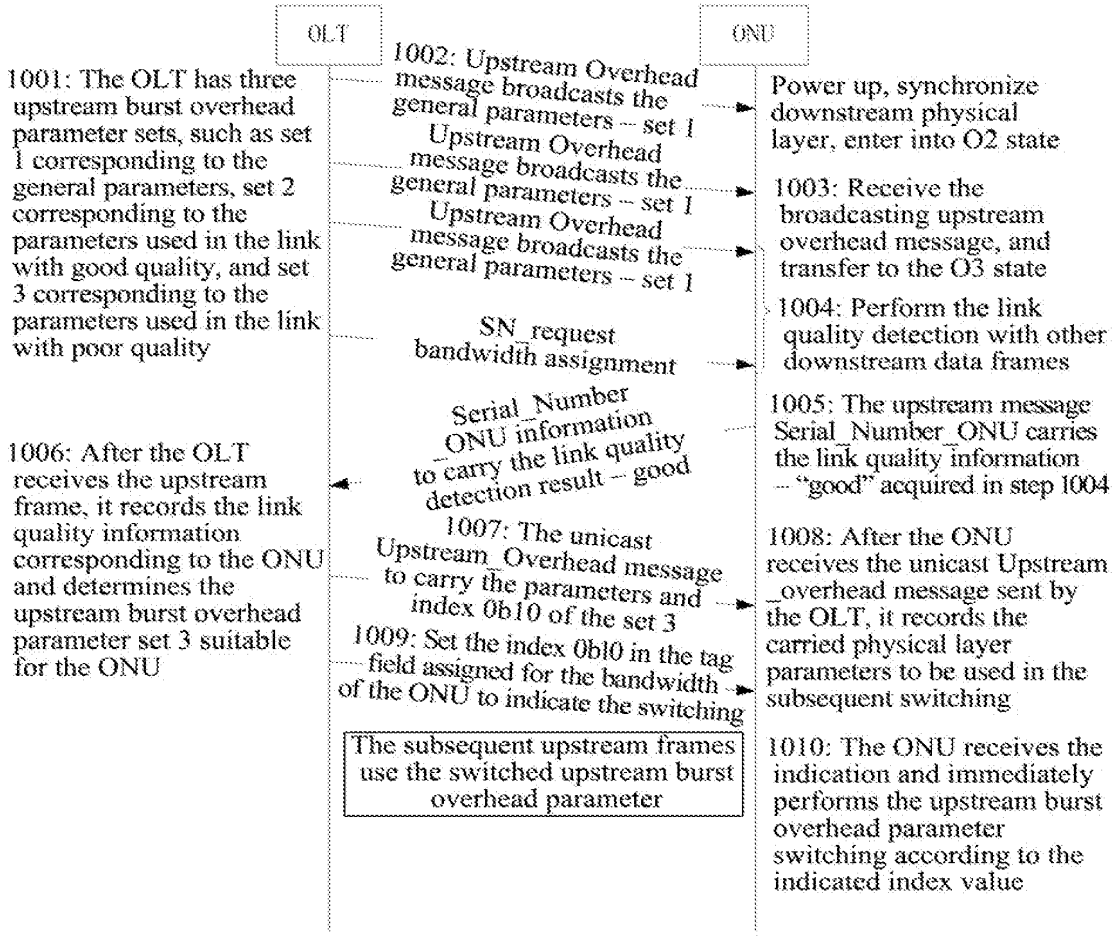

OLT
ONU
1001: The OLT has three upstream burst overhead parameter sets, such as set 1 corresponding to the general parameters, set 2 corresponding to the parameters used in the link with good quality, and set 3 corresponding to the parameters used in the link with poor quality
1002: Upstream Overhead message broadcasts the general parameters – set 1
Upstream Overhead message broadcasts the general parameters – set 1
Upstream Overhead message broadcasts the general parameters – set 1
Power up, synchronize downstream physical layer, enter into O2 state
1003: Receive the broadcasting upstream overhead message, and transfer to the O3 state
1004: Perform the link quality detection with other downstream data frames
SN_request bandwidth assignment
Serial_Number _ONU information to carry the link quality detection result – good
1005: The upstream message Serial_Number_ONU carries the link quality information – "good" acquired in step 1004
1006: After the OLT receives the upstream frame, it records the link quality information corresponding to the ONU and determines the upstream burst overhead parameter set 3 suitable for the ONU
1007: The unicast Upstream_Overhead message to carry the parameters and index 0b10 of the set 3
1008: After the ONU receives the unicast Upstream _overhead message sent by the OLT, it records the carried physical layer parameters to be used in the subsequent switching
1009: Set the index 0b10 in the tag field assigned for the bandwidth of the ONU to indicate the switching
The subsequent upstream frames use the switched upstream burst overhead parameter
1010: The ONU receives the indication and immediately performs the upstream burst overhead parameter switching according to the indicated index value

FIG. 3

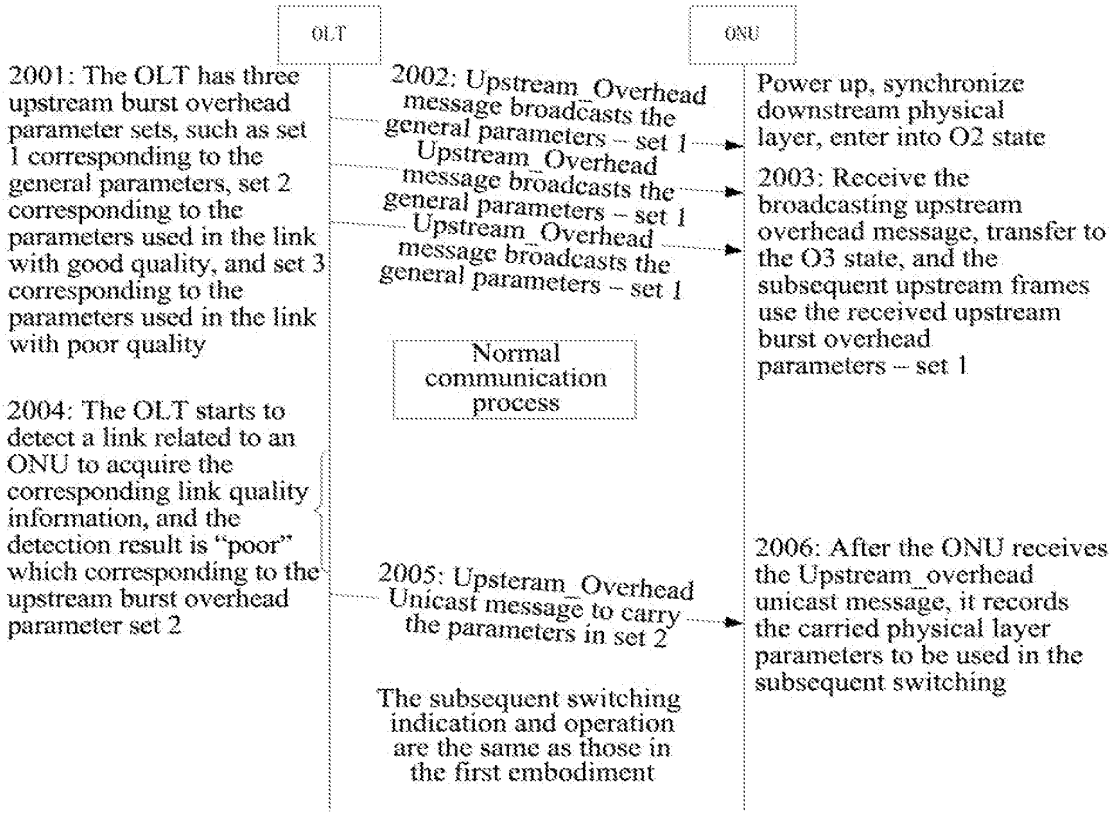

OLT
ONU
2001: The OLT has three upstream burst overhead parameter sets, such as set 1 corresponding to the general parameters, set 2 corresponding to the parameters used in the link with good quality, and set 3 corresponding to the parameters used in the link with poor quality
2002: Upstream_Overhead message broadcasts the general parameters – set 1
Upstream_Overhead message broadcasts the general parameters – set 1
Upstream_Overhead message broadcasts the general parameters – set 1
Power up, synchronize downstream physical layer, enter into O2 state
2003: Receive the broadcasting upstream overhead message, transfer to the O3 state, and the subsequent upstream frames use the received upstream burst overhead parameters – set 1
Normal communication process
2004: The OLT starts to detect a link related to an ONU to acquire the corresponding link quality information, and the detection result is "poor" which corresponding to the upstream burst overhead parameter set 2
2005: Upsteram_Overhead Unicast message to carry the parameters in set 2
2006: After the ONU receives the Upstream_overhead unicast message, it records the carried physical layer parameters to be used in the subsequent switching
The subsequent switching indication and operation are the same as those in the first embodiment

FIG. 4

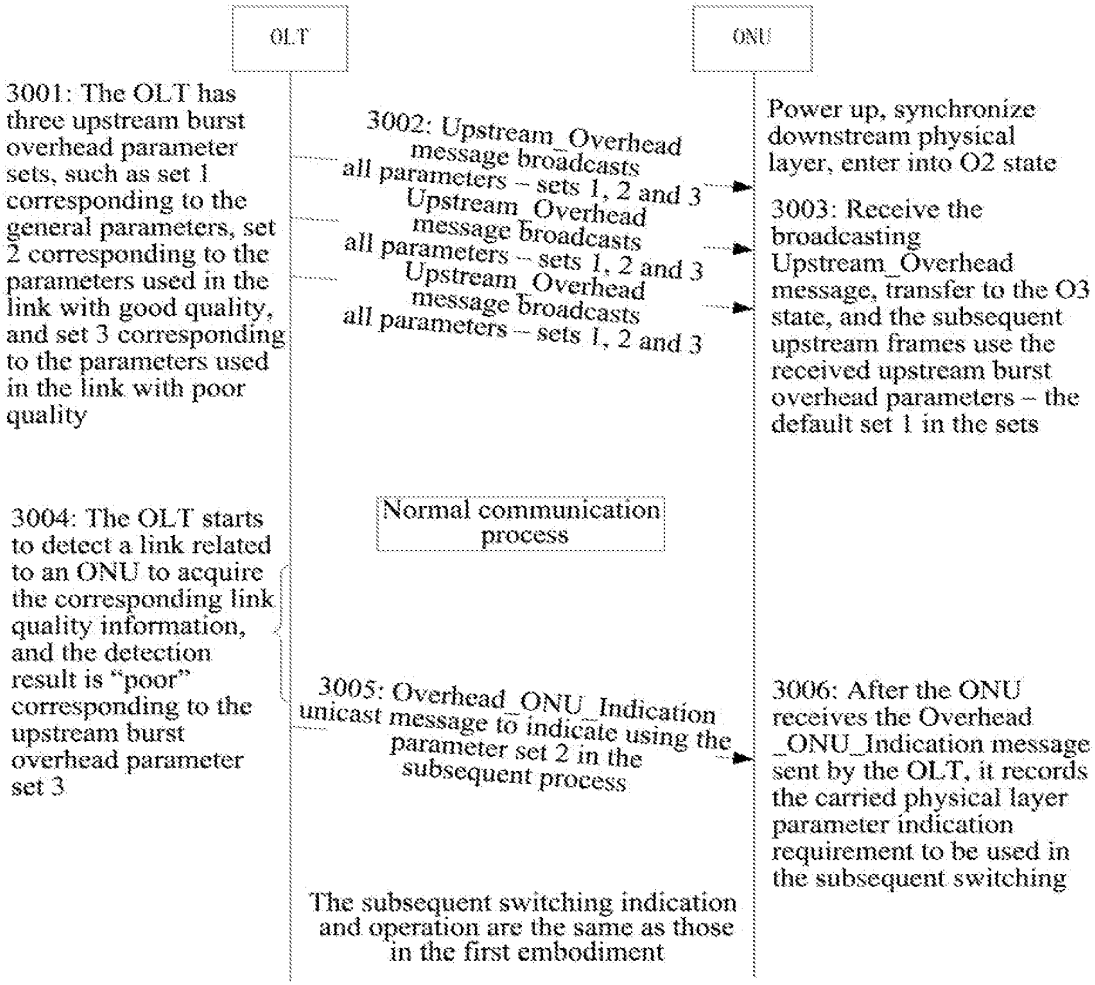

OLT
ONU
3001: The OLT has three upstream burst overhead parameter sets, such as set 1 corresponding to the general parameters, set 2 corresponding to the parameters used in the link with good quality, and set 3 corresponding to the parameters used in the link with poor quality
3002: Upstream_Overhead message broadcasts all parameters – sets 1, 2 and 3
Upstream_Overhead message broadcasts all parameters – sets 1, 2 and 3
Upstream_Overhead message broadcasts all parameters – sets 1, 2 and 3
Power up, synchronize downstream physical layer, enter into O2 state
3003: Receive the broadcasting Upstream_Overhead message, transfer to the O3 state, and the subsequent upstream frames use the received upstream burst overhead parameters – the default set 1 in the sets
Normal communication process
3004: The OLT starts to detect a link related to an ONU to acquire the corresponding link quality information, and the detection result is "poor" corresponding to the upstream burst overhead parameter set 3
3005: Overhead_ONU_Indication unicast message to indicate using the parameter set 2 in the subsequent process
3006: After the ONU receives the Overhead _ONU_Indication message sent by the OLT, it records the carried physical layer parameter indication requirement to be used in the subsequent switching
The subsequent switching indication and operation are the same as those in the first embodiment

FIG. 5

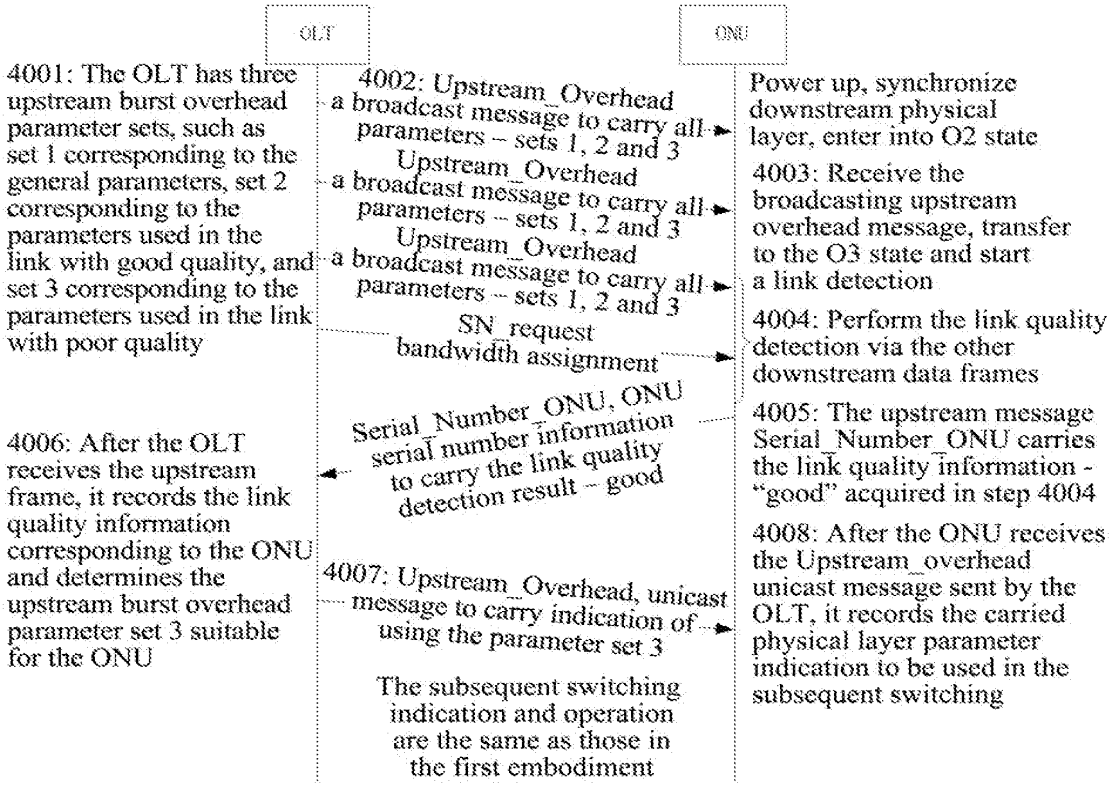

OLT
ONU
4001: The OLT has three upstream burst overhead parameter sets, such as set 1 corresponding to the general parameters, set 2 corresponding to the parameters used in the link with good quality, and set 3 corresponding to the parameters used in the link with poor quality
4002: Upstream_Overhead a broadcast message to carry all parameters – sets 1, 2 and 3
Upstream_Overhead a broadcast message to carry all parameters – sets 1, 2 and 3
Upstream_Overhead a broadcast message to carry all parameters – sets 1, 2 and 3
Power up, synchronize downstream physical layer, enter into O2 state
4003: Receive the broadcasting upstream overhead message, transfer to the O3 state and start a link detection
SN_request bandwidth assignment
4004: Perform the link quality detection via the other downstream data frames
Serial_Number_ONU, ONU serial number information to carry the link quality detection result – good
4005: The upstream message Serial_Number_ONU carries the link quality information - "good" acquired in step 4004
4006: After the OLT receives the upstream frame, it records the link quality information corresponding to the ONU and determines the upstream burst overhead parameter set 3 suitable for the ONU
4007: Upstream_Overhead, unicast message to carry indication of using the parameter set 3
4008: After the ONU receives the Upstream_overhead unicast message sent by the OLT, it records the carried physical layer parameter indication to be used in the subsequent switching
The subsequent switching indication and operation are the same as those in the first embodiment

FIG. 6

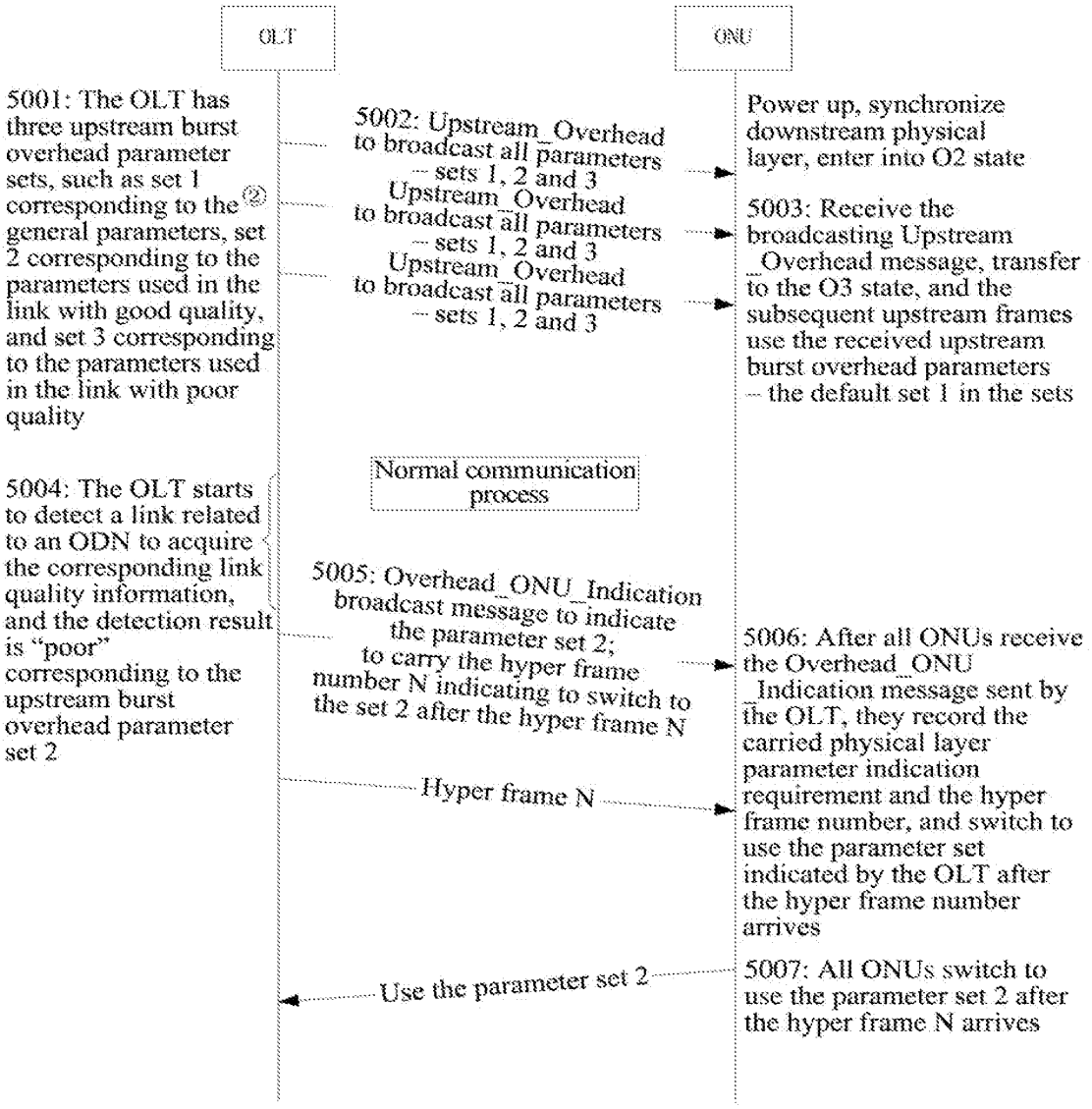

OLT
ONU
5001: The OLT has three upstream burst overhead parameter sets, such as set 1 corresponding to the general parameters, set 2 corresponding to the parameters used in the link with good quality, and set 3 corresponding to the parameters used in the link with poor quality
5002: Upstream_Overhead to broadcast all parameters – sets 1, 2 and 3
Upstream_Overhead to broadcast all parameters – sets 1, 2 and 3
Upstream_Overhead to broadcast all parameters – sets 1, 2 and 3
Power up, synchronize downstream physical layer, enter into O2 state
5003: Receive the broadcasting Upstream _Overhead message, transfer to the O3 state, and the subsequent upstream frames use the received upstream burst overhead parameters – the default set 1 in the sets
Normal communication process
5004: The OLT starts to detect a link related to an ODN to acquire the corresponding link quality information, and the detection result is "poor" corresponding to the upstream burst overhead parameter set 2
5005: Overhead_ONU_Indication broadcast message to indicate the parameter set 2; to carry the hyper frame number N indicating to switch to the set 2 after the hyper frame N
5006: After all ONUs receive the Overhead_ONU _Indication message sent by the OLT, they record the carried physical layer parameter indication requirement and the hyper frame number, and switch to use the parameter set indicated by the OLT after the hyper frame number arrives
Hyper frame N
Use the parameter set 2
5007: All ONUs switch to use the parameter set 2 after the hyper frame N arrives

FIG. 7

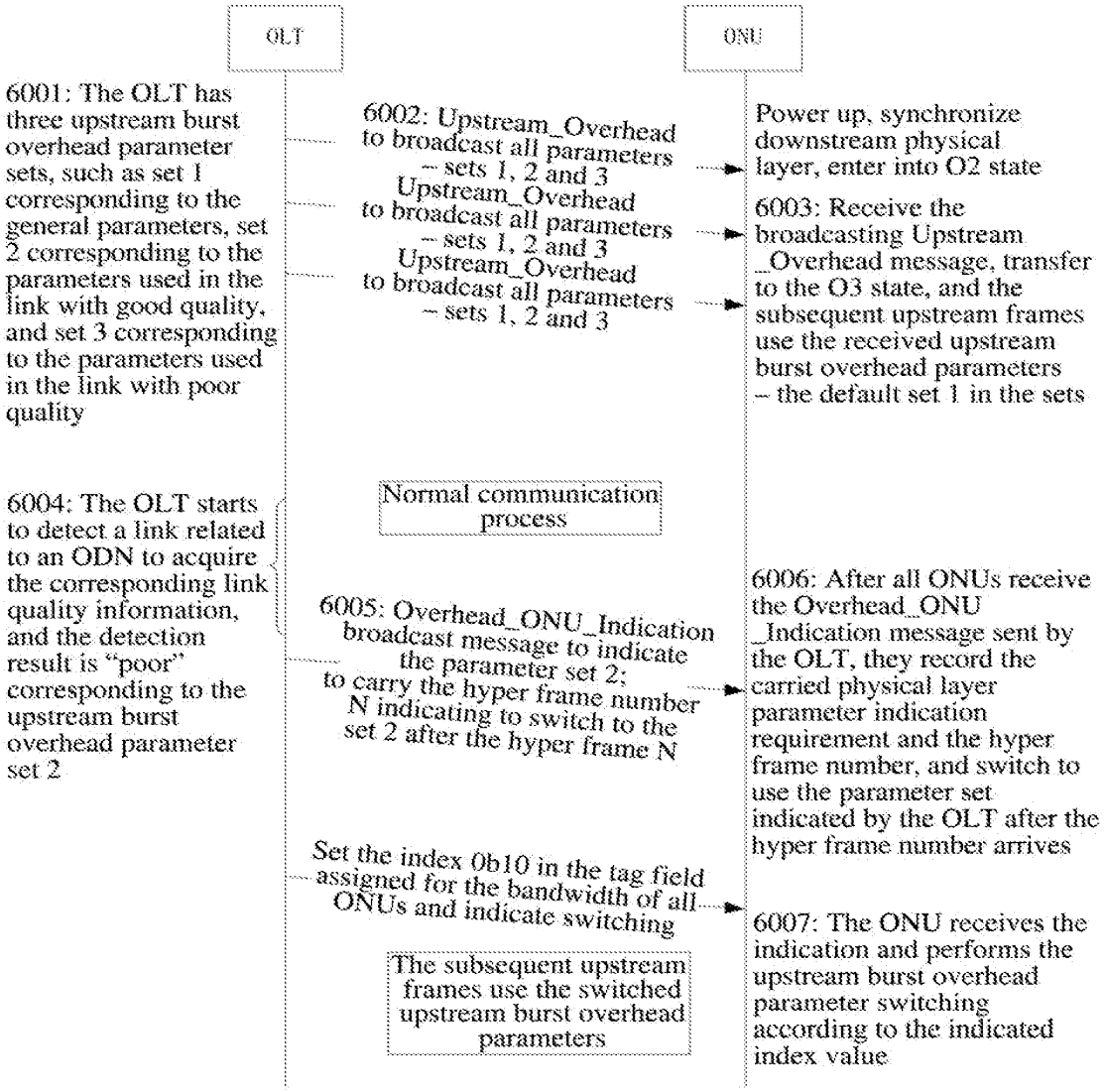

OLT
ONU
6001: The OLT has three upstream burst overhead parameter sets, such as set 1 corresponding to the general parameters, set 2 corresponding to the parameters used in the link with good quality, and set 3 corresponding to the parameters used in the link with poor quality
6002: Upstream_Overhead to broadcast all parameters – sets 1, 2 and 3
Upstream_Overhead to broadcast all parameters – sets 1, 2 and 3
Upstream_Overhead to broadcast all parameters – sets 1, 2 and 3
Power up, synchronize downstream physical layer, enter into O2 state
6003: Receive the broadcasting Upstream _Overhead message, transfer to the O3 state, and the subsequent upstream frames use the received upstream burst overhead parameters – the default set 1 in the sets
6004: The OLT starts to detect a link related to an ODN to acquire the corresponding link quality information, and the detection result is "poor" corresponding to the upstream burst overhead parameter set 2
Normal communication process
6005: Overhead_ONU_Indication broadcast message to indicate the parameter set 2; to carry the hyper frame number N indicating to switch to the set 2 after the hyper frame N
6006: After all ONUs receive the Overhead_ONU _Indication message sent by the OLT, they record the carried physical layer parameter indication requirement and the hyper frame number, and switch to use the parameter set indicated by the OLT after the hyper frame number arrives
Set the index 0b10 in the tag field assigned for the bandwidth of all ONUs and indicate switching
6007: The ONU receives the indication and performs the upstream burst overhead parameter switching according to the indicated index value
The subsequent upstream frames use the switched upstream burst overhead parameters

FIG. 8

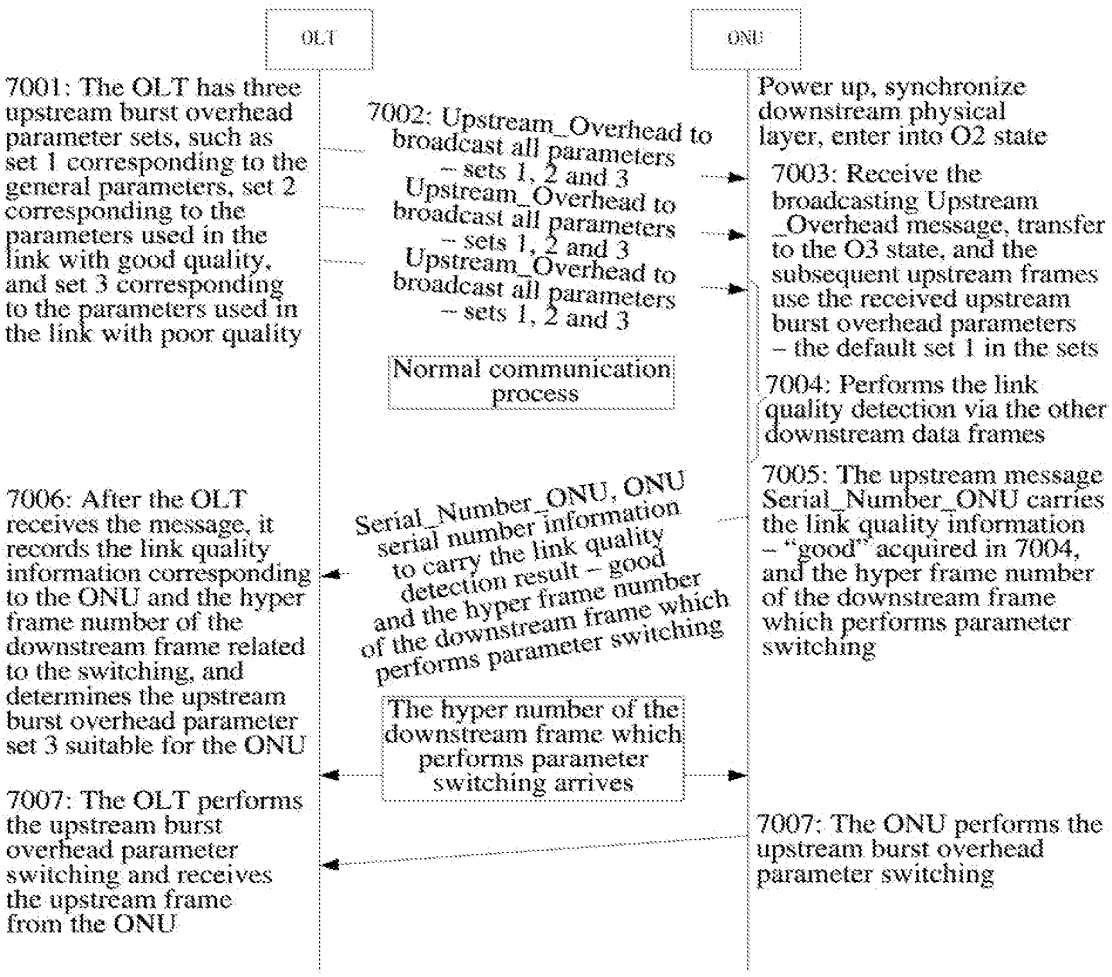

OLT
ONU
7001: The OLT has three upstream burst overhead parameter sets, such as set 1 corresponding to the general parameters, set 2 corresponding to the parameters used in the link with good quality, and set 3 corresponding to the parameters used in the link with poor quality
7002: Upstream_Overhead to broadcast all parameters – sets 1, 2 and 3
Upstream_Overhead to broadcast all parameters – sets 1, 2 and 3
Upstream_Overhead to broadcast all parameters – sets 1, 2 and 3
Power up, synchronize downstream physical layer, enter into O2 state
7003: Receive the broadcasting Upstream _Overhead message, transfer to the O3 state, and the subsequent upstream frames use the received upstream burst overhead parameters – the default set 1 in the sets
Normal communication process
7004: Performs the link quality detection via the other downstream data frames
7005: The upstream message Serial_Number_ONU carries the link quality information – "good" acquired in 7004, and the hyper frame number of the downstream frame which performs parameter switching
7006: After the OLT receives the message, it records the link quality information corresponding to the ONU and the hyper frame number of the downstream frame related to the switching, and determines the upstream burst overhead parameter set 3 suitable for the ONU
Serial_Number_ONU, ONU serial number information to carry the link quality detection result – good and the hyper frame number of the downstream frame which performs parameter switching
The hyper number of the downstream frame which performs parameter switching arrives
7007: The OLT performs the upstream burst overhead parameter switching and receives the upstream frame from the ONU
7007: The ONU performs the upstream burst overhead parameter switching

FIG. 9

PTO/SB/06 (07-06)
Approved for use through 1/31/2007. OMB 0651-0032
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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number	Filing Date	☐ To be Mailed
13/257,621	04/02/2012	

APPLICATION AS FILED – PART I

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

APPLICATION AS AMENDED – PART II

AMENDMENT 04/02/2012	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE ($)	SMALL ENTITY ADDITIONAL FEE ($)	OR	OTHER THAN SMALL ENTITY RATE ($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 18	Minus	** 20	= 0	X $ =		OR	X $60=	0
Independent (37 CFR 1.16(h))	* 3	Minus	***3	= 0	X $ =		OR	X $250=	0
☐ Application Size Fee (37 CFR 1.16(s))									
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	0

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

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

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

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

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

Legal Instrument Examiner:
/BRENDA L. GRAY/

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[见续页]

(54) **Title**: METHOD AND PASSIVE OPTICAL NETWORK SYSTEM FOR MANAGING UPLINK BURST OVERHEAD PARAMETERS

(54) **发明名称** : 一种管理上行突发开销参数的方法及无源光网络系统

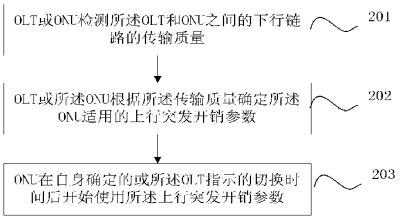


图 2 /FIG. 2

201 AN OLT OR AN ONU DETECTS THE TRANSMISSION QUALITY OF THE DOWNLINK BETWEEN THE OLT AND THE ONU
202 THE OLT OR THE ONU DETERMINES THE UPLINK BURST OVERHEAD PARAMETERS SUITABLE FOR THE ONU ACCORDING TO THE TRANSMISSION QUALITY
203 THE ONU STARTS TO USE THE UPLINK BURST OVERHEAD PARAMETERS SUITABLE FOR THE ONU AFTER THE SWITCHING TIME DETERMINED BY ITSELF OR INDICATED BY THE OLT

(57) **Abstract**: A method for managing uplink burst overhead parameters includes: an Optical Line Terminal (OLT) or an Optical Network Unit (ONU) detects the transmission quality of the downlink between the OLT and the ONU; the OLT or the ONU determines the uplink burst overhead parameters suitable for the ONU according to the transmission quality; and the ONU starts to use the uplink burst overhead parameters suitable for the ONU after the switching time determined by itself or indicated by the OLT. The present invention also provides an ONU and an OLT for managing the uplink burst overhead parameters. The present invention can improve the bandwidth utilization rate, decrease the complexity of the indication of the uplink burst overhead parameters in the Passive Optical Network (PON) system, and enable the ONU and the OLT to select the uplink burst overhead parameters flexibly and simply.

(57) **摘要**:

[见续页]

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本国际公布:

— 包括国际检索报告(条约第 21 条(3))。

— 在修改权利要求的期限届满之前进行，在收到该修改后将重新公布(细则 48.2(h))。

— 根据申请人的请求，在条约第 21 条(2)(a)所规定的期限届满之前进行。

一种管理上行突发开销参数的方法，包括：光线路终端（OLT）或光网络单元（ONU）检测所述 OLT 和所述 ONU 之间的下行链路的传输质量；所述 OLT 或所述 ONU 根据所述传输质量确定所述 ONU 适用的上行突发开销参数； 以及所述 ONU 在自身确定的或所述 OLT 指示的切换时间后开始使用所述 ONU 适用的上行突发开销参数。本发明还提供了一种管理上行突发开销参数的 ONU 和一种管理上行突发开销参数的 OLT。本发明可以提高带宽利用率，还可以降低 PON 系统中指示上行突发开销参数的复杂度，使 ONU 和 OLT 能灵活且简单的选择上行突发开销参数。

一种管理上行突发开销参数的方法及无源光网络系统

技术领域

本发明涉及光通讯技术领域，尤其涉及一种用于无源光网络（Passive Optical Network，简称 PON）系统中光线路终端（Optical Line Terminal，简称 OLT）和光网络单元（Optical Network Unit，简称 ONU）之间针对所使用的上行突发开销参数的一种分配及管理方法及无源光网络系统。

背景技术

在 PON 技术中，OLT 和 ONU 之间，都需要有双方一致的上行突发开销参数：ONU 按照确定好的上行突发开销参数发送上行帧；OLT 也按照确定好的上行突发开销参数正确的接收上行帧，基于这样的前提条件，PON 才能正常的工作。一般这样的上行突发开销参数包含：

（1）前向纠错（Forward Error Correction，简称 FEC）状态（开或者关）。

（2）定界符（Delimiter）参数，可变长，适应于不同的光纤链路质量。

（3）前导码（Preamble）参数，通常为固定值，但是可以是几种固定值供选择，也和不同光纤链路质量以及光模块的性能相关。

（4） 保护带宽（Guard time）参数，保护带宽的比特位数，一般是固定长度。

现有 ITU G.984.3 GPON 技术标准中，这些上行突发开销参数在 OLT 和 ONU 之间是按照下面的方法进行确定的：OLT 在周期性启动的注册过程中，对与之通信的所有 ONU 广播 OLT 所需要使用的部分上行突发开销参数，包括上述上行突发开销参数中的参数（2）（3）（4）。如图 1 所示，ONU 在取得下行物理层同步并进入等待状态（即 O2 状态）后，一直在侦听下行 OLT 广播的携带部分上行突发开销参数的消息，一旦成功接收到，则记录所携带的上行突发开销参数，并迁移到序列号状态（即 O3 状态），且在后续上行工作过程中一直使用所接收到的这些上行突发开销参数，不再更改。

Exhibit 1002
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另外，在吉比特无源光网络（Gigabit Passive Optical Network，简称GPON）现有标准中，上行突发开销参数中参数（1）FEC的状态通知机制也独立于上述（2）（3）（4）参数的沟通机制。参数（1）FEC的开关通知是通过下行帧的带宽分配域中每个 ONU 的每个上行突发带宽分配的标志域中固定指示位进行实时指示。

发明内容

现有技术实际实现中有两个问题:

复杂度问题:GPON 系统中对于上行突发开销参数的指示是分开进行的，复杂度较高。

效率问题：GPON 系统中 ONU 在确定前导码和定界符等上行突发开销参数后都不再更新，在某些链路质量提升后，允许使用较短的前导码参数来进行上行通讯时，也没有提供相应的机制进行协商，被迫使用原先的上行突发开销参数进行上行通讯，这样不够灵活，且带宽效率也无法随着线路质量好转进行提升。

本发明要解决的技术问题是提供一种光接入节点之间上行突发开销参数的管理方法，提高带宽利用率。

为了解决上述问题，本发明提供了一种管理上行突发开销参数的方法，包括:

光线路终端（OLT）或光网络单元（ONU）检测所述 OLT 和所述 ONU 之间的下行链路的传输质量;

所述 OLT 或所述 ONU 根据所述传输质量确定所述 ONU 适用的上行突发开销参数；以及

所述 ONU 在自身确定的或所述 OLT 指示的切换时间后开始使用所述 ONU 适用的上行突发开销参数。

OLT 或 ONU 检测所述 OLT 和所述 ONU 之间的下行链路的传输质量的步骤之前，所述方法还包括:

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所述 OLT 针对不同级别的链路质量确定 N 种上行突发开销参数集合并进行标识；其中，N 为大于零的整数；以及

所述 OLT 将默认的一种上行突发开销参数集合的参数值或上行突发开销参数集合的标识发送至所述 ONU，所述 ONU 在等待状态下接收所述上行突发开销参数集合的参数值或上行突发开销参数集合标识，并使用此上行突发开销参数集合；或者，

所述 OLT 将一种以上上行突发开销参数集合的参数值或上行突发开销参数集合标识发送至所述 ONU，所述 ONU 在等待状态下接收所述一种以上上行突发开销参数集合的参数值或上行突发开销参数集合标识，并使用其中一种上行突发开销参数集合。

ONU 接收上行突发开销参数集合的参数值或上行突发开销参数集合标识的步骤之后，所述方法还包括：所述 ONU 进入序列号状态；

ONU 检测所述 OLT 和所述 ONU 之间的下行链路的传输质量的步骤包括：在 ONU 的序列号状态下，所述 OLT 检测所述 ONU 与所述 OLT 之间的下行链路，获知所述下行链路的质量信息；

所述 OLT 根据所述传输质量确定所述 ONU 适用的上行突发开销参数的步骤包括：所述 OLT 根据所述下行链路的质量信息确定所述 ONU 适用的上行突发开销参数集合，通过单播消息或多播消息将所述 ONU 适用的上行突发开销参数集合中参数值或者 ONU 适用的上行突发开销参数集合的标识通知至所述 ONU。

ONU 接收上行突发开销参数集合的参数值或上行突发开销参数集合标识的步骤之后，所述方法还包括：所述 ONU 进入序列号状态；

ONU 检测所述 OLT 和所述 ONU 之间的下行链路的传输质量的步骤包括：在 ONU 的序列号状态下，所述 ONU 检测所述 ONU 与所述 OLT 之间的下行链路，获知所述下行链路的质量信息；

获知所述下行链路的质量信息的步骤之后，所述方法还包括：所述 ONU 将所述下行链路的质量信息通知至所述 OLT；

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所述 OLT 根据所述传输质量确定所述 ONU 适用的上行突发开销参数的步骤包括：所述 OLT 根据所述下行链路的质量信息确定所述 ONU 适用的上行突发开销参数集合，通过单播消息或多播消息将所述 ONU 适用的上行突发开销参数集合中参数值或者 ONU 适用的上行突发开销参数集合的标识通知至所述 ONU。

ONU 接收上行突发开销参数集合的参数值或上行突发开销参数集合标识的步骤之后，所述方法还包括：所述 ONU 进入序列号状态；

ONU 检测所述 OLT 和所述 ONU 之间的下行链路的传输质量的步骤包括：在 ONU 的序列号状态下，所述 ONU 检测所述 ONU 与所述 OLT 之间的下行链路，获知此下行链路的质量信息；

所述 ONU 根据所述传输质量确定所述 ONU 适用的上行突发开销参数的步骤包括：所述 ONU 根据所述下行链路的质量信息确定所述 ONU 适用的上行突发开销参数集合，通过单播消息或多播消息将所述 ONU 适用的上行突发开销参数集合中参数值或者 ONU 适用的上行突发开销参数集合的标识通知至所述 OLT。

所述 OLT 在将确定的上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 ONU 的步骤的同时或之后，或者，所述 ONU 将所述上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 OLT 的步骤的同时或之后，所述方法还包括：所述 OLT 在为 ONU 的带宽分配的标志域中设置上行突发开销参数的切换索引值，通过下行帧发送给所述 ONU；所述 ONU 在所述 OLT 指示的切换时间后开始使用所述上行突发开销参数的步骤包括：所述 ONU 接收到所述切换索引值后，在下一帧中使用所述 ONU 适用的上行突发开销参数；或者

所述 OLT 在将确定的上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 ONU 的步骤的同时或之后，或者，所述 ONU 将所述上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 OLT 的步骤的同时或之后，所述方法还包括：所述 OLT 向所述 ONU 通知超帧号；所述 ONU 在所述 OLT 指示的切换时间后开始使用所述上行突

发开销参数的步骤包括：所述 ONU 接收到所述超帧号后，在所述超帧号指示的帧到达后，开始使用所述 ONU 适用的上行突发开销参数；或者

所述 OLT 在将确定的上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 ONU 的步骤的同时或之后，或者，所述 ONU 在将确定的上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 OLT 的步骤的同时或之后，所述方法还包括：所述 ONU 向所述 OLT 通知超帧号；所述 ONU 在自身确定的切换时间后开始使用所述上行突发开销参数的步骤包括：所述 ONU 在所述超帧号指示的帧到达后，开始使用所述 ONU 适用的上行突发开销参数。

所述上行突发开销参数集合包括：前向纠错状态，定界符参数，前导码参数和保护带宽参数。

所述 OLT 将一种以上上行突发开销参数集合的参数值或上行突发开销参数集合标识发送至所述 ONU 的步骤中，所述 OLT 是将一种或多种上行突发开销参数集合的参数值或上行突发开销参数集合的标识发送至与之相通信的所有 ONU 或其中一个或几个 ONU。

为了解决上述技术问题，本发明还提供了一种管理上行突发开销参数的无源光网络系统，包括光线路终端 OLT 或光网络单元 ONU；所述光线路终端 OLT，用于检测所述 OLT 与所述 ONU 之间的下行链路的传输质量，根据此传输质量确定所述 ONU 适用的上行突发开销参数，并通知至所述 ONU；还用于向所述 ONU 指示切换时间；所述光网络单元 ONU，用于检测所述 OLT 和所述 ONU 之间的下行链路的传输质量，根据所述传输质量确定适用的上行突发开销参数；或者，直接从所述 OLT 接收所述 OLT 确定的下行链路传输质量；还用于在自身确定的切换时间或者所述 OLT 指示的切换时间后开始使用所述上行突发开销参数。

为了解决上述问题，本发明还提供了一种管理上行突发开销参数的光网络单元（ONU），其包括：第一参数获取模块和切换模块；其中：

所述第一参数获取模块设置为：

检测所述光线路终端（OLT）和所述 ONU 之间的下行链路的传输质量或接收光线路终端（OLT）发送的所述 OLT 检测得到的下行链路的传输质量，根据所述传输质量确定 ONU 适用的上行突发开销参数，并将所述 ONU 适用的上行突发开销参数发送至所述 OLT；或者，

检测所述 OLT 和所述 ONU 之间的下行链路的传输质量，将所述传输质量发送至所述 OLT，并接收所述 OLT 发送的根据所述传输质量确定的 ONU 适用的上行突发开销参数；或者，

直接从所述 OLT 接收所述 OLT 确定的 ONU 适用的上行突发开销参数；以及，

将确定的所述 ONU 适用的上行突发开销参数通知至所述 OLT 的同时或之后，或者，接收 OLT 发送的所述 ONU 适用的上行突发开销参数的同时或之后，指示所述切换模块；

所述切换模块设置为：

收到所述第一参数获取模块的指示的同时或之后，确定切换事件或接收所述 OLT 指示的切换时间，在自身确定的切换时间或者所述 OLT 指示的切换时间后开始使用所述 ONU 适用的上行突发开销参数。

所述 ONU 还包括突发开销参数集合接收模块；

所述突发开销参数集合接收模块设置为：在等待状态下接收所述 OLT 针对不同级别的链路质量确定的 N 种上行突发开销参数集合并进行标识后向所述 ONU 发送的默认的一种上行突发开销参数集合的参数值或上行突发开销参数集合的标识，并使用此上行突发开销参数集合；或者，

在等待状态下接收所述 OLT 针对不同级别的链路质量确定的 N 种上行突发开销参数集合并进行标识后向所述 ONU 发送的一种以上上行突发开销参数集合的参数值或上行突发开销参数集合标识，并使用其中一种上行突发开销参数集合；

其中，N 为大于零的整数。

所述切换模块还设置为：收到所述第一参数获取模块的指示的同时或之后，接收所述 OLT 通过下行帧向所述 ONU 发送的所述 OLT 为 ONU 的带宽分配的标志域中设置的上行突发开销参数的切换索引值；以及，所述切换模块是设置为按如下方式在所述 OLT 指示的切换时间后开始使用所述上行突发开销参数：接收到所述切换索引值后，在下一帧中使用所述上行突发开销参数；或者

所述切换模块还设置为：收到所述第一参数获取模块的指示的同时或之后，接收所述 OLT 向所述 ONU 通知的超帧号；以及，所述切换模块是设置为按如下方式在所述 OLT 指示的切换时间后开始使用所述上行突发开销参数：在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数；或者

所述切换模块还设置为：收到所述第一参数获取模块的指示的同时或之后，向所述 OLT 通知超帧号；以及，所述 ONU 是设置为按如下方式在自身确定的切换时间后开始使用所述上行突发开销参数：在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数。

为了解决上述问题，本发明还提供了一种管理上行突发开销参数的光线路终端（OLT），其包括：第二参数获取模块和切换时间收发模块，其中：

所述第二参数获取模块设置为：

检测所述 OLT 与光网络单元（ONU）之间的下行链路的传输质量，将所述传输质量发送给所述 ONU，并接收所述 ONU 根据所述 OLT 发送的传输质量所确定的 ONU 适用的上行突发开销参数；或者，

检测所述 OLT 与光网络单元（ONU）之间的下行链路的传输质量，并根据所述传输质量确定所述 ONU 适用的上行突发开销参数，并将确定的所述 ONU 适用的上行突发开销参数通知至所述 ONU；或者

接收所述 ONU 发送的所述 ONU 检测得到的下行链路的传输质量，根据所述传输质量确定 ONU 适用的上行突发开销参数，并将确定的所述 ONU 适用的上行突发开销参数通知至所述 ONU；或者

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接收所述ONU发送的根据所述ONU自身检测得到的下行链路的传输质量所确定的ONU适用的上行突发开销参数；以及

将确定的所述ONU适用的上行突发开销参数通知至所述ONU的同时或之后，或者，接收到ONU发送的所述ONU适用的上行突发开销参数的同时或之后，指示所述切换时间收发模块；

所述切换时间收发模块设置为：

收到所述第二参数获取模块的指示的同时或之后，向所述ONU指示切换时间或者接收所述ONU发送的切换时间，以使所述ONU在所述切换时间后开始使用所述上行突发开销参数。

上行突发开销参数集合获取模块，其设置为：针对不同级别的链路质量确定N种上行突发开销参数集合并进行标识；其中，N为大于零的整数；以及将默认的一种上行突发开销参数集合的参数值或标识发送至所述ONU，或者，将一种以上上行突发开销参数集合的参数值或上行突发开销参数集合标识发送至所述ONU，

以使所述ONU在等待状态下接收一种上行突发开销参数集合的参数值或上行突发开销参数的标识，并使用此上行突发开销参数集合；或者，在等待状态下接收所述一种以上上行突发开销参数集合的参数值或上行突发开销参数集合上行突发开销参数标识后，使用其中一种上行突发开销参数集合。

所述切换时间收发模块是设置为按如下方式向所述ONU指示切换时间：在为ONU的带宽分配的标志域中设置上行突发开销参数的切换索引值，通过下行帧发送给所述ONU，以使所述ONU接收到所述切换索引值后，在下一帧中使用所述上行突发开销参数；或者

所述切换时间收发模块是设置为按如下方式向所述ONU指示切换时间：向所述ONU通知超帧号，以使所述ONU在所述OLT在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数；或者

所述切换时间收发模块是设置为按如下方式接收所述ONU发送的切换时间：接收所述ONT通知的超帧号，以使所述ONU在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数。

本发明可以提高带宽利用率，还可以降低PON系统中指示上行突发开销参数的复杂度，使ONU和OLT能灵活且简单的选择上行突发开销参数。

附图概述

图1是现有技术中GPON系统中OLT周期性广播上行突发开销参数的示意图；

图2是实施例中光接入节点之间上行突发开销参数的管理方法的示意图；

图3是实施例一中上行突发开销参数的管理方法示意图；

图4是实施例二中上行突发开销参数的管理方法示意图；

图5是实施例三中上行突发开销参数的管理方法示意图；

图6是实施例四中上行突发开销参数的管理方法示意图；

图7是实施例五中上行突发开销参数的管理方法示意图；

图8是实施例六中上行突发开销参数的管理方法示意图；

图9是实施例七中上行突发开销参数的管理方法示意图。

本发明的较佳实施方式

如图2所示，光接入节点之间上行突发开销参数的管理方法包括以下步骤：

步骤201，在ONU处于序列号状态（即O3状态）时，OLT或ONU检测所述OLT和所述ONU之间的下行链路的传输质量；

步骤202，OLT或ONU根据所述传输质量确定所述ONU适用的上行突发开销参数；以及

步骤203，所述ONU在自身确定的或所述OLT指示的切换时间后开始使用所述上行突发开销参数。

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下面详细描述本发明的方法。

本发明的方法中，在 ONU 处于初始状态（即 O1 状态）时，OLT 针对不同级别的链路质量确定 N 种上行突发开销参数集合并进行标识；N 为大于零的整数。每个上行突发开销参数集合均包括以下参数：前向纠错状态，定界符参数，前导码参数和保护带宽参数。

OLT 将默认的一种上行突发开销参数集合的参数值或标识发送至 ONU，ONU 在等待状态（即 O2 状态）下接收上行突发开销参数集合的参数值或标识，并使用此上行突发开销参数集合；或者，OLT 将一种以上上行突发开销参数集合的参数值或标识发送至 ONU，ONU 在 O2 状态下接收所述一种以上上行突发开销参数集合的参数值或标识后，使用其中一种上行突发开销参数集合。上行突发开销参数集合的个数为多个时，可以设定其中一个为默认的集合，ONU 收到一个以上突发开销参数集合参数后，可以选用默认的集合，或者从多个中任意选择一个使用。

OLT 可以将上行突发开销参数集合单播到特定的 ONU，还可以广播到所有 ONU。

在步骤 201 和步骤 202 中，OLT 检测所述 ONU 与所述 OLT 之间的下行链路的情况下，OLT 通过检测下行链路，获知此下行链路的质量信息，并根据此下行链路的质量信息确定所述 ONU 使用的上行突发开销参数集合，通过单播消息或多播消息将所述上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 ONU；

或者，在步骤 201 和步骤 202 中，ONU 检测所述 ONU 与所述 OLT 之间的下行链路的情况下，ONU 通过检测下行链路，获知此下行链路的质量信息，并将所述下行链路的质量信息通知至所述 OLT，所述 OLT 根据所述下行链路的质量信息确定所述 ONU 使用的上行突发开销参数集合，通过单播消息或多播消息将所述上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 ONU；

或者，在步骤 201 和步骤 202 中，ONU 检测所述 ONU 与所述 OLT 之

间的下行链路的情况下，还可以由 ONU 确定其使用的上行突发开销参数集合。ONU 通过检测下行链路，获知此下行链路的质量信息，并根据所述下行链路的质量信息确定所述 ONU 使用的上行突发开销参数集合，通过单播消息或多播消息将所述上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 OLT。

在步骤 203 中，可以由 OLT 通过切换索引值通知 ONU 切换。具体的，OLT 在将确定的上行突发开销参数集合通知至所述 ONU 的同时或之后，在为 ONU 的带宽分配的标志域中设置上行突发开销参数的切换索引值，通过下行帧发送给所述 ONU，所述 ONU 接收到所述切换索引值后，在下一帧中使用所述上行突发开销参数;

或者，在步骤 203 中，还可以由 OLT 通过指示超帧号的方式通知 ONU 切换。具体的，OLT 在将确定的上行突发开销参数集合通知至所述 ONU 的同时或之后，向所述 ONU 通知超帧号，所述 ONU 接收到后，在所述超帧号指示的超帧到达后，开始使用所述上行突发开销参数;

在步骤 203 中，还可以由 ONU 确定超帧号并通知至 OLT。ONU 在将确定的上行突发开销参数集合通知至所述 OLT 的同时或之后，向所述 OLT 通知超帧号，所述 ONU 在所述超帧号指示的超帧到达后，开始使用所述上行突发开销参数。

下面通地过具体实施例来说明本发明的方法。下述各实施例中，假设 OLT 针对线路质量确定了三种上行突发开销参数集合，其中集合 1 是通用的上行开销突发参数，属于默认使用的参数，也对应于一般链路质量的所要求使用的参数，索引值设置为 0b00; 集合 2 是增强的上行突发开销参数，对应于线路质量比一般链路质量恶劣时所使用的参数，索引值设置为 0b01; 集合 3 是减弱的上行突发开销参数，对应于线路质量比一般链路质量良好时所使用的参数，索引值设置为 0b10。此处举例只有三种集合，还可以按照线路质量的实际情况定义多种对应的参数等级，以及设定一一对应的多种上行突发开销参数集合，后续实施例中设置参数集合也可以这样考虑进行设置。

具体实施例一:

具体实施例一中,OLT 向 ONU 广播默认的上行突发开销参数集合,ONU 在进入 O3 状态后,检测 ONU 与 OLT 间的下行链路质量,并将检测的链路质量信号通知至 OLT,OLT 根据此质量信号确定适合所述 ONU 使用的上行突发开销参数集合,并通过单播消息通知至所述 ONU,还在为 ONU 的带宽分配标志域中指示切换,ONU 收到后,在后续上行帧中使用收到的此上行突发开销参数集合参数。

如图 3 所示,具体实施例一中具体包括:

步骤 1001,OLT 确定各上行突发开销参数集合;

步骤 1002,OLT 在下行方向上广播发送上行开销(Upstream_overhead)消息,携带通用的上行突发开销集合参数(即集合 1)。

其中,Upstream_overhead 消息可以携带此集合的参数也可以携带此集合 1 的标识。

此消息可发送一次或多次,本发明中不作限制。

步骤 1003,ONU 上电启动,在 O2 状态接收到 OLT 下发的 Upstream_overhead 消息并成功获取所携带的上行突发开销参数后,转移到 O3 状态。

步骤 1004,从 O3 状态开始,ONU 启动对针对下行链路的传输质量分析,可以采用目前通用的比特间插奇偶校验(Bit Interleaved Parity,BIP)检测方法获取结果,也可以采用常用的前向纠错(FEC)结果和校正位数来来获取结果。本发明中,不排除 ONU 采用其他类似的检测手段,来获取下行链路的传输质量信息。假定 ONU 测量的链路质量的结果是良好。

步骤 1005,ONU 在后续上行帧携带 ONU 对下行链路质量检测(或者是评估)的结果(此时上行帧使用在第 1003 步中接收到的通用上行突发开销参数)上报给 OLT。

例如 ONU 在 O3 状态中响应 OLT 下发的序列号请求带宽分配(SN_Request)时,在上行消息 Serial_Number_ONU 中携带第 1004 步中获

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得的链路质量信息－“良好”。如下表 1 所示:

表 1

ONU序列号 (Serial_Number_ONU) 信息		
Octet	Content	Description
1	11111111 ONU-ID	=11111111：ONU-ID尚未分配，，广播消息 如果已分配，则填入ONU-ID数值，单播消息
2	00000001	消息类型： " ONU序列号信息"
3-6	VID1-VID4	设备商标识 字节1-字节4
7-10	VID2	设备商定义的序列号信息字节1-字节4
11	RRRRRRRR	随机试验的高位8bit
12	RRRRAATT	RRRR =随机试验的低4位bit AA : ONU向OLT通知的链路质量测量结果,此时设置为”01”,对应于”良好” (00- OLT忽略 01-线路质量良好 10-线路质量一般 11-线路质量较差) TT = ONU发射功率 TT = 00 – Low Power TT = 01 – Medium Power TT = 10 – High Power TT = 11 – Reserved
13-20	Reserve	保留

使用 Serial_number_ONU 消息携带该信息仅仅是举例，也可以使用其他上行帧消息中的空闲位，赋予上述表格“AA”类似的定义，用来通知 OLT 链路检测的结果，或者使用专门定义的消息来传递该检测结果。

步骤 1006，OLT 在接收到该上行帧后,记录和该 ONU 对应的线路质量信息,并确定该 ONU 所适合使用的上行突发开销参数集合，本实施例为集合 3.

步骤 1007，在 ONU 被分配好 ONU-ID 之后，OLT 通过单播 Upstream_overhead 消息将该 ONU 所将要使用的参数集合以及对应的索引传递给该 ONU。如下表 2 所示。

表 2

Upstream_Overhead message 上行突发开销参数

Octet	Content	Description
1	ONU-ID	ONU标识
2	00000001	消息标识 "上行突发开销参数".
3	000000ss	ss是该消息中所包含参数集合的索引值 00：参数集合1 01：参数集合2 **10：参数集合3** 11：保留
4	Gggggggg	保护带宽的比特位数
5	Xxxxxxxx	前导码位数.
6-8	Bbbbbbbb bbbbbbbb Bbbbbbbb	定界符 字节1-字节3
9-10	Xxxxxxxx xxxxxxxx Xxxxxxxx	xx = reserved:
11-12	Ddddddddd Ddddddddd	预分配延迟参数
13-20	Reserve	保留

步骤 1008，ONU 接收到 OLT 下发给自己的单播 Upstream_overhead 消息之后，记录其所携带的物理层参数和集合 3 的索引值 0b10。

步骤 1009，OLT 在给该 ONU 的带宽分配的标志域中设置上行突发开销参数的切换索引值，并通过下行帧发给该 ONU。

步骤 1010，ONU 一旦接收到第 1009 步中切换指示，立刻在下一帧按照所指示的索引值进行上行突发开销参数切换，在后续上行传输时使用。

具体实施例二:

具体实施例二中，OLT 向 ONU 广播默认的上行突发开销参数集合，ONU 在进入 O3 状态后，OLT 检测 ONU 与 OLT 间的下行链路质量，并根据此质量信号确定适合所述 ONU 使用的上行突发开销参数集合，并通过单播消息通知至所述 ONU，还在为 ONU 的带宽分配标志域中指示切换，ONU 收到后，在后续上行帧中使用收到的此上行突发开销参数集合参数。

如图 4 所示，具体实施例二中具体包括:

步骤 2001，OLT 确定各上行突发开销参数集合;

步骤 2002，OLT 在下行方向上广播发送 Upstream_overhead 消息，携带通用的上行突发开销参数（即集合 1）。

可以携带此集合的参数也可以携带此集合 1 的标识。此消息可发送一次或多次，本发明中不作限制。

步骤 2003，ONU 上电启动，在 O2 状态接收到 OLT 下发的 Upstream_overhead 消息并成功获取所携带的上行物理层突发开销参数后，转移到 O3 状态。并与 OLT 按照标准（现有技术）制定的规范，进行正常的数据通信。

步骤 2004，OLT 启动对某一个 ONU 对应链路的检测，获取其链路质量信息,测试结果为“较差”，对应于上行突发开销参数集合 2。

本步骤中，启动检测的条件可以是很多种：可以是上行帧误码增多，也可以是上行帧丢失，也可以是运营商主动要求检测等。OLT 的检测方法可以采用目前通用的 BIP，也可以采用常用的 FEC，不排除其他类似的检测手段，只要能获取相关信息即可。

步骤 2005，OLT 通过单播 Upstream_overhead 消息将该 ONU 所将要使用的上行开销参数集合 2 传递给该 ONU。如表 3 所示。

表 3

Upstream_Overhead message 上行突发开销参数		
Octet	Content	Description
1	ONU-ID	ONU标识
2	00000001	消息标识 "上行突发开销参数".
3	gggggggg	保护带宽的比特位数
4	xxxxxxxx	前导码位数.
5-7	bbbbbbbb bbbbbbbb bbbbbbbb	定界符 字节1-字节3

Upstream_Overhead message 上行突发开销参数		
Octet	Content	Description
8-10	xxxxxxxx xxxxxxxx xxxxxxxx	xx = reserved:
11-12	ddddddddd ddddddddd	预分配延迟参数
13-20	Reserve	保留

步骤 2006，ONU 接收到 OLT 下发给自己的单播 Upstream_overhead 消息之后，记录其所携带的物理层参数，后续切换时使用。

后续切换指示和操作可以与实施例一中的相同。

具体实施例三:

具体实施例三与具体实施例二不同之处在于OLT 事先向ONU广播所有参数集合。

如图 5 所示，具体实施例三中具体包括:

步骤 3001 与步骤 2001 相同;

步骤 3002，OLT 在下行方向上广播发送 Upstream_overhead 消息，携带所有的上行突发开销参数（即集合 1，2，3 都在一个消息中发送）。如表 4 所示，此消息可发送一次或多次，本发明中不作限制。

表 4

Upstream_Overhead message 上行突发开销参数		
Octet	Content	Description
1	11111111	广播消息类型
2	00000001	消息标识 "上行突发开销参数".
3-7	ggggggggg ggggggggg ggggggggg ggggggggg ggggggggg	上行突发开销参数－集合1，也是默认使用的参数集合

Upstream_Overhead message 上行突发开销参数		
Octet	Content	Description
8-12	xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx	上行突发开销参数－集合2:对应于传输质量恶劣的链路使用
13-17	bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb	上行突发开销参数－集合3:对应于传输质量优良的链路使用
18-19	dddddddd dddddddd	预分配延迟参数
20	Reserve	保留

步骤 3003，ONU 上电启动，在 O2 状态接收到 OLT 下发的 Upstream_overhead 消息并成功获取所携带的所有上行物理层突发开销参数集合后，转移到 O3 状态。在没有明确指示的情况下，默认使用其中的参数集合 1。ONU 按照标准（现有技术）制定的规范，进行正常的数据通信。

步骤 3004 与步骤 2004 相同;

步骤 3005，OLT 通过单播消息 Upstream_overhead 将该 ONU 所将要使用的上行开销参数集合 2 传递给该 ONU。如表 5 所示的消息格式，其中 BB 应该赋值为“01”。

表 5

Overhead_ONU_Indication message 上行突发开销参数指示消息		
Octet	Content	Description
1	ONU-ID	ONU标识
2	00000001	消息标识 "上行突发开销参数指示".

Overhead_ONU_Indication message 上行突发开销参数指示消息		
Octet	Content	Description
3	000000BB	BB: OLT指示ONU采用的何种上行突发开销参数集合 00: 集合1 **01: 集合2** 10: 集合3 11: 保留
4-20	Reserve	保留

步骤 3006，ONU 接收到 OLT 下发给自己的单播 ONU 开销指示（Overhead_ONU_Indication）消息之后，记录其所携带的物理层参数 BB(01)，后续按照指示进行参数切换。后续切换指示和操作可以同实施例一。

具体实施例四：

具体实施例三与具体实施例二不同之处在于OLT 事先向ONU广播所有参数集合。

如图 6 所示，具体实施例四中具体包括：

步骤 4001 与步骤 1001 相同；

步骤 4002，OLT 在下行方向上广播发送 Upstream_overhead 消息，携带所有的上行突发开销参数集合（即集合 1，2，3 都在一个消息中发送）。如表 6 所示。此消息可发送一次或多次，本发明中不作限制。

表 6

Upstream_Overhead message 上行突发开销参数		
Octet	Content	Description
1	11111111 ONU-ID	=11111111：ONU-ID尚未分配，广播消息 如果已分配，则填入ONU-ID数值,单播消息
2	00000001	消息标识 "上行突发开销参数".

Upstream_Overhead message 上行突发开销参数		
Octet	Content	Description
3	000000xx	xx：本消息为单播消息，OLT指示ONU采用的何种上行突发开销参数集合 00: 集合1 01: 集合2 10: 集合3 11: 保留。 在本消息为广播消息时，xx值无效，ONU忽略
4-8	gggggggg gggggggg gggggggg gggggggg gggggggg	上行突发开销参数－集合1，也是默认使用的参数集合
9-13	xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx	上行突发开销参数－集合2:对应于传输质量恶劣的链路使用
14-18	bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb	上行突发开销参数－集合3:对应于传输质量优良的链路使用
19-20	dddddddd dddddddd	预分配延迟参数

步骤 4003 与步骤 1003 相同；

步骤 4004 与步骤 1004 相同；

步骤 4005 与步骤 1005 相同；ONU 在 O3 状态中响应 OLT 下发的序列号请求带宽分配(SN_Request)时，在上行 ONU 序列号(Serial_Number_ONU) 消息中携带第 1004 步中获得的链路质量信息－“良好”。如表 7 所示：

表 7

Serial_Number_ONU ONU序列号信息		
Octet	Content	Description
1	11111111 ONU-ID	=11111111：ONU-ID尚未分配 如果已经分配，则填入ONU-ID数值
2	00000001	消息类型： " ONU序列号信息"
3-6	VID1-VID4	设备商标识 字节1-字节4
7-10	VID2	设备商定义的序列号信息字节1-字节4
11	RRRRRRRR	随机试验的高位8bit
12	RRRRAATT	RRRR =随机试验的低4位bit **AA：ONU向OLT通知的链路质量测量结果,此时设置为"01",对应于"良好"** **(00- OLT忽略** **01-线路质量良好** **10-线路质量一般** **11-线路质量较差)** TT = ONU发射功率 TT = 00 – Low Power TT = 01 – Medium Power TT = 10 – High Power TT = 11 – Reserved
13-20	Reserve	保留

（使用 Serial_number_ONU 消息携带该信息仅仅是举例，也可以使用其他上行帧消息中的空闲位，赋予上述表格“AA”类似的定义，用来通知 OLT 链路检测的结果，或者使用专门定义的消息来传递该检测结果）。

步骤 4006 与步骤 1006 相同;

步骤 4007，在 ONU 被分配好 ONU-ID 之后，OLT 通过单播 Upstream_overhead 消息指示 ONU 所将要使用的上行突发开销参数是集合 3.(单播消息中 xx 设置为"10")。如表 8 所示。

表 8

Upstream_Overhead message 上行突发开销参数

Octet	Content	Description
1	11111111 ONU-ID	=11111111：ONU-ID尚未分配，广播消息 如果已分配，则填入ONU-ID数值,单播消息
2	00000001	消息标识 "上行突发开销参数".
3	000000xx	xx：本消息为单播消息，OLT指示ONU采用的何种上行突发开销参数集合 00: 集合1 01: 集合2 **10: 集合3** 11: 保留。 在本消息为广播消息时，xx值无效，ONU忽略
4-8	gggggggg gggggggg gggggggg gggggggg gggggggg	上行突发开销参数一集合1，也是默认使用的参数集合
9-13	xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx	上行突发开销参数一集合2:对应于传输质量恶劣的链路使用
14-18	bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb	上行突发开销参数一集合3:对应于传输质量优良的链路使用
19-20	dddddddd dddddddd	预分配延迟参数

步骤 4008，ONU 接收到 OLT 下发给自己的 Upstream_overhead 单播消息之后，记录其所携带的上行突发开销参数指示，后续切换时使用。后续切换指示和操作可以同实施例一。

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具体实施例五：

具体实施例五与具体实施例三的不同之处是，OLT 检测下行链路质量

后，通过广播通道消息 Overhead_ONU_indication 通知 ONU 记录需要切换的上行突发开销参数和切换的超帧号，在超帧号对应的帧来临之后，所有 ONU 切换使用 OLT 指示的上行突发开销参数进行上行传输。

如图 7 所示，具体实施例五中具体包括:

步骤 5001 至步骤 5004 与步骤 3001 至步骤 3004 相同;

步骤 5005，OLT 通过广播 Overhead_ONU_Indication 消息传递给所有 ONU 将要切换使用的上行开销参数集合 2，以及执行参数切换的超帧号. 按照下面的消息格式，其中 BB 应该赋值为“01”。超帧号域（4-7）填入 OLT 要求切换的超帧号的值。如表 9 所示。

表 9

Overhead_ONU_Indication message 上行突发开销参数指示消息		
Octet	Content	Description
1	**11111111**	**广播消息类型**
2	00000001	消息标识 "上行突发开销参数指示".
3	000000BB	BB: OLT指示ONU采用的何种上行突发开销参数集合 00: 集合1 **01: 集合2** 10: 集合3 11: 保留
4－7	ssssssss ssssssss ssssssss ssssssss	OLT要求所有ONU执行切换的超帧号，在该超帧到来之后，所有ONU切换使用OLT指示的上行突发开销参数进行上行传输
8-20	Reserve	保留

步骤 5006，所有 ONU 接收到 OLT 广播的 Overhead_ONU_Indication 消息之后，记录其所携带的物理层参数 BB(01)，和指示切换时刻的超帧号，后续按照指示进行参数切换。

步骤 5007，在后续超帧号所对应的下行帧到来后，ONU 进行上行突发开销参数切换操作，将切换后的值用于上行传输。

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本实施例可以经过简单的修改，将第 5005-5006 步中消息设计成单播消息，这样就可以支持单个 ONU 进行切换，而不是所有 ONU 一起进行切换。

具体实施例六:

具体实施例六与具体实施例五的不同之处是，OLT 检测下行链路质量后，通过广播通道消息 Overhead_ONU_indication 通知 ONU 记录需要切换的上行突发开销参数和切换的超帧号后，OLT 在给所有 ONU 的带宽分配的标志域中设置上行突发开销参数的切换索引值，ONU 接收到此切换指示后，在下下一帧按照所指示的索引值进行上行突发开销参数切换。

如图 8 所示，具体实施例六中具体包括:

步骤 6001 至步骤 6006 与步骤 5001 至步骤 5006 相同;

步骤 6007，OLT 在给所有 ONU 的带宽分配的标志域中设置上行突发开销参数的切换索引值，并通过下行帧发给所有 ONU。

所有的 ONU 一旦接收到第 6007 步中切换指示，立刻在下一帧按照所指示的索引值进行上行突发开销参数切换,在后续上行传输时使用。

本实施例可以经过简单的修改，将第 6005/6006/6007 步中消息设计成单播消息且针对某个 ONU 进行设置，这样就可以支持单个 ONU 进行切换，而不是所有 ONU 一起进行切换。

具体实施例七:

具体实施例七中，ONU 测试线路质量，并根据链路质量确定其使用的上行突发开销参数，ONU 通知 OLT 此上行突发开销参数并指示切换超帧号。

如图 9 所示，具体实施例七中具体包括:

步骤 7001-步骤 7002 与步骤 6001-步骤 6002 相同;

步骤 7003，ONU 上电启动，在 O2 状态接收到 OLT 下发的 Upstream_overhead 消息并成功获取所携带的上行物理层突发开销参数后，转

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移到 O3 状态。

步骤 7004，从 O3 状态开始，ONU 启动对针对下行链路的传输质量分析，可以采用目前通用的 BIP 检测方法获取结果，也可以采用常用的 FEC 结果和校正位数来来获取结果。（不排除 ONU 采用其他类似的检测手段，来获取下行链路的传输质量信息，只要方法可行就可以），假定测量的结果是良好。

步骤 7005，ONU 在得到步骤 7004 中传输质量信息后，后续上行帧携带 ONU 对下行链路质量检测结果“良好”，并根据链路质量确定上行突发开销参数集合即集合 3，ONU 将其确定的上行突发开销参数集合 3 和准备切换使用参数集合 3 的超帧号上报给 OLT。例如 ONU 在 O3 状态中响应 OLT 下发的序列号请求带宽分配（SN_Request）时，在上行消息 Serial_Number_ONU 中携带第 4 步中获得的链路质量信息 - “良好”。如下表 10 所示。

表 10

Serial_Number_ONU ONU序列号信息		
Octet	Content	Description
1	11111111 ONU-ID	=11111111：ONU-ID尚未分配，，广播消息 如果已分配，则填入ONU-ID数值，单播消息
2	00000001	消息类型： " ONU序列号信息"
3-6	VID1-VID4	设备商标识 字节1-字节4
7-10	VID2	设备商定义的序列号信息字节1-字节4
11	RRRRRRRR	随机试验的高位8bit
12	RRRRAATT	RRRR =随机试验的低4位bit AA : ONU向OLT通知的链路质量测量结果,此时设置为”01”,对应于”良好” (00- OLT忽略 01-线路质量良好 10-线路质量一般 11-线路质量较差) TT = ONU发射功率 TT = 00 – Low Power TT = 01 – Medium Power TT = 10 – High Power TT = 11 – Reserved

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Serial_Number_ONU ONU序列号信息		
Octet	Content	Description
13-16	ssssssss ssssssss ssssssss ssssssss	ONU准备切换使用参数集合3的下行帧超帧号. OLT在发送了该超帧号对应的下行帧之后，对该ONU上行帧使用新的上行突发开销参数进行接收。
17-20	Reserve	保留

使用 Serial_number_ONU 消息携带该信息仅仅是举例，也可以使用其他上行帧消息中的空闲位，赋予上述表格中相关域的类似定义，用来通知 OLT 链路检测的结果和切换相关的下行帧超帧号，或者使用专门定义的消息来传递该检测结果。

步骤 7006，OLT 在接收到该消息后,记录和该 ONU 对应的线路质量信息和切换相关的下行帧超帧号,并确定该 ONU 所适合使用的上行突发开销参数集合 3。

步骤 7007，某一时刻 OLT 在发送了该超帧号对应的下行帧之后，ONU 在此时切换使用参数集合 3 发送上行帧，OLT 使用参数集合 3 接收该 ONU 的上行帧。

上述方法可以提高带宽利用率,还可以降低 PON 系统中指示上行突发开销参数的复杂度，使 ONU 和 OLT 能灵活且简单的选择上行突发开销参数。

本发明中管理上行突发开销参数的无源光网络系统包括光线路终端 OLT 或光网络单元 ONU，此两个实体的功能与上述方法中描述的功能相同。如下所述：

所述光线路终端 OLT 设置为：检测所述 OLT 与所述 ONU 之间的下行链路的传输质量，根据此传输质量确定所述 ONU 适用的上行突发开销参数，并通知至所述 ONU；以及向所述 ONU 指示切换时间；

所述光网络单元 ONU 设置为：检测所述 OLT 和所述 ONU 之间的下行

链路的传输质量，根据所述传输质量确定适用的上行突发开销参数；或者，直接从所述 OLT 接收所述 OLT 确定的下行链路传输质量；以及在自身确定的切换时间或者所述 OLT 指示的切换时间后开始使用所述上行突发开销参数。

所述 OLT 还设置为：针对不同级别的链路质量确定 N 种上行突发开销参数集合并进行标识；N 为大于零的整数；还用于将默认的一种上行突发开销参数集合的参数值或标识发送至所述 ONU，或者，将一种以上上行突发开销参数集合的参数值或标识发送至所述 ONU；所述 ONU 还设置为：在等待状态下接收一种上行突发开销参数集合的参数值或标识，并使用此上行突发开销参数集合；或者，在等待状态下接收所述一种以上上行突发开销参数集合的参数值或标识后，使用其中一种上行突发开销参数集合。

所述OLT还设置为：在将确定的上行突发开销参数集合通知至所述ONU的同时或之后，在为 ONU 的带宽分配的标志域中设置上行突发开销参数的切换索引值，通过下行帧发送给所述 ONU；所述 ONU，还用于接收到所述切换索引值后，在下一帧中使用所述上行突发开销参数。

所述OLT还设置为：在将确定的上行突发开销参数集合通知至所述ONU的同时或之后，向所述 ONU 通知超帧号；所述 ONU 还设置为：在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数。

所述ONU还设置为：在将确定的上行突发开销参数集合通知至所述OLT的同时或之后，向所述 OLT 通知超帧号，并在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数。

基于上述系统，本发明还提供了一种管理上行突发开销参数的光网络单元（ONU），其包括：第一参数获取模块和切换模块；其中：

所述第一参数获取模块设置为：

检测光线路终端（OLT）和所述 ONU 之间的下行链路的传输质量或接收 OLT 发送的所述 OLT 检测得到的下行链路的传输质量，根据所述传输质量确定所述 ONU 适用的上行突发开销参数，并将所述 ONU 适

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用的上行突发开销参数发送至所述 OLT；或者，

检测所述 OLT 和所述 ONU 之间的下行链路的传输质量，将所述传输质量发送至所述 OLT，并接收所述 OLT 发送的根据所述传输质量确定的 ONU 适用的上行突发开销参数；或者，

直接从所述 OLT 接收所述 OLT 确定的 ONU 适用的上行突发开销参数；以及，

将确定的所述 ONU 适用的上行突发开销参数通知至所述 OLT 的同时或之后，或者，接收 OLT 发送的所述 ONU 适用的上行突发开销参数的同时或之后，指示所述切换模块；

所述切换模块设置为：

收到所述第一参数获取模块的指示的同时或之后，确定切换时间或接收所述 OLT 指示的切换时间，在自身确定的切换时间或者所述 OLT 指示的切换时间后开始使用所述 ONU 适用的上行突发开销参数。

所述 ONU 还包括突发开销参数集合接收模块；

所述突发开销参数集合接收模块设置为：在等待状态下接收所述 OLT 针对不同级别的链路质量确定的 N 种上行突发开销参数集合并进行标识后向所述 ONU 发送的默认的一种上行突发开销参数集合的参数值或上行突发开销参数集合的标识，并使用此上行突发开销参数集合；或者，

在等待状态下接收所述 OLT 针对不同级别的链路质量确定的 N 种上行突发开销参数集合并进行标识后向所述 ONU 发送的一种以上上行突发开销参数集合的参数值或上行突发开销参数集合标识，并使用其中一种上行突发开销参数集合；

其中，N 为大于零的整数。

所述切换模块还设置为：收到所述第一参数获取模块的指示的同时或之后，接收所述 OLT 通过下行帧向所述 ONU 发送的所述 OLT 为 ONU 的带宽分配的标志域中设置的上行突发开销参数的切换索引值；以及，所述切换模块是设置为按如下方式在所述 OLT 指示的切换时间后开始使用所述上行突发开销参数：接收到所述切换索引值后，在下一帧中使用所述上行突发开销参数；或者

所述切换模块还设置为：收到所述第一参数获取模块的指示的同时或之后，接收所述 OLT 向所述 ONU 通知的超帧号；以及，所述切换模块是设置为按如下方式在所述 OLT 指示的切换时间后开始使用所述上行突发开销参数：在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数；或者

所述切换模块还设置为：收到所述第一参数获取模块的指示的同时或之后，向所述 OLT 通知超帧号；以及，所述 ONU 是设置为按如下方式在自身确定的切换时间后开始使用所述上行突发开销参数：在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数。

基于上述系统，本发明还提供了一种管理上行突发开销参数的光线路终端（OLT），其包括：第二参数获取模块和切换时间收发模块，其中：

所述第二参数获取模块设置为：

检测所述 OLT 与光网络单元（ONU）之间的下行链路的传输质量，将所述传输质量发送给所述 ONU，并接收所述 ONU 根据所述 OLT 发送的传输质量所确定的 ONU 适用的上行突发开销参数；或者，

检测所述 OLT 与 ONU 之间的下行链路的传输质量，并根据所述传输质量确定 ONU 适用的上行突发开销参数，并将确定的所述 ONU 适用的上行突发开销参数通知至所述 ONU；或者

接收所述 ONU 发送的所述 ONU 检测得到的下行链路的传输质量，根据所述传输质量确定 ONU 适用的上行突发开销参数，并将确定的所述 ONU 适用的上行突发开销参数通知至所述 ONU；或者

接收所述ONU发送的根据所述ONU自身检测得到的下行链路的传输质量所确定的ONU适用的上行突发开销参数；以及

将确定的所述ONU适用的上行突发开销参数通知至所述ONU的同时或之后，或者，接收到ONU发送的所述ONU适用的上行突发开销参数的同时或之后，指示所述切换时间收发模块；

所述切换时间收发模块设置为：

收到所述第二参数获取模块的指示的同时或之后，向所述ONU指示切换时间或者接收所述ONU发送的切换时间，以使所述ONU在所述切换时间后开始使用所述上行突发开销参数。

所述OLT还包括：

上行突发开销参数集合获取模块，其设置为：针对不同级别的链路质量确定N种上行突发开销参数集合并进行标识；其中，N为大于零的整数；以及将默认的一种上行突发开销参数集合的参数值或标识发送至所述ONU，或者，将一种以上上行突发开销参数集合的参数值或标识发送至所述ONU，

以使所述ONU在等待状态下接收一种上行突发开销参数集合的参数值或上行突发开销参数的标识，并使用此上行突发开销参数集合；或者，在等待状态下接收所述一种以上上行突发开销参数集合的参数值或上行突发开销参数标识后，使用其中一种上行突发开销参数集合。

所述切换时间收发模块是设置为按如下方式向所述ONU指示切换时间：在为ONU的带宽分配的标志域中设置上行突发开销参数的切换索引值，通过下行帧发送给所述ONU，以使所述ONU接收到所述切换索引值后，在下一帧中使用所述上行突发开销参数；或者

所述切换时间收发模块是设置为按如下方式向所述ONU指示切换时间：向所述ONU通知超帧号，以使所述ONU在所述OLT在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数；或者

所述切换时间收发模块是设置为按如下方式接收所述ONU发送的切换时间：接收所述ONT通知的超帧号，以使所述ONU在所述超帧号指示的帧

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到达后，开始使用所述上行突发开销参数。

以上所述仅为本发明的优选实施例而已，并不用于限制本发明，对于本领域的技术人员来说，本发明可以有各种更改和变化。凡在本发明的精神和原则之内，所作的任何修改、等同替换、改进等，均应包含在本发明的保护范围之内。

工业实用性

本发明可以提高带宽利用率，还可以降低 PON 系统中指示上行突发开销参数的复杂度，使 ONU 和 OLT 能灵活且简单的选择上行突发开销参数。

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权 利 要 求 书

1、一种管理上行突发开销参数的方法，包括:

光线路终端（OLT）或光网络单元（ONU）检测所述 OLT 和所述 ONU 之间的下行链路的传输质量;

所述 OLT 或所述 ONU 根据所述传输质量确定所述 ONU 适用的上行突发开销参数; 以及

所述 ONU 在自身确定的或所述 OLT 指示的切换时间后开始使用所述 ONU 适用的上行突发开销参数。

2、如权利要求 1 所述的方法，其中，OLT 或 ONU 检测所述 OLT 和所述 ONU 之间的下行链路的传输质量的步骤之前，所述方法还包括:

所述 OLT 针对不同级别的链路质量确定 N 种上行突发开销参数集合并进行标识; 其中，N 为大于零的整数; 以及

所述 OLT 将默认的一种上行突发开销参数集合的参数值或上行突发开销参数集合的标识发送至所述 ONU，所述 ONU 在等待状态下接收所述上行突发开销参数集合的参数值或上行突发开销参数集合标识，并使用此上行突发开销参数集合; 或者，

所述 OLT 将一种以上上行突发开销参数集合的参数值或上行突发开销参数集合标识发送至所述 ONU，所述 ONU 在等待状态下接收所述一种以上上行突发开销参数集合的参数值或上行突发开销参数集合标识，并使用其中一种上行突发开销参数集合。

3、如权利要求 2 所述的方法，其中:

ONU 接收上行突发开销参数集合的参数值或上行突发开销参数集合标识的步骤之后，所述方法还包括: 所述 ONU 进入序列号状态;

ONU 检测所述 OLT 和所述 ONU 之间的下行链路的传输质量的步骤包括: 在 ONU 的序列号状态下，所述 OLT 检测所述 ONU 与所述 OLT 之间的

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下行链路，获知所述下行链路的质量信息；

所述 OLT 根据所述传输质量确定所述 ONU 适用的上行突发开销参数的步骤包括：所述 OLT 根据所述下行链路的质量信息确定所述 ONU 适用的上行突发开销参数集合，通过单播消息或多播消息将所述 ONU 适用的上行突发开销参数集合中参数值或者 ONU 适用的上行突发开销参数集合的标识通知至所述 ONU。

4、如权利要求 2 所述的方法，其中：

ONU 接收上行突发开销参数集合的参数值或上行突发开销参数集合标识的步骤之后，所述方法还包括：所述 ONU 进入序列号状态；

ONU 检测所述 OLT 和所述 ONU 之间的下行链路的传输质量的步骤包括：在 ONU 的序列号状态下，所述 ONU 检测所述 ONU 与所述 OLT 之间的下行链路，获知所述下行链路的质量信息；

获知所述下行链路的质量信息的步骤之后，所述方法还包括：所述 ONU 将所述下行链路的质量信息通知至所述 OLT；

所述 OLT 根据所述传输质量确定所述 ONU 适用的上行突发开销参数的步骤包括：所述 OLT 根据所述下行链路的质量信息确定所述 ONU 适用的上行突发开销参数集合，通过单播消息或多播消息将所述 ONU 适用的上行突发开销参数集合中参数值或者 ONU 适用的上行突发开销参数集合的标识通知至所述 ONU。

5、如权利要求 2 所述的方法，其中：

ONU 接收上行突发开销参数集合的参数值或上行突发开销参数集合标识的步骤之后，所述方法还包括：所述 ONU 进入序列号状态；

ONU 检测所述 OLT 和所述 ONU 之间的下行链路的传输质量的步骤包括：在 ONU 的序列号状态下，所述 ONU 检测所述 ONU 与所述 OLT 之间的下行链路，获知此下行链路的质量信息；

所述 ONU 根据所述传输质量确定所述 ONU 适用的上行突发开销参数的

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步骤包括：所述 ONU 根据所述下行链路的质量信息确定所述 ONU 适用的上行突发开销参数集合，通过单播消息或多播消息将所述 ONU 适用的上行突发开销参数集合中参数值或者 ONU 适用的上行突发开销参数集合的标识通知至所述 OLT。

6、如权利要求 3、4 或 5 所述的方法，其中：

所述 OLT 在将确定的上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 ONU 的步骤的同时或之后，或者，所述 ONU 将所述上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 OLT 的步骤的同时或之后，所述方法还包括：所述 OLT 在为 ONU 的带宽分配的标志域中设置上行突发开销参数的切换索引值，通过下行帧发送给所述 ONU；所述 ONU 在所述 OLT 指示的切换时间后开始使用所述上行突发开销参数的步骤包括：所述 ONU 接收到所述切换索引值后，在下一帧中使用所述 ONU 适用的上行突发开销参数；或者

所述 OLT 在将确定的上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 ONU 的步骤的同时或之后，或者，所述 ONU 将所述上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 OLT 的步骤的同时或之后，所述方法还包括：所述 OLT 向所述 ONU 通知超帧号；所述 ONU 在所述 OLT 指示的切换时间后开始使用所述上行突发开销参数的步骤包括：所述 ONU 接收到所述超帧号后，在所述超帧号指示的帧到达后，开始使用所述 ONU 适用的上行突发开销参数；或者

所述 OLT 在将确定的上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 ONU 的步骤的同时或之后，或者，所述 ONU 在将确定的上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 OLT 的步骤的同时或之后，所述方法还包括：所述 ONU 向所述 OLT 通知超帧号；所述 ONU 在自身确定的切换时间后开始使用所述上行突发开销参数的步骤包括：所述 ONU 在所述超帧号指示的帧到达后，开始使用所述 ONU 适用的上行突发开销参数。

7、如权利要求 3、4 或 5 所述的方法，其中：

所述上行突发开销参数集合包括：前向纠错状态，定界符参数，前导码参数和保护带宽参数。

8、如权利要求 2 所述的方法，其中：

所述 OLT 将一种以上上行突发开销参数集合的参数值或上行突发开销参数集合标识发送至所述 ONU 的步骤中，所述 OLT 是将一种或多种上行突发开销参数集合的参数值或上行突发开销参数集合的标识发送至与之相通信的所有 ONU 或其中一个或几个 ONU。

9、一种管理上行突发开销参数的光网络单元（ONU），其包括：第一参数获取模块和切换模块；其中：

所述第一参数获取模块设置为：

检测所述光线路终端（OLT）和所述 ONU 之间的下行链路的传输质量或接收光线路终端（OLT）发送的所述 OLT 检测得到的下行链路的传输质量，根据所述传输质量确定 ONU 适用的上行突发开销参数，并将所述 ONU 适用的上行突发开销参数发送至所述 OLT；或者，

检测所述 OLT 和所述 ONU 之间的下行链路的传输质量，将所述传输质量发送至所述 OLT，并接收所述 OLT 发送的根据所述传输质量确定的 ONU 适用的上行突发开销参数；或者，

直接从所述 OLT 接收所述 OLT 确定的 ONU 适用的上行突发开销参数；以及，

将确定的所述 ONU 适用的上行突发开销参数通知至所述 OLT 的同时或之后，或者，接收 OLT 发送的所述 ONU 适用的上行突发开销参数的同时或之后，指示所述切换模块；

所述切换模块设置为：

收到所述第一参数获取模块的指示的同时或之后，确定切换事件或接收所述 OLT 指示的切换时间，在自身确定的切换时间或者所述 OLT

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指示的切换时间后开始使用所述 ONU 适用的上行突发开销参数。

10、如权利要求 9 所述的 ONU，其还包括：

突发开销参数集合接收模块，其设置为：

在等待状态下接收所述 OLT 针对不同级别的链路质量确定的 N 种上行突发开销参数集合并进行标识后向所述 ONU 发送的默认的一种上行突发开销参数集合的参数值或上行突发开销参数集合的标识，并使用此上行突发开销参数集合；或者，

在等待状态下接收所述 OLT 针对不同级别的链路质量确定的 N 种上行突发开销参数集合并进行标识后向所述 ONU 发送的一种以上上行突发开销参数集合的参数值或上行突发开销参数集合标识，并使用其中一种上行突发开销参数集合；

其中，N 为大于零的整数。

11、如权利要求 9 所述的 ONU，其中：

所述切换模块还设置为：收到所述第一参数获取模块的指示的同时或之后，接收所述 OLT 通过下行帧向所述 ONU 发送的所述 OLT 为 ONU 的带宽分配的标志域中设置的上行突发开销参数的切换索引值；以及，所述切换模块是设置为按如下方式在所述 OLT 指示的切换时间后开始使用所述上行突发开销参数：接收到所述切换索引值后，在下一帧中使用所述上行突发开销参数；或者

所述切换模块还设置为：收到所述第一参数获取模块的指示的同时或之后，接收所述 OLT 向所述 ONU 通知的超帧号；以及，所述切换模块是设置为按如下方式在所述 OLT 指示的切换时间后开始使用所述上行突发开销参数：在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数；或者

所述切换模块还设置为：收到所述第一参数获取模块的指示的同时或之后，向所述 OLT 通知超帧号；以及，所述 ONU 是设置为按如下方式在自身确定的切换时间后开始使用所述上行突发开销参数：在所述超帧号指示的帧

到达后，开始使用所述上行突发开销参数。

12、一种管理上行突发开销参数的光线路终端（OLT），其包括：第二参数获取模块和切换时间收发模块，其中：

所述第二参数获取模块设置为：

检测所述 OLT 与光网络单元（ONU）之间的下行链路的传输质量，将所述传输质量发送给所述 ONU，并接收所述 ONU 根据所述 OLT 发送的传输质量所确定的 ONU 适用的上行突发开销参数；或者，

检测所述 OLT 与光网络单元（ONU）之间的下行链路的传输质量，并根据所述传输质量确定所述 ONU 适用的上行突发开销参数，并将确定的所述 ONU 适用的上行突发开销参数通知至所述 ONU；或者

接收所述 ONU 发送的所述 ONU 检测得到的下行链路的传输质量，根据所述传输质量确定 ONU 适用的上行突发开销参数，并将确定的所述 ONU 适用的上行突发开销参数通知至所述 ONU；或者

接收所述 ONU 发送的根据所述 ONU 自身检测得到的下行链路的传输质量所确定的 ONU 适用的上行突发开销参数；以及

将确定的所述 ONU 适用的上行突发开销参数通知至所述 ONU 的同时或之后，或者，接收到 ONU 发送的所述 ONU 适用的上行突发开销参数的同时或之后，指示所述切换时间收发模块；

所述切换时间收发模块设置为：

收到所述第二参数获取模块的指示的同时或之后，向所述 ONU 指示切换时间或者接收所述 ONU 发送的切换时间，以使所述 ONU 在所述切换时间后开始使用所述上行突发开销参数。

13、如权利要求 12 所述的 OLT，其还包括：

上行突发开销参数集合获取模块，其设置为：针对不同级别的链路质量确定 N 种上行突发开销参数集合并进行标识；其中，N 为大于零的整数；以及将默认的一种上行突发开销参数集合的参数值或标识发送至所述 ONU，或

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者，将一种以上上行突发开销参数集合的参数值或上行突发开销参数集合标识发送至所述 ONU，

以使所述 ONU 在等待状态下接收一种上行突发开销参数集合的参数值或上行突发开销参数的标识，并使用此上行突发开销参数集合；或者，在等待状态下接收所述一种以上上行突发开销参数集合的参数值或上行突发开销参数集合上行突发开销参数标识后，使用其中一种上行突发开销参数集合。

14、如权利要求 12 所述的 OLT，其中：

所述切换时间收发模块是设置为按如下方式向所述 ONU 指示切换时间：在为 ONU 的带宽分配的标志域中设置上行突发开销参数的切换索引值，通过下行帧发送给所述 ONU，以使所述 ONU 接收到所述切换索引值后，在下一帧中使用所述上行突发开销参数；或者

所述切换时间收发模块是设置为按如下方式向所述 ONU 指示切换时间：向所述 ONU 通知超帧号，以使所述 ONU 在所述 OLT 在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数；或者

所述切换时间收发模块是设置为按如下方式接收所述 ONU 发送的切换时间：接收所述 ONT 通知的超帧号，以使所述 ONU 在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数。

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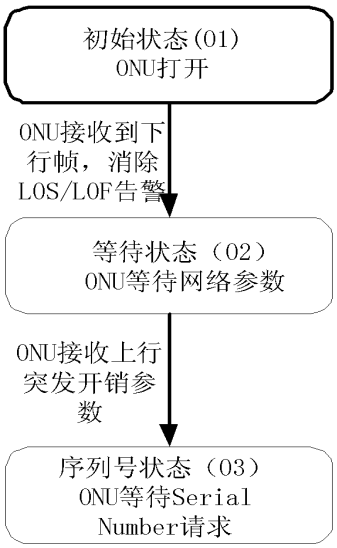

初始状态(01)
ONU打开
ONU接收到下行帧，消除LOS/LOF告警
等待状态（02）
ONU等待网络参数
ONU接收上行突发开销参数
序列号状态（03）
ONU等待Serial Number请求

图 1

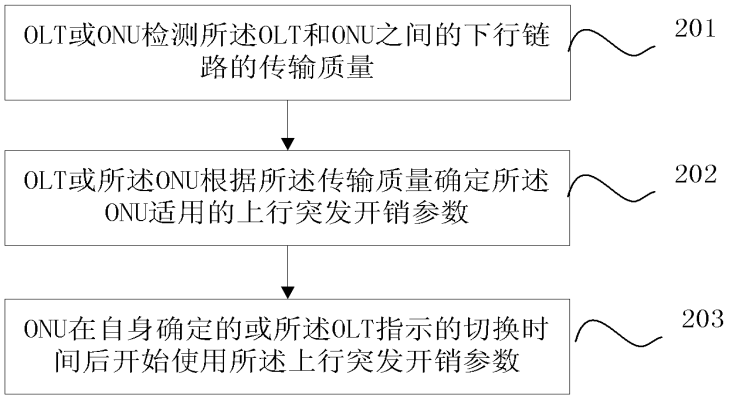

OLT或ONU检测所述OLT和ONU之间的下行链路的传输质量
201
OLT或所述ONU根据所述传输质量确定所述ONU适用的上行突发开销参数
202
ONU在自身确定的或所述OLT指示的切换时间后开始使用所述上行突发开销参数
203

图 2

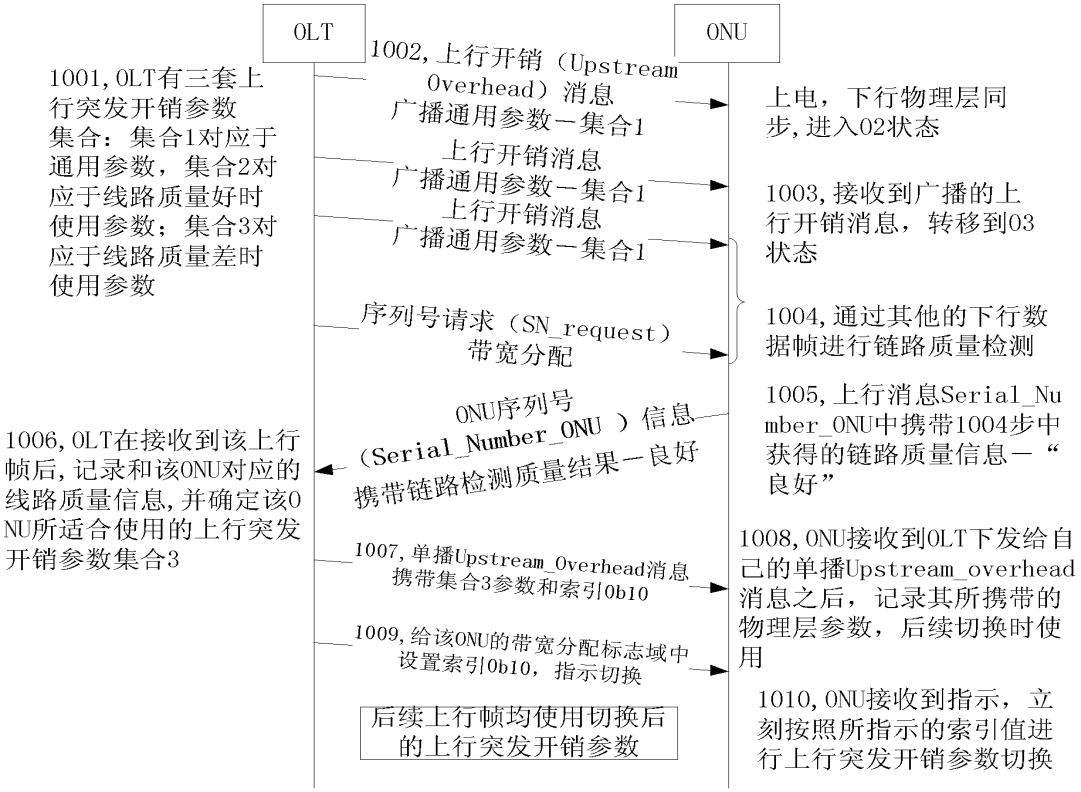


图 3

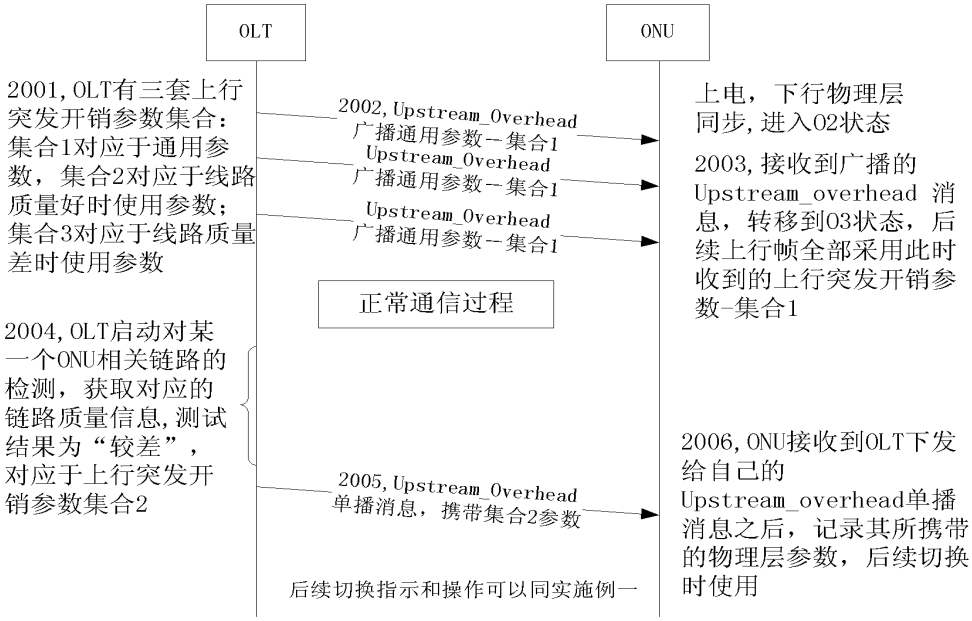


图 4

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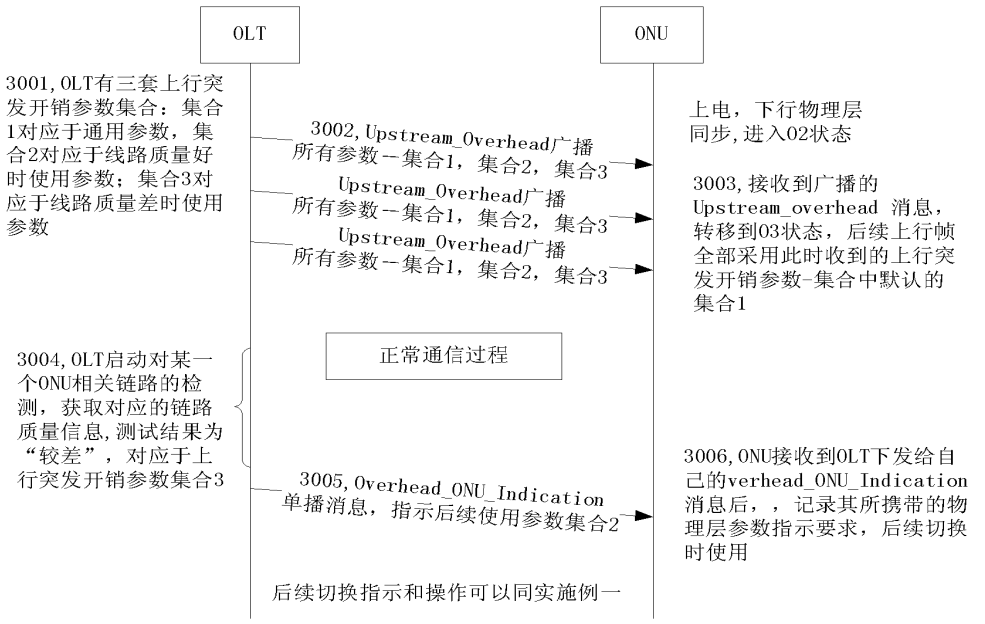

OLT
ONU
3001,OLT有三套上行突发开销参数集合：集合1对应于通用参数，集合2对应于线路质量好时使用参数；集合3对应于线路质量差时使用参数
3002,Upstream_Overhead广播所有参数--集合1，集合2，集合3
Upstream_Overhead广播所有参数--集合1，集合2，集合3
Upstream_Overhead广播所有参数--集合1，集合2，集合3
上电，下行物理层同步,进入02状态
3003,接收到广播的Upstream_overhead 消息，转移到03状态，后续上行帧全部采用此时收到的上行突发开销参数-集合中默认的集合1
正常通信过程
3004,OLT启动对某一个ONU相关链路的检测，获取对应的链路质量信息,测试结果为“较差”，对应于上行突发开销参数集合3
3005,Overhead_ONU_Indication单播消息，指示后续使用参数集合2
3006,ONU接收到OLT下发给自己的verhead_ONU_Indication消息后，，记录其所携带的物理层参数指示要求，后续切换时使用
后续切换指示和操作可以同实施例一

图 5

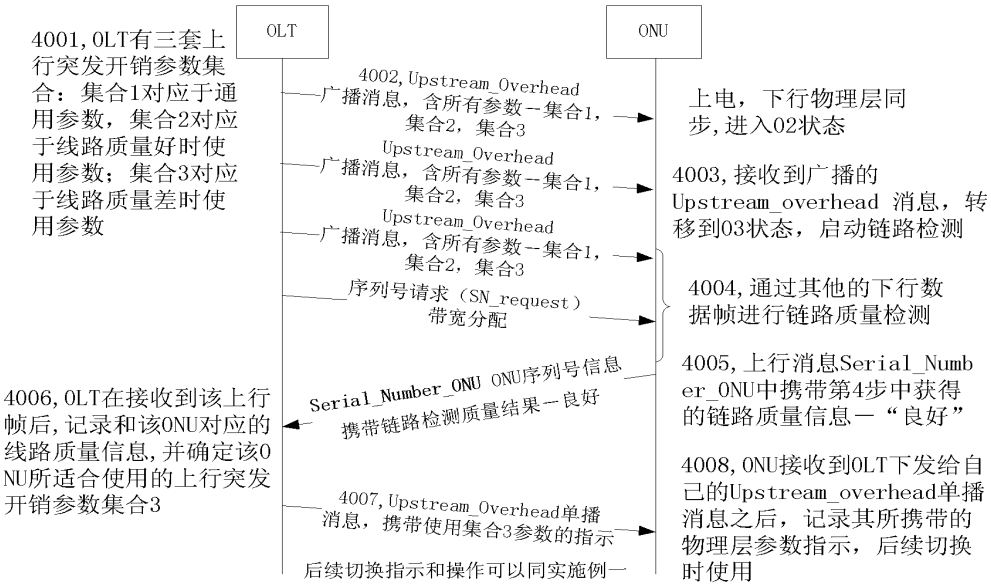

OLT
ONU
4001,OLT有三套上行突发开销参数集合：集合1对应于通用参数，集合2对应于线路质量好时使用参数；集合3对应于线路质量差时使用参数
4002,Upstream_Overhead广播消息，含所有参数--集合1，集合2，集合3
Upstream_Overhead广播消息，含所有参数--集合1，集合2，集合3
Upstream_Overhead广播消息，含所有参数--集合1，集合2，集合3
上电，下行物理层同步,进入02状态
4003,接收到广播的Upstream_overhead 消息，转移到03状态，启动链路检测
序列号请求（SN_request）带宽分配
4004,通过其他的下行数据帧进行链路质量检测
Serial_Number_ONU ONU序列号信息
携带链路检测质量结果--良好
4005,上行消息Serial_Number_ONU中携带第4步中获得的链路质量信息--“良好”
4006,OLT在接收到该上行帧后,记录和该ONU对应的线路质量信息,并确定该ONU所适合使用的上行突发开销参数集合3
4007,Upstream_Overhead单播消息，携带使用集合3参数的指示
4008,ONU接收到OLT下发给自己的Upstream_overhead单播消息之后，记录其所携带的物理层参数指示，后续切换时使用
后续切换指示和操作可以同实施例一

图 6

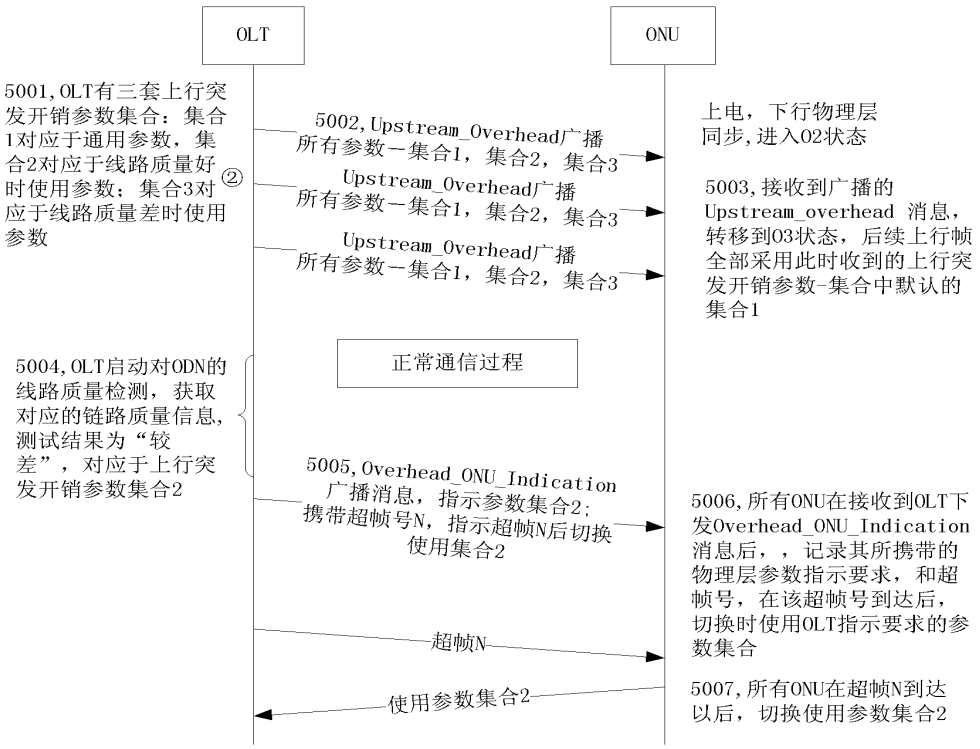

OLT
ONU
5001,OLT有三套上行突发开销参数集合：集合1对应于通用参数，集合2对应于线路质量好时使用参数；集合3对应于线路质量差时使用参数 ②
5002,Upstream_Overhead广播所有参数－集合1，集合2，集合3
Upstream_Overhead广播所有参数－集合1，集合2，集合3
Upstream_Overhead广播所有参数－集合1，集合2，集合3
上电，下行物理层同步,进入O2状态
5003,接收到广播的Upstream_overhead 消息，转移到O3状态，后续上行帧全部采用此时收到的上行突发开销参数-集合中默认的集合1
正常通信过程
5004,OLT启动对ODN的线路质量检测，获取对应的链路质量信息，测试结果为“较差”，对应于上行突发开销参数集合2
5005,Overhead_ONU_Indication广播消息，指示参数集合2;携带超帧号N，指示超帧N后切换使用集合2
5006,所有ONU在接收到OLT下发Overhead_ONU_Indication消息后，，记录其所携带的物理层参数指示要求，和超帧号，在该超帧号到达后，切换时使用OLT指示要求的参数集合
超帧N
使用参数集合2
5007,所有ONU在超帧N到达以后，切换使用参数集合2

图 7

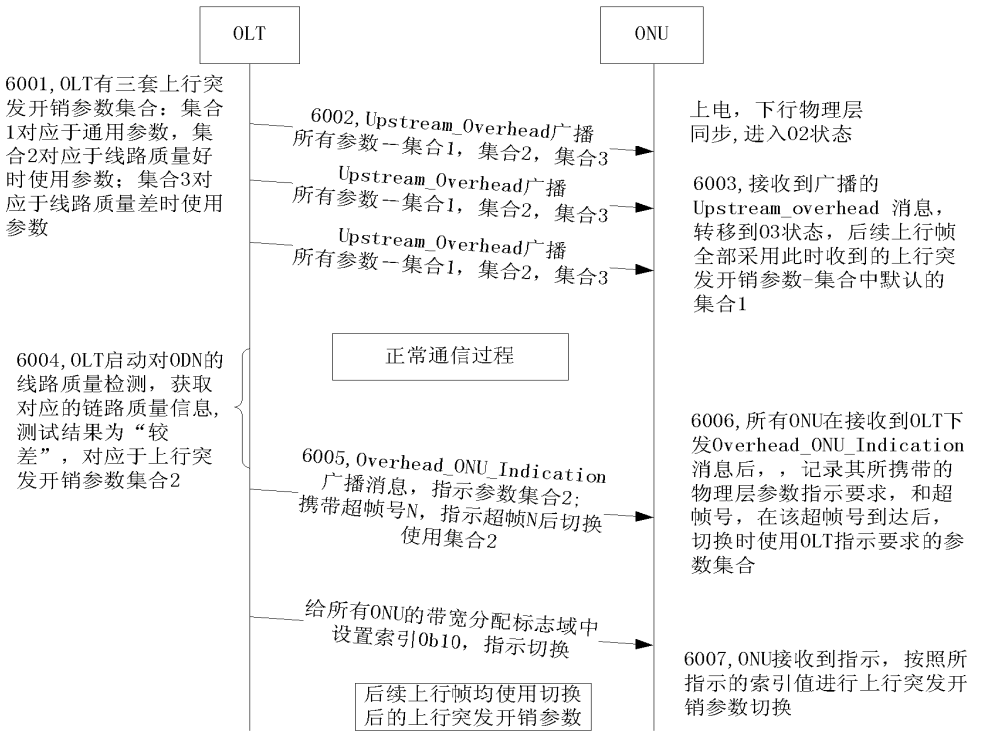


图 8

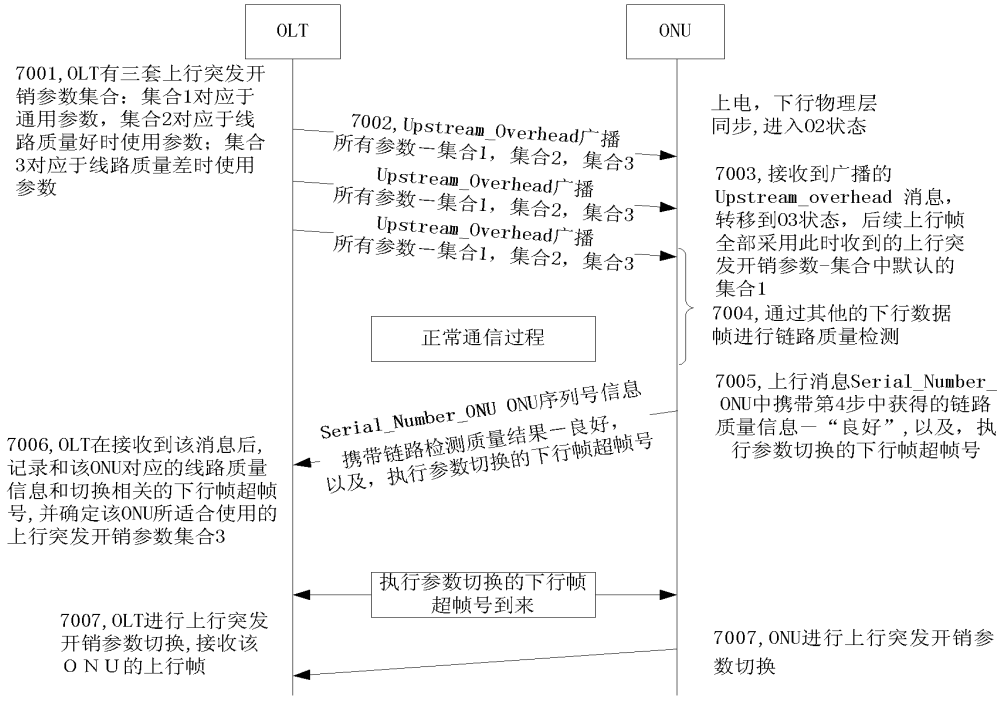


图 9

Exhibit 1002
IPR2024-00900, USPN 8,934,359
347 of 441

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2010/073773

A. CLASSIFICATION OF SUBJECT MATTER

H04L 29/06 (2006.01) 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: 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)

CNKI, CNPAT, WPI, EPODOC: OLT, ONU, parameter, transmi+, communicat???, quality, status, monitor???, detect???, PON, overhead, burst, optical, network?, terminal, state

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN101346958A (NTT DOCOMO INC) 14 Jan. 2009 (14.01.2009) The whole document	1-14
A	CN1677898A (HITACHI INTERNAT ELECTRIC K K) 05 Oct. 2005 (05.10.2005) The whole document	1-14
A	US2002051455A1 (KOREA ELECTRONICS&TELECOM RES INST) 02 May 2002 (02.05.2002) The whole document	1-14

☐ 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
24 Aug. 2010 (24.08.2010)	**23 Sep. 2010 (23.09.2010)**
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 YIN, Yue Telephone No. (86-10)62411226

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2010/073773

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN101346958A	14.01.2009	WO2007052812A1	10.05.2007
		JP2007151056A	14.06.2007
		TW200729791A	01.08.2007
		EP1953977A1	06.08.2008
		KR20080074915A	13.08.2008
		INKOLNP200801711E	26.12.2008
		US2009247180A1	01.10.2009
		JP2009273172A	19.11.2009
		RU2008119078A	10.12.2009
CN1677898A	05.10.2005	US2005213674A1	29.09.2005
		JP2005286446A	13.10.2005
		JP2006217663A	17.08.2006
		JP3898192B2	28.03.2007
		CN100414856C	27.08.2008
		JP4206104B2	07.01.2009
		US2009296852A1	03.12.2009
US2002051455A1	02.05.2002	KR20020033362A	06.05.2002

国际检索报告

国际申请号
PCT/CN2010/073773

A. 主题的分类

H04L 29/06（2006.01）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：H04L

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）)

CNKI, CNPAT, WPI, EPODOC: 突发开销, 光网络单元, 光线路终端, 传输, 链路, 通信, 质量, 状态, 参数, 检测, OLT, ONU, parameter, transmi+, communicat???, quality, status, monitor???, detect???, PON

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
A	CN101346958A（株式会社 NTT 都科摩） 14.1 月 2009（14.01.2009）全文	1-14
A	CN1677898A（株式会社日立国际电气） 05.10 月 2005（05.10.2005）全文	1-14
A	US2002051455A1（KOREA ELECTRONICS&TELECOM RES INST） 02.5 月 2002（02.05.2002）全文	1-14

☐ 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
24.8 月 2010 (24.08.2010)	**23.9 月 2010 (23.09.2010)**
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 殷跃 电话号码：(86-10) **62411226**

PCT/ISA/210 表(第 2 页) (2009 年 7 月)

国际检索报告
关于同族专利的信息

国际申请号
PCT/CN2010/073773

检索报告中引用的专利文件	公布日期	同族专利	公布日期
CN101346958A	14.01.2009	WO2007052812A1	10.05.2007
		JP2007151056A	14.06.2007
		TW200729791A	01.08.2007
		EP1953977A1	06.08.2008
		KR20080074915A	13.08.2008
		INKOLNP200801711E	26.12.2008
		US2009247180A1	01.10.2009
		JP2009273172A	19.11.2009
		RU2008119078A	10.12.2009
CN1677898A	05.10.2005	US2005213674A1	29.09.2005
		JP2005286446A	13.10.2005
		JP2006217663A	17.08.2006
		JP3898192B2	28.03.2007
		CN100414856C	27.08.2008
		JP4206104B2	07.01.2009
		US2009296852A1	03.12.2009
US2002051455A1	02.05.2002	KR20020033362A	06.05.2002

Electronic Patent Application Fee Transmittal	
Application Number:	
Filing Date:	
Title of Invention:	Method and Passive Optical Network System for Managing Uplink Burst Overhead Parameters
First Named Inventor/Applicant Name:	Dezhi ZHANG
Filer:	Ling Wu
Attorney Docket Number:	AFD111101442-US
Filed as Large Entity	

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

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
National Stage Fee	1631	1	330	330
Natl Stage Search Fee - Report provided	1642	1	430	430
National Stage Exam - all other cases	1633	1	220	220
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**980**

Electronic Acknowledgement Receipt

EFS ID:	10985155
Application Number:	13257621
International Application Number:	PCT/CN10/73773
Confirmation Number:	1450
Title of Invention:	Method and Passive Optical Network System for Managing Uplink Burst Overhead Parameters
First Named Inventor/Applicant Name:	Dezhi ZHANG
Customer Number:	95957
Filer:	Ling Wu
Filer Authorized By:	
Attorney Docket Number:	AFD111101442-US
Receipt Date:	20-SEP-2011
Filing Date:	
Time Stamp:	09:51:32
Application Type:	U.S. National Stage under 35 USC 371

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	$980
RAM confirmation Number	17286
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)

1	Application Data Sheet	sb0014_111101442-US.pdf	1348914 a8c1313e93d4b2d2fe789a7850243049964 02d6d	no	5
Warnings:					
Information:					
2	Documents submitted with 371 Applications	PCT_publication.pdf	2349705 628c681f6c933128c560cd03ed810040bea 5fd30	no	48
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	33275 a29021338b62ab22c2a5f678f9063fea5e04 c52e	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	3731894		

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

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

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

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

PTO/SB/14 (07-07)
Approved for use through 06/30/2010. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	AFD111101442-US
	Application Number	
Title of Invention	Method and Passive Optical Network System for Managing Uplink Burst Overhead Parameters	

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

Secrecy Order 37 CFR 5.2

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

Applicant Information:

Applicant 1 Remove

Applicant Authority ◉ Inventor ○ Legal Representative under 35 U.S.C. 117 ○ Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Dezhi		ZHANG	

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

City	Shenzhen	Country Of Residence[i]	CN

Citizenship under 37 CFR 1.41(b)[i] CN

Mailing Address of Applicant:

Address 1	ZTE Plaza, Keji Road South,
Address 2	Hi-Tech Industrial Park, Nanshan District,

City	Shenzhen City, Guangdong Province	State/Province	
Postal Code	518057	Country[i]	CN

Applicant 2 Remove

Applicant Authority ◉ Inventor ○ Legal Representative under 35 U.S.C. 117 ○ Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Marek		HAJDUCZENIA	

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

City		Country Of Residence[i]	PL

Citizenship under 37 CFR 1.41(b)[i] PL

Mailing Address of Applicant:

Address 1	ZTE Plaza, Keji Road South,
Address 2	Hi-Tech Industrial Park, Nanshan District,

City	Shenzhen City, Guangdong Province	State/Province	
Postal Code	518057	Country[i]	CN

Applicant 3 Remove

Applicant Authority ◉ Inventor ○ Legal Representative under 35 U.S.C. 117 ○ Party of Interest under 35 U.S.C. 118

Prefix	Given Name	Middle Name	Family Name	Suffix
	Liquan		YUAN	

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

City	Shenzhen	Country Of Residence[i]	CN

PTO/SB/14 (07-07)
Approved for use through 06/30/2010. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	AFD111101442-US
	Application Number	
Title of Invention	Method and Passive Optical Network System for Managing Uplink Burst Overhead Parameters	

Citizenship under 37 CFR 1.41(b) i	CN			
Mailing Address of Applicant:				
Address 1	ZTE Plaza, Keji Road South,			
Address 2	Hi-Tech Industrial Park, Nanshan District,			
City	Shenzhen City, Guangdong Province	**State/Province**		
Postal Code	518057	**Country**i	CN	
Applicant 4				Remove
Applicant Authority (•) Inventor	( ) Legal Representative under 35 U.S.C. 117	( ) Party of Interest under 35 U.S.C. 118		

Prefix	**Given Name**	**Middle Name**	**Family Name**	**Suffix**
	Weiliang		ZHANG	

Residence Information (Select One) ( ) US Residency	(•) Non US Residency	( ) Active US Military Service		
City	Shenzhen	**Country Of Residence**i	CN	
Citizenship under 37 CFR 1.41(b) i	CN			
Mailing Address of Applicant:				
Address 1	ZTE Plaza, Keji Road South,			
Address 2	Hi-Tech Industrial Park, Nanshan District,			
City	Shenzhen City, Guangdong Province	**State/Province**		
Postal Code	518057	**Country**i	CN	

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

Correspondence Information:

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

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

Customer Number	95957		
Email Address	ling.wu@afdip.com	Add Email	Remove Email

Application Information:

Title of the Invention	Method and Passive Optical Network System for Managing Uplink Burst Overhead Parameters		
Attorney Docket Number	AFD111101442-US	**Small Entity Status Claimed** ☐	
Application Type	Nonprovisional		
Subject Matter	Utility		
Suggested Class (if any)		**Sub Class (if any)**	
Suggested Technology Center (if any)			
Total Number of Drawing Sheets (if any)		**Suggested Figure for Publication (if any)**	

PTO/SB/14 (07-07)
Approved for use through 06/30/2010. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	AFD111101442-US
	Application Number	
Title of Invention	Method and Passive Optical Network System for Managing Uplink Burst Overhead Parameters	

Publication Information:

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

Representative Information:

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

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	95957		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78(a)(2) or CFR 1.78(a)(4), and need not otherwise be made part of the specification.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	a 371 of international	PCT/CN2010/073773	2010-06-10

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

Foreign Priority Information:

This section allows for the applicant to claim benefit of foreign priority and to identify any prior foreign application for which priority is not claimed. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(a).

Remove

Application Number	Country [i]	Parent Filing Date (YYYY-MM-DD)	Priority Claimed
200910212093.3	CN	2009-11-04	◉ Yes ○ No

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

Assignee Information:

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

Assignee 1 Remove

PTO/SB/14 (07-07)
Approved for use through 06/30/2010. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	AFD111101442-US
	Application Number	
Title of Invention	Method and Passive Optical Network System for Managing Uplink Burst Overhead Parameters	

If the Assignee is an Organization check here. ☒			
Organization Name	ZTE CORPORATION		
Mailing Address Information:			
Address 1	ZTE Plaza, Keji Road South,		
Address 2	Hi-Tech Industrial Park, Nanshan District		
City	Shenzhen City, Guangdong Provinc	**State/Province**	
Country [i]	CN	Postal Code	518057
Phone Number		Fax Number	
Email Address			
Additional Assignee Data may be generated within this form by selecting the **Add** button.		Add	

Signature:

A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 10.18. Please see 37 CFR 1.4(d) for the form of the signature.					
Signature	/Ling Wu/			Date (YYYY-MM-DD)	2011-09-20
First Name	Ling	Last Name	Wu	Registration Number	66304

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

Privacy Act Statement

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

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

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

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

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

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

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

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

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

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

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

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(54) **Title**: METHOD AND PASSIVE OPTICAL NETWORK SYSTEM FOR MANAGING UPLINK BURST OVERHEAD PARAMETERS

(54) **发明名称**: 一种管理上行突发开销参数的方法及无源光网络系统

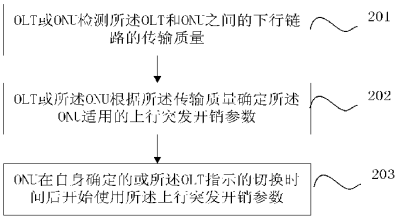


图 2 /FIG. 2

201 AN OLT OR AN ONU DETECTS THE TRANSMISSION QUALITY OF THE DOWNLINK BETWEEN THE OLT AND THE ONU
202 THE OLT OR THE ONU DETERMINES THE UPLINK BURST OVERHEAD PARAMETERS SUITABLE FOR THE ONU ACCORDING TO THE TRANSMISSION QUALITY
203 THE ONU STARTS TO USE THE UPLINK BURST OVERHEAD PARAMETERS SUITABLE FOR THE ONU AFTER THE SWITCHING TIME DETERMINED BY ITSELF OR INDICATED BY THE OLT

(57) **Abstract**: A method for managing uplink burst overhead parameters includes: an Optical Line Terminal (OLT) or an Optical Network Unit (ONU) detects the transmission quality of the downlink between the OLT and the ONU; the OLT or the ONU determines the uplink burst overhead parameters suitable for the ONU according to the transmission quality; and the ONU starts to use the uplink burst overhead parameters suitable for the ONU after the switching time determined by itself or indicated by the OLT. The present invention also provides an ONU and an OLT for managing the uplink burst overhead parameters. The present invention can improve the bandwidth utilization rate, decrease the complexity of the indication of the uplink burst overhead parameters in the Passive Optical Network (PON) system, and enable the ONU and the OLT to select the uplink burst overhead parameters flexibly and simply.

(57) **摘要**:

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本国际公布:

— 包括国际检索报告(条约第 21 条(3))。

— 在修改权利要求的期限届满之前进行，在收到该修改后将重新公布(细则 48.2(h))。

— 根据申请人的请求，在条约第 21 条(2)(a)所规定的期限届满之前进行。

一种管理上行突发开销参数的方法，包括：光线路终端（OLT）或光网络单元（ONU）检测所述 OLT 和所述 ONU 之间的下行链路的传输质量；所述 OLT 或所述 ONU 根据所述传输质量确定所述 ONU 适用的上行突发开销参数； 以及所述 ONU 在自身确定的或所述 OLT 指示的切换时间后开始使用所述 ONU 适用的上行突发开销参数。本发明还提供了一种管理上行突发开销参数的 ONU 和一种管理上行突发开销参数的 OLT。本发明可以提高带宽利用率，还可以降低 PON 系统中指示上行突发开销参数的复杂度，使 ONU 和 OLT 能灵活且简单的选择上行突发开销参数。

一种管理上行突发开销参数的方法及无源光网络系统

技术领域

本发明涉及光通讯技术领域，尤其涉及一种用于无源光网络（Passive Optical Network，简称 PON）系统中光线路终端（Optical Line Terminal，简称 OLT）和光网络单元（Optical Network Unit，简称 ONU）之间针对所使用的上行突发开销参数的一种分配及管理方法及无源光网络系统。

背景技术

在 PON 技术中，OLT 和 ONU 之间，都需要有双方一致的上行突发开销参数：ONU 按照确定好的上行突发开销参数发送上行帧；OLT 也按照确定好的上行突发开销参数正确的接收上行帧，基于这样的前提条件，PON 才能正常的工作。一般这样的上行突发开销参数包含：

（1）前向纠错（Forward Error Correction，简称 FEC）状态（开或者关）。

（2）定界符（Delimiter）参数，可变长，适应于不同的光纤链路质量。

（3）前导码（Preamble）参数，通常为固定值，但是可以是几种固定值供选择，也和不同光纤链路质量以及光模块的性能相关。

（4） 保护带宽（Guard time）参数，保护带宽的比特位数，一般是固定长度。

现有 ITU G.984.3 GPON 技术标准中，这些上行突发开销参数在 OLT 和 ONU 之间是按照下面的方法进行确定的：OLT 在周期性启动的注册过程中，对与之通信的所有 ONU 广播 OLT 所需要使用的部分上行突发开销参数，包括上述上行突发开销参数中的参数（2）（3）（4）。如图 1 所示，ONU 在取得下行物理层同步并进入等待状态（即 O2 状态）后，一直在侦听下行 OLT 广播的携带部分上行突发开销参数的消息，一旦成功接收到，则记录所携带的上行突发开销参数，并迁移到序列号状态（即 O3 状态），且在后续上行工作过程中一直使用所接收到的这些上行突发开销参数，不再更改。

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另外，在吉比特无源光网络（Gigabit Passive Optical Network，简称GPON）现有标准中，上行突发开销参数中参数（1）FEC的状态通知机制也独立于上述（2）（3）（4）参数的沟通机制。参数（1）FEC的开关通知是通过下行帧的带宽分配域中每个 ONU 的每个上行突发带宽分配的标志域中固定指示位进行实时指示。

发明内容

现有技术实际实现中有两个问题:

复杂度问题:GPON 系统中对于上行突发开销参数的指示是分开进行的，复杂度较高。

效率问题：GPON 系统中 ONU 在确定前导码和定界符等上行突发开销参数后都不再更新，在某些链路质量提升后，允许使用较短的前导码参数来进行上行通讯时，也没有提供相应的机制进行协商，被迫使用原先的上行突发开销参数进行上行通讯，这样不够灵活，且带宽效率也无法随着线路质量好转进行提升。

本发明要解决的技术问题是提供一种光接入节点之间上行突发开销参数的管理方法，提高带宽利用率。

为了解决上述问题，本发明提供了一种管理上行突发开销参数的方法，包括:

光线路终端（OLT）或光网络单元（ONU）检测所述 OLT 和所述 ONU 之间的下行链路的传输质量;

所述 OLT 或所述 ONU 根据所述传输质量确定所述 ONU 适用的上行突发开销参数；以及

所述 ONU 在自身确定的或所述 OLT 指示的切换时间后开始使用所述 ONU 适用的上行突发开销参数。

OLT 或 ONU 检测所述 OLT 和所述 ONU 之间的下行链路的传输质量的步骤之前，所述方法还包括:

所述 OLT 针对不同级别的链路质量确定 N 种上行突发开销参数集合并进行标识；其中，N 为大于零的整数；以及

所述 OLT 将默认的一种上行突发开销参数集合的参数值或上行突发开销参数集合的标识发送至所述 ONU，所述 ONU 在等待状态下接收所述上行突发开销参数集合的参数值或上行突发开销参数集合标识，并使用此上行突发开销参数集合；或者，

所述 OLT 将一种以上上行突发开销参数集合的参数值或上行突发开销参数集合标识发送至所述 ONU，所述 ONU 在等待状态下接收所述一种以上上行突发开销参数集合的参数值或上行突发开销参数集合标识，并使用其中一种上行突发开销参数集合。

ONU 接收上行突发开销参数集合的参数值或上行突发开销参数集合标识的步骤之后，所述方法还包括：所述 ONU 进入序列号状态；

ONU 检测所述 OLT 和所述 ONU 之间的下行链路的传输质量的步骤包括：在 ONU 的序列号状态下，所述 OLT 检测所述 ONU 与所述 OLT 之间的下行链路，获知所述下行链路的质量信息；

所述 OLT 根据所述传输质量确定所述 ONU 适用的上行突发开销参数的步骤包括：所述 OLT 根据所述下行链路的质量信息确定所述 ONU 适用的上行突发开销参数集合，通过单播消息或多播消息将所述 ONU 适用的上行突发开销参数集合中参数值或者 ONU 适用的上行突发开销参数集合的标识通知至所述 ONU。

ONU 接收上行突发开销参数集合的参数值或上行突发开销参数集合标识的步骤之后，所述方法还包括：所述 ONU 进入序列号状态；

ONU 检测所述 OLT 和所述 ONU 之间的下行链路的传输质量的步骤包括：在 ONU 的序列号状态下，所述 ONU 检测所述 ONU 与所述 OLT 之间的下行链路，获知所述下行链路的质量信息；

获知所述下行链路的质量信息的步骤之后，所述方法还包括：所述 ONU 将所述下行链路的质量信息通知至所述 OLT；

所述 OLT 根据所述传输质量确定所述 ONU 适用的上行突发开销参数的步骤包括：所述 OLT 根据所述下行链路的质量信息确定所述 ONU 适用的上行突发开销参数集合，通过单播消息或多播消息将所述 ONU 适用的上行突发开销参数集合中参数值或者 ONU 适用的上行突发开销参数集合的标识通知至所述 ONU。

ONU 接收上行突发开销参数集合的参数值或上行突发开销参数集合标识的步骤之后，所述方法还包括：所述 ONU 进入序列号状态；

ONU 检测所述 OLT 和所述 ONU 之间的下行链路的传输质量的步骤包括：在 ONU 的序列号状态下，所述 ONU 检测所述 ONU 与所述 OLT 之间的下行链路，获知此下行链路的质量信息；

所述 ONU 根据所述传输质量确定所述 ONU 适用的上行突发开销参数的步骤包括：所述 ONU 根据所述下行链路的质量信息确定所述 ONU 适用的上行突发开销参数集合，通过单播消息或多播消息将所述 ONU 适用的上行突发开销参数集合中参数值或者 ONU 适用的上行突发开销参数集合的标识通知至所述 OLT。

所述 OLT 在将确定的上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 ONU 的步骤的同时或之后，或者，所述 ONU 将所述上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 OLT 的步骤的同时或之后，所述方法还包括：所述 OLT 在为 ONU 的带宽分配的标志域中设置上行突发开销参数的切换索引值，通过下行帧发送给所述 ONU；所述 ONU 在所述 OLT 指示的切换时间后开始使用所述上行突发开销参数的步骤包括：所述 ONU 接收到所述切换索引值后，在下一帧中使用所述 ONU 适用的上行突发开销参数；或者

所述 OLT 在将确定的上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 ONU 的步骤的同时或之后，或者，所述 ONU 将所述上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 OLT 的步骤的同时或之后，所述方法还包括：所述 OLT 向所述 ONU 通知超帧号；所述 ONU 在所述 OLT 指示的切换时间后开始使用所述上行突

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发开销参数的步骤包括：所述 ONU 接收到所述超帧号后，在所述超帧号指示的帧到达后，开始使用所述 ONU 适用的上行突发开销参数；或者

所述 OLT 在将确定的上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 ONU 的步骤的同时或之后，或者，所述 ONU 在将确定的上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 OLT 的步骤的同时或之后，所述方法还包括：所述 ONU 向所述 OLT 通知超帧号；所述 ONU 在自身确定的切换时间后开始使用所述上行突发开销参数的步骤包括：所述 ONU 在所述超帧号指示的帧到达后，开始使用所述 ONU 适用的上行突发开销参数。

所述上行突发开销参数集合包括：前向纠错状态，定界符参数，前导码参数和保护带宽参数。

所述 OLT 将一种以上上行突发开销参数集合的参数值或上行突发开销参数集合标识发送至所述 ONU 的步骤中，所述 OLT 是将一种或多种上行突发开销参数集合的参数值或上行突发开销参数集合的标识发送至与之相通信的所有 ONU 或其中一个或几个 ONU。

为了解决上述技术问题，本发明还提供了一种管理上行突发开销参数的无源光网络系统，包括光线路终端 OLT 或光网络单元 ONU；所述光线路终端 OLT，用于检测所述 OLT 与所述 ONU 之间的下行链路的传输质量，根据此传输质量确定所述 ONU 适用的上行突发开销参数，并通知至所述 ONU；还用于向所述 ONU 指示切换时间；所述光网络单元 ONU，用于检测所述 OLT 和所述 ONU 之间的下行链路的传输质量，根据所述传输质量确定适用的上行突发开销参数；或者，直接从所述 OLT 接收所述 OLT 确定的下行链路传输质量；还用于在自身确定的切换时间或者所述 OLT 指示的切换时间后开始使用所述上行突发开销参数。

为了解决上述问题，本发明还提供了一种管理上行突发开销参数的光网络单元（ONU），其包括：第一参数获取模块和切换模块；其中：

所述第一参数获取模块设置为：

检测所述光线路终端（OLT）和所述 ONU 之间的下行链路的传输质量或接收光线路终端（OLT）发送的所述 OLT 检测得到的下行链路的传输质量，根据所述传输质量确定 ONU 适用的上行突发开销参数，并将所述 ONU 适用的上行突发开销参数发送至所述 OLT；或者，

检测所述 OLT 和所述 ONU 之间的下行链路的传输质量，将所述传输质量发送至所述 OLT，并接收所述 OLT 发送的根据所述传输质量确定的 ONU 适用的上行突发开销参数；或者，

直接从所述 OLT 接收所述 OLT 确定的 ONU 适用的上行突发开销参数；以及，

将确定的所述 ONU 适用的上行突发开销参数通知至所述 OLT 的同时或之后，或者，接收 OLT 发送的所述 ONU 适用的上行突发开销参数的同时或之后，指示所述切换模块；

所述切换模块设置为：

收到所述第一参数获取模块的指示的同时或之后，确定切换事件或接收所述 OLT 指示的切换时间，在自身确定的切换时间或者所述 OLT 指示的切换时间后开始使用所述 ONU 适用的上行突发开销参数。

所述 ONU 还包括突发开销参数集合接收模块；

所述突发开销参数集合接收模块设置为：在等待状态下接收所述 OLT 针对不同级别的链路质量确定的 N 种上行突发开销参数集合并进行标识后向所述 ONU 发送的默认的一种上行突发开销参数集合的参数值或上行突发开销参数集合的标识，并使用此上行突发开销参数集合；或者，

在等待状态下接收所述 OLT 针对不同级别的链路质量确定的 N 种上行突发开销参数集合并进行标识后向所述 ONU 发送的一种以上上行突发开销参数集合的参数值或上行突发开销参数集合标识，并使用其中一种上行突发开销参数集合；

其中，N 为大于零的整数。

所述切换模块还设置为：收到所述第一参数获取模块的指示的同时或之后，接收所述 OLT 通过下行帧向所述 ONU 发送的所述 OLT 为 ONU 的带宽分配的标志域中设置的上行突发开销参数的切换索引值；以及，所述切换模块是设置为按如下方式在所述 OLT 指示的切换时间后开始使用所述上行突发开销参数：接收到所述切换索引值后，在下一帧中使用所述上行突发开销参数；或者

所述切换模块还设置为：收到所述第一参数获取模块的指示的同时或之后，接收所述 OLT 向所述 ONU 通知的超帧号；以及，所述切换模块是设置为按如下方式在所述 OLT 指示的切换时间后开始使用所述上行突发开销参数：在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数；或者

所述切换模块还设置为：收到所述第一参数获取模块的指示的同时或之后，向所述 OLT 通知超帧号；以及，所述 ONU 是设置为按如下方式在自身确定的切换时间后开始使用所述上行突发开销参数：在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数。

为了解决上述问题，本发明还提供了一种管理上行突发开销参数的光线路终端（OLT），其包括：第二参数获取模块和切换时间收发模块，其中：

所述第二参数获取模块设置为：

检测所述 OLT 与光网络单元（ONU）之间的下行链路的传输质量，将所述传输质量发送给所述 ONU，并接收所述 ONU 根据所述 OLT 发送的传输质量所确定的 ONU 适用的上行突发开销参数；或者，

检测所述 OLT 与光网络单元（ONU）之间的下行链路的传输质量，并根据所述传输质量确定所述 ONU 适用的上行突发开销参数，并将确定的所述 ONU 适用的上行突发开销参数通知至所述 ONU；或者

接收所述 ONU 发送的所述 ONU 检测得到的下行链路的传输质量，根据所述传输质量确定 ONU 适用的上行突发开销参数，并将确定的所述 ONU 适用的上行突发开销参数通知至所述 ONU；或者

接收所述ONU发送的根据所述ONU自身检测得到的下行链路的传输质量所确定的ONU适用的上行突发开销参数；以及

将确定的所述ONU适用的上行突发开销参数通知至所述ONU的同时或之后，或者，接收到ONU发送的所述ONU适用的上行突发开销参数的同时或之后，指示所述切换时间收发模块；

所述切换时间收发模块设置为：

收到所述第二参数获取模块的指示的同时或之后，向所述ONU指示切换时间或者接收所述ONU发送的切换时间，以使所述ONU在所述切换时间后开始使用所述上行突发开销参数。

上行突发开销参数集合获取模块，其设置为：针对不同级别的链路质量确定N种上行突发开销参数集合并进行标识；其中，N为大于零的整数；以及将默认的一种上行突发开销参数集合的参数值或标识发送至所述ONU，或者，将一种以上上行突发开销参数集合的参数值或上行突发开销参数集合标识发送至所述ONU，

以使所述ONU在等待状态下接收一种上行突发开销参数集合的参数值或上行突发开销参数的标识，并使用此上行突发开销参数集合；或者，在等待状态下接收所述一种以上上行突发开销参数集合的参数值或上行突发开销参数集合上行突发开销参数标识后，使用其中一种上行突发开销参数集合。

所述切换时间收发模块是设置为按如下方式向所述ONU指示切换时间：在为ONU的带宽分配的标志域中设置上行突发开销参数的切换索引值，通过下行帧发送给所述ONU，以使所述ONU接收到所述切换索引值后，在下一帧中使用所述上行突发开销参数；或者

所述切换时间收发模块是设置为按如下方式向所述ONU指示切换时间：向所述ONU通知超帧号，以使所述ONU在所述OLT在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数；或者

所述切换时间收发模块是设置为按如下方式接收所述ONU发送的切换时间：接收所述ONT通知的超帧号，以使所述ONU在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数。

本发明可以提高带宽利用率，还可以降低PON系统中指示上行突发开销参数的复杂度，使ONU和OLT能灵活且简单的选择上行突发开销参数。

附图概述

图1是现有技术中GPON系统中OLT周期性广播上行突发开销参数的示意图；

图2是实施例中光接入节点之间上行突发开销参数的管理方法的示意图；

图3是实施例一中上行突发开销参数的管理方法示意图；

图4是实施例二中上行突发开销参数的管理方法示意图；

图5是实施例三中上行突发开销参数的管理方法示意图；

图6是实施例四中上行突发开销参数的管理方法示意图；

图7是实施例五中上行突发开销参数的管理方法示意图；

图8是实施例六中上行突发开销参数的管理方法示意图；

图9是实施例七中上行突发开销参数的管理方法示意图。

本发明的较佳实施方式

如图2所示，光接入节点之间上行突发开销参数的管理方法包括以下步骤：

步骤201，在ONU处于序列号状态（即O3状态）时，OLT或ONU检测所述OLT和所述ONU之间的下行链路的传输质量；

步骤202，OLT或ONU根据所述传输质量确定所述ONU适用的上行突发开销参数；以及

步骤203，所述ONU在自身确定的或所述OLT指示的切换时间后开始使用所述上行突发开销参数。

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下面详细描述本发明的方法。

本发明的方法中，在 ONU 处于初始状态（即 O1 状态）时，OLT 针对不同级别的链路质量确定 N 种上行突发开销参数集合并进行标识；N 为大于零的整数。每个上行突发开销参数集合均包括以下参数：前向纠错状态，定界符参数，前导码参数和保护带宽参数。

OLT 将默认的一种上行突发开销参数集合的参数值或标识发送至 ONU，ONU 在等待状态（即 O2 状态）下接收上行突发开销参数集合的参数值或标识，并使用此上行突发开销参数集合；或者，OLT 将一种以上上行突发开销参数集合的参数值或标识发送至 ONU，ONU 在 O2 状态下接收所述一种以上上行突发开销参数集合的参数值或标识后，使用其中一种上行突发开销参数集合。上行突发开销参数集合的个数为多个时，可以设定其中一个为默认的集合，ONU 收到一个以上突发开销参数集合参数后，可以选用默认的集合，或者从多个中任意选择一个使用。

OLT 可以将上行突发开销参数集合单播到特定的 ONU，还可以广播到所有 ONU。

在步骤 201 和步骤 202 中，OLT 检测所述 ONU 与所述 OLT 之间的下行链路的情况下，OLT 通过检测下行链路，获知此下行链路的质量信息，并根据此下行链路的质量信息确定所述 ONU 使用的上行突发开销参数集合，通过单播消息或多播消息将所述上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 ONU；

或者，在步骤 201 和步骤 202 中，ONU 检测所述 ONU 与所述 OLT 之间的下行链路的情况下，ONU 通过检测下行链路，获知此下行链路的质量信息，并将所述下行链路的质量信息通知至所述 OLT，所述 OLT 根据所述下行链路的质量信息确定所述 ONU 使用的上行突发开销参数集合，通过单播消息或多播消息将所述上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 ONU；

或者，在步骤 201 和步骤 202 中，ONU 检测所述 ONU 与所述 OLT 之

间的下行链路的情况下，还可以由 ONU 确定其使用的上行突发开销参数集合。ONU 通过检测下行链路，获知此下行链路的质量信息，并根据所述下行链路的质量信息确定所述 ONU 使用的上行突发开销参数集合，通过单播消息或多播消息将所述上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 OLT。

在步骤 203 中，可以由 OLT 通过切换索引值通知 ONU 切换。具体的，OLT 在将确定的上行突发开销参数集合通知至所述 ONU 的同时或之后，在为 ONU 的带宽分配的标志域中设置上行突发开销参数的切换索引值，通过下行帧发送给所述 ONU，所述 ONU 接收到所述切换索引值后，在下一帧中使用所述上行突发开销参数;

或者，在步骤 203 中，还可以由 OLT 通过指示超帧号的方式通知 ONU 切换。具体的，OLT 在将确定的上行突发开销参数集合通知至所述 ONU 的同时或之后，向所述 ONU 通知超帧号，所述 ONU 接收到后，在所述超帧号指示的超帧到达后，开始使用所述上行突发开销参数;

在步骤 203 中，还可以由 ONU 确定超帧号并通知至 OLT。ONU 在将确定的上行突发开销参数集合通知至所述 OLT 的同时或之后，向所述 OLT 通知超帧号，所述 ONU 在所述超帧号指示的超帧到达后，开始使用所述上行突发开销参数。

下面通地过具体实施例来说明本发明的方法。下述各实施例中，假设 OLT 针对线路质量确定了三种上行突发开销参数集合，其中集合 1 是通用的上行开销突发参数，属于默认使用的参数，也对应于一般链路质量的所要求使用的参数，索引值设置为 0b00; 集合 2 是增强的上行突发开销参数，对应于线路质量比一般链路质量恶劣时所使用的参数，索引值设置为 0b01; 集合 3 是减弱的上行突发开销参数，对应于线路质量比一般链路质量良好时所使用的参数，索引值设置为 0b10。此处举例只有三种集合，还可以按照线路质量的实际情况定义多种对应的参数等级，以及设定一一对应的多种上行突发开销参数集合，后续实施例中设置参数集合也可以这样考虑进行设置。

具体实施例一:

具体实施例一中,OLT 向 ONU 广播默认的上行突发开销参数集合,ONU 在进入 O3 状态后,检测 ONU 与 OLT 间的下行链路质量,并将检测的链路质量信号通知至 OLT,OLT 根据此质量信号确定适合所述 ONU 使用的上行突发开销参数集合,并通过单播消息通知至所述 ONU,还在为 ONU 的带宽分配标志域中指示切换,ONU 收到后,在后续上行帧中使用收到的此上行突发开销参数集合参数。

如图 3 所示,具体实施例一中具体包括:

步骤 1001,OLT 确定各上行突发开销参数集合;

步骤 1002,OLT 在下行方向上广播发送上行开销(Upstream_overhead)消息,携带通用的上行突发开销集合参数(即集合 1)。

其中,Upstream_overhead 消息可以携带此集合的参数也可以携带此集合 1 的标识。

此消息可发送一次或多次,本发明中不作限制。

步骤 1003,ONU 上电启动,在 O2 状态接收到 OLT 下发的 Upstream_overhead 消息并成功获取所携带的上行突发开销参数后,转移到 O3 状态。

步骤 1004,从 O3 状态开始,ONU 启动对针对下行链路的传输质量分析,可以采用目前通用的比特间插奇偶校验(Bit Interleaved Parity,BIP)检测方法获取结果,也可以采用常用的前向纠错(FEC)结果和校正位数来来获取结果。本发明中,不排除 ONU 采用其他类似的检测手段,来获取下行链路的传输质量信息。假定 ONU 测量的链路质量的结果是良好。

步骤 1005,ONU 在后续上行帧携带 ONU 对下行链路质量检测(或者是评估)的结果(此时上行帧使用在第 1003 步中接收到的通用上行突发开销参数)上报给 OLT。

例如 ONU 在 O3 状态中响应 OLT 下发的序列号请求带宽分配(SN_Request)时,在上行消息 Serial_Number_ONU 中携带第 1004 步中获

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得的链路质量信息－“良好”。如下表 1 所示:

表 1

ONU序列号 (Serial_Number_ONU) 信息		
Octet	Content	Description
1	11111111 ONU-ID	=11111111：ONU-ID尚未分配，，广播消息 如果已分配，则填入ONU-ID数值，单播消息
2	00000001	消息类型： "ONU序列号信息"
3-6	VID1-VID4	设备商标识 字节1-字节4
7-10	VID2	设备商定义的序列号信息字节1-字节4
11	RRRRRRRR	随机试验的高位8bit
12	RRRRAATT	RRRR =随机试验的低4位bit AA : ONU向OLT通知的链路质量测量结果,此时设置为"01",对应于"良好" (00- OLT忽略 01-线路质量良好 10-线路质量一般 11-线路质量较差) TT = ONU发射功率 TT = 00 – Low Power TT = 01 – Medium Power TT = 10 – High Power TT = 11 – Reserved
13-20	Reserve	保留

使用 Serial_number_ONU 消息携带该信息仅仅是举例，也可以使用其他上行帧消息中的空闲位，赋予上述表格“AA”类似的定义，用来通知 OLT 链路检测的结果，或者使用专门定义的消息来传递该检测结果。

步骤 1006，OLT 在接收到该上行帧后,记录和该 ONU 对应的线路质量信息,并确定该 ONU 所适合使用的上行突发开销参数集合，本实施例为集合 3.

步骤 1007，在 ONU 被分配好 ONU-ID 之后，OLT 通过单播 Upstream_overhead 消息将该 ONU 所将要使用的参数集合以及对应的索引传递给该 ONU。如下表 2 所示。

表 2

Upstream_Overhead message 上行突发开销参数

Octet	Content	Description
1	ONU-ID	ONU标识
2	00000001	消息标识 "上行突发开销参数".
3	000000ss	ss是该消息中所包含参数集合的索引值 00：参数集合1 01：参数集合2 **10：参数集合3** 11：保留
4	Gggggggg	保护带宽的比特位数
5	Xxxxxxxx	前导码位数.
6-8	Bbbbbbbb bbbbbbbb Bbbbbbbb	定界符 字节1-字节3
9-10	Xxxxxxxx xxxxxxxx Xxxxxxxx	xx = reserved:
11-12	Ddddddddd Ddddddddd	预分配延迟参数
13-20	Reserve	保留

步骤 1008，ONU 接收到 OLT 下发给自己的单播 Upstream_overhead 消息之后，记录其所携带的物理层参数和集合 3 的索引值 0b10。

步骤 1009，OLT 在给该 ONU 的带宽分配的标志域中设置上行突发开销参数的切换索引值，并通过下行帧发给该 ONU。

步骤 1010，ONU 一旦接收到第 1009 步中切换指示，立刻在下一帧按照所指示的索引值进行上行突发开销参数切换，在后续上行传输时使用。

具体实施例二:

具体实施例二中，OLT 向 ONU 广播默认的上行突发开销参数集合，ONU 在进入 O3 状态后，OLT 检测 ONU 与 OLT 间的下行链路质量，并根据此质量信号确定适合所述 ONU 使用的上行突发开销参数集合，并通过单播消息通知至所述 ONU，还在为 ONU 的带宽分配标志域中指示切换，ONU 收到后，在后续上行帧中使用收到的此上行突发开销参数集合参数。

如图 4 所示，具体实施例二中具体包括:

步骤 2001，OLT 确定各上行突发开销参数集合;

步骤 2002，OLT 在下行方向上广播发送 Upstream_overhead 消息，携带通用的上行突发开销参数（即集合 1）。

可以携带此集合的参数也可以携带此集合 1 的标识。此消息可发送一次或多次，本发明中不作限制。

步骤 2003，ONU 上电启动，在 O2 状态接收到 OLT 下发的 Upstream_overhead 消息并成功获取所携带的上行物理层突发开销参数后，转移到 O3 状态。并与 OLT 按照标准（现有技术）制定的规范，进行正常的数据通信。

步骤 2004，OLT 启动对某一个 ONU 对应链路的检测，获取其链路质量信息,测试结果为“较差”，对应于上行突发开销参数集合 2。

本步骤中，启动检测的条件可以是很多种：可以是上行帧误码增多，也可以是上行帧丢失，也可以是运营商主动要求检测等。OLT 的检测方法可以采用目前通用的 BIP，也可以采用常用的 FEC，不排除其他类似的检测手段，只要能获取相关信息即可。

步骤 2005，OLT 通过单播 Upstream_overhead 消息将该 ONU 所将要使用的上行开销参数集合 2 传递给该 ONU。如表 3 所示。

表 3

Upstream_Overhead message 上行突发开销参数		
Octet	Content	Description
1	ONU-ID	ONU标识
2	00000001	消息标识 "上行突发开销参数".
3	gggggggg	保护带宽的比特位数
4	xxxxxxxx	前导码位数.
5-7	bbbbbbbb bbbbbbbb bbbbbbbb	定界符 字节1-字节3

Upstream_Overhead message 上行突发开销参数		
Octet	Content	Description
8-10	xxxxxxxx xxxxxxxx xxxxxxxx	xx = reserved:
11-12	ddddddddd ddddddddd	预分配延迟参数
13-20	Reserve	保留

步骤 2006，ONU 接收到 OLT 下发给自己的单播 Upstream_overhead 消息之后，记录其所携带的物理层参数，后续切换时使用。

后续切换指示和操作可以与实施例一中的相同。

具体实施例三:

具体实施例三与具体实施例二不同之处在于OLT 事先向ONU广播所有参数集合。

如图 5 所示，具体实施例三中具体包括:

步骤 3001 与步骤 2001 相同;

步骤 3002，OLT 在下行方向上广播发送 Upstream_overhead 消息，携带所有的上行突发开销参数（即集合 1，2，3 都在一个消息中发送）。如表 4 所示，此消息可发送一次或多次，本发明中不作限制。

表 4

Upstream_Overhead message 上行突发开销参数		
Octet	Content	Description
1	11111111	广播消息类型
2	00000001	消息标识 "上行突发开销参数".
3-7	ggggggggg ggggggggg ggggggggg ggggggggg ggggggggg	上行突发开销参数－集合1，也是默认使用的参数集合

Upstream_Overhead message 上行突发开销参数		
Octet	Content	Description
8-12	xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx	上行突发开销参数－集合2:对应于传输质量恶劣的链路使用
13-17	bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb	上行突发开销参数－集合3:对应于传输质量优良的链路使用
18-19	dddddddd dddddddd	预分配延迟参数
20	Reserve	保留

步骤 3003，ONU 上电启动，在 O2 状态接收到 OLT 下发的 Upstream_overhead 消息并成功获取所携带的所有上行物理层突发开销参数集合后，转移到 O3 状态。在没有明确指示的情况下，默认使用其中的参数集合 1。ONU 按照标准（现有技术）制定的规范，进行正常的数据通信。

步骤 3004 与步骤 2004 相同;

步骤 3005，OLT 通过单播消息 Upstream_overhead 将该 ONU 所将要使用的上行开销参数集合 2 传递给该 ONU。如表 5 所示的消息格式，其中 BB 应该赋值为“01”。

表 5

Overhead_ONU_Indication message 上行突发开销参数指示消息		
Octet	Content	Description
1	ONU-ID	ONU标识
2	00000001	消息标识 "上行突发开销参数指示".

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Overhead_ONU_Indication message 上行突发开销参数指示消息		
Octet	Content	Description
3	000000BB	BB: OLT指示ONU采用的何种上行突发开销参数集合 00: 集合1 **01: 集合2** 10: 集合3 11: 保留
4-20	Reserve	保留

步骤 3006，ONU 接收到 OLT 下发给自己的单播 ONU 开销指示（Overhead_ONU_Indication）消息之后，记录其所携带的物理层参数 BB(01)，后续按照指示进行参数切换。后续切换指示和操作可以同实施例一。

具体实施例四：

具体实施例三与具体实施例二不同之处在于OLT 事先向ONU广播所有参数集合。

如图 6 所示，具体实施例四中具体包括：

步骤 4001 与步骤 1001 相同；

步骤 4002，OLT 在下行方向上广播发送 Upstream_overhead 消息，携带所有的上行突发开销参数集合（即集合 1，2，3 都在一个消息中发送）。如表 6 所示。此消息可发送一次或多次，本发明中不作限制。

表 6

Upstream_Overhead message 上行突发开销参数		
Octet	Content	Description
1	11111111 ONU-ID	=11111111：ONU-ID尚未分配，广播消息 如果已分配，则填入ONU-ID数值,单播消息
2	00000001	消息标识 "上行突发开销参数".

Upstream_Overhead message 上行突发开销参数		
Octet	Content	Description
3	000000xx	xx：本消息为单播消息，OLT指示ONU采用的何种上行突发开销参数集合 00: 集合1 01: 集合2 10: 集合3 11: 保留。 在本消息为广播消息时，xx值无效，ONU忽略
4-8	gggggggg gggggggg gggggggg gggggggg gggggggg	上行突发开销参数－集合1，也是默认使用的参数集合
9-13	xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx	上行突发开销参数－集合2:对应于传输质量恶劣的链路使用
14-18	bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb	上行突发开销参数－集合3:对应于传输质量优良的链路使用
19-20	dddddddd dddddddd	预分配延迟参数

步骤 4003 与步骤 1003 相同；

步骤 4004 与步骤 1004 相同；

步骤 4005 与步骤 1005 相同；ONU 在 O3 状态中响应 OLT 下发的序列号请求带宽分配(SN_Request)时，在上行 ONU 序列号(Serial_Number_ONU) 消息中携带第 1004 步中获得的链路质量信息－“良好”。如表 7 所示：

表 7

Serial_Number_ONU ONU序列号信息		
Octet	Content	Description
1	11111111 ONU-ID	=11111111：ONU-ID尚未分配 如果已经分配，则填入ONU-ID数值
2	00000001	消息类型： " ONU序列号信息"
3-6	VID1-VID4	设备商标识 字节1-字节4
7-10	VID2	设备商定义的序列号信息字节1-字节4
11	RRRRRRRR	随机试验的高位8bit
12	RRRRAATT	RRRR =随机试验的低4位bit **AA : ONU向OLT通知的链路质量测量结果,此时设置为"01",对应于"良好"** **(00- OLT忽略** **01-线路质量良好** **10-线路质量一般** **11-线路质量较差)** TT = ONU发射功率 TT = 00 – Low Power TT = 01 – Medium Power TT = 10 – High Power TT = 11 – Reserved
13-20	Reserve	保留

（使用 Serial_number_ONU 消息携带该信息仅仅是举例，也可以使用其他上行帧消息中的空闲位，赋予上述表格“AA”类似的定义，用来通知 OLT 链路检测的结果，或者使用专门定义的消息来传递该检测结果）。

步骤 4006 与步骤 1006 相同;

步骤 4007，在 ONU 被分配好 ONU-ID 之后，OLT 通过单播 Upstream_overhead 消息指示 ONU 所将要使用的上行突发开销参数是集合 3.(单播消息中 xx 设置为”10”)。如表 8 所示。

表 8

Upstream_Overhead message 上行突发开销参数

Octet	Content	Description
1	11111111 ONU-ID	=11111111：ONU-ID尚未分配，广播消息 如果已分配，则填入ONU-ID数值,单播消息
2	00000001	消息标识 "上行突发开销参数".
3	000000xx	xx：本消息为单播消息，OLT指示ONU采用的何种上行突发开销参数集合 00: 集合1 01: 集合2 **10: 集合3** 11: 保留。 在本消息为广播消息时，xx值无效，ONU忽略
4-8	gggggggg gggggggg gggggggg gggggggg gggggggg	上行突发开销参数一集合1，也是默认使用的参数集合
9-13	xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx	上行突发开销参数一集合2:对应于传输质量恶劣的链路使用
14-18	bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb	上行突发开销参数一集合3:对应于传输质量优良的链路使用
19-20	dddddddd dddddddd	预分配延迟参数

步骤 4008，ONU 接收到 OLT 下发给自己的 Upstream_overhead 单播消息之后，记录其所携带的上行突发开销参数指示，后续切换时使用。后续切换指示和操作可以同实施例一。

5

具体实施例五：

具体实施例五与具体实施例三的不同之处是，OLT 检测下行链路质量

后，通过广播通道消息 Overhead_ONU_indication 通知 ONU 记录需要切换的上行突发开销参数和切换的超帧号，在超帧号对应的帧来临之后，所有 ONU 切换使用 OLT 指示的上行突发开销参数进行上行传输。

如图 7 所示，具体实施例五中具体包括:

步骤 5001 至步骤 5004 与步骤 3001 至步骤 3004 相同;

步骤 5005，OLT 通过广播 Overhead_ONU_Indication 消息传递给所有 ONU 将要切换使用的上行开销参数集合 2，以及执行参数切换的超帧号. 按照下面的消息格式，其中 BB 应该赋值为“01”。超帧号域（4-7）填入 OLT 要求切换的超帧号的值。如表 9 所示。

表 9

Overhead_ONU_Indication message 上行突发开销参数指示消息		
Octet	Content	Description
1	**11111111**	**广播消息类型**
2	00000001	消息标识 "上行突发开销参数指示".
3	000000BB	BB: OLT指示ONU采用的何种上行突发开销参数集合 00: 集合1 **01: 集合2** 10: 集合3 11: 保留
4－7	ssssssss ssssssss ssssssss ssssssss	OLT要求所有ONU执行切换的超帧号，在该超帧到来之后，所有ONU切换使用OLT指示的上行突发开销参数进行上行传输
8-20	Reserve	保留

步骤 5006，所有 ONU 接收到 OLT 广播的 Overhead_ONU_Indication 消息之后，记录其所携带的物理层参数 BB(01)，和指示切换时刻的超帧号，后续按照指示进行参数切换。

步骤 5007，在后续超帧号所对应的下行帧到来后，ONU 进行上行突发开销参数切换操作，将切换后的值用于上行传输。

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本实施例可以经过简单的修改，将第 5005-5006 步中消息设计成单播消息，这样就可以支持单个 ONU 进行切换，而不是所有 ONU 一起进行切换。

具体实施例六:

具体实施例六与具体实施例五的不同之处是，OLT 检测下行链路质量后，通过广播通道消息 Overhead_ONU_indication 通知 ONU 记录需要切换的上行突发开销参数和切换的超帧号后，OLT 在给所有 ONU 的带宽分配的标志域中设置上行突发开销参数的切换索引值，ONU 接收到此切换指示后，在下下一帧按照所指示的索引值进行上行突发开销参数切换。

如图 8 所示，具体实施例六中具体包括:

步骤 6001 至步骤 6006 与步骤 5001 至步骤 5006 相同;

步骤 6007，OLT 在给所有 ONU 的带宽分配的标志域中设置上行突发开销参数的切换索引值，并通过下行帧发给所有 ONU。

所有的 ONU 一旦接收到第 6007 步中切换指示，立刻在下一帧按照所指示的索引值进行上行突发开销参数切换,在后续上行传输时使用。

本实施例可以经过简单的修改，将第 6005/6006/6007 步中消息设计成单播消息且针对某个 ONU 进行设置，这样就可以支持单个 ONU 进行切换，而不是所有 ONU 一起进行切换。

具体实施例七:

具体实施例七中，ONU 测试线路质量，并根据链路质量确定其使用的上行突发开销参数，ONU 通知 OLT 此上行突发开销参数并指示切换超帧号。

如图 9 所示，具体实施例七中具体包括:

步骤 7001-步骤 7002 与步骤 6001-步骤 6002 相同;

步骤 7003，ONU 上电启动，在 O2 状态接收到 OLT 下发的 Upstream_overhead 消息并成功获取所携带的上行物理层突发开销参数后，转

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移到 O3 状态。

步骤 7004，从 O3 状态开始，ONU 启动对针对下行链路的传输质量分析，可以采用目前通用的 BIP 检测方法获取结果，也可以采用常用的 FEC 结果和校正位数来来获取结果。（不排除 ONU 采用其他类似的检测手段，来获取下行链路的传输质量信息，只要方法可行就可以），假定测量的结果是良好。

步骤 7005，ONU 在得到步骤 7004 中传输质量信息后，后续上行帧携带 ONU 对下行链路质量检测结果“良好”，并根据链路质量确定上行突发开销参数集合即集合 3，ONU 将其确定的上行突发开销参数集合 3 和准备切换使用参数集合 3 的超帧号上报给 OLT。例如 ONU 在 O3 状态中响应 OLT 下发的序列号请求带宽分配（SN_Request）时，在上行消息 Serial_Number_ONU 中携带第 4 步中获得的链路质量信息－“良好”。如下表 10 所示。

表 10

Serial_Number_ONU ONU序列号信息		
Octet	Content	Description
1	11111111 ONU-ID	=11111111：ONU-ID尚未分配，，广播消息 如果已分配，则填入ONU-ID数值，单播消息
2	00000001	消息类型： " ONU序列号信息"
3-6	VID1-VID4	设备商标识 字节1-字节4
7-10	VID2	设备商定义的序列号信息字节1-字节4
11	RRRRRRRR	随机试验的高位8bit
12	RRRRAATT	RRRR =随机试验的低4位bit AA : ONU向OLT通知的链路质量测量结果,此时设置为”01”,对应于”良好” (00- OLT忽略 01-线路质量良好 10-线路质量一般 11-线路质量较差) TT = ONU发射功率 TT = 00 – Low Power TT = 01 – Medium Power TT = 10 – High Power TT = 11 – Reserved

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Serial_Number_ONU ONU序列号信息		
Octet	Content	Description
13-16	ssssssss ssssssss ssssssss ssssssss	ONU准备切换使用参数集合3的下行帧超帧号. OLT在发送了该超帧号对应的下行帧之后，对该ONU上行帧使用新的上行突发开销参数进行接收。
17-20	Reserve	保留

使用 Serial_number_ONU 消息携带该信息仅仅是举例，也可以使用其他上行帧消息中的空闲位，赋予上述表格中相关域的类似定义，用来通知 OLT 链路检测的结果和切换相关的下行帧超帧号，或者使用专门定义的消息来传递该检测结果。

步骤 7006，OLT 在接收到该消息后,记录和该 ONU 对应的线路质量信息和切换相关的下行帧超帧号,并确定该 ONU 所适合使用的上行突发开销参数集合 3。

步骤 7007，某一时刻 OLT 在发送了该超帧号对应的下行帧之后，ONU 在此时切换使用参数集合 3 发送上行帧，OLT 使用参数集合 3 接收该 ONU 的上行帧。

上述方法可以提高带宽利用率,还可以降低 PON 系统中指示上行突发开销参数的复杂度，使 ONU 和 OLT 能灵活且简单的选择上行突发开销参数。

本发明中管理上行突发开销参数的无源光网络系统包括光线路终端 OLT 或光网络单元 ONU，此两个实体的功能与上述方法中描述的功能相同。如下所述：

所述光线路终端 OLT 设置为：检测所述 OLT 与所述 ONU 之间的下行链路的传输质量，根据此传输质量确定所述 ONU 适用的上行突发开销参数，并通知至所述 ONU；以及向所述 ONU 指示切换时间；

所述光网络单元 ONU 设置为：检测所述 OLT 和所述 ONU 之间的下行

链路的传输质量，根据所述传输质量确定适用的上行突发开销参数；或者，直接从所述 OLT 接收所述 OLT 确定的下行链路传输质量；以及在自身确定的切换时间或者所述 OLT 指示的切换时间后开始使用所述上行突发开销参数。

所述 OLT 还设置为：针对不同级别的链路质量确定 N 种上行突发开销参数集合并进行标识；N 为大于零的整数；还用于将默认的一种上行突发开销参数集合的参数值或标识发送至所述 ONU，或者，将一种以上上行突发开销参数集合的参数值或标识发送至所述 ONU；所述 ONU 还设置为：在等待状态下接收一种上行突发开销参数集合的参数值或标识，并使用此上行突发开销参数集合；或者，在等待状态下接收所述一种以上上行突发开销参数集合的参数值或标识后，使用其中一种上行突发开销参数集合。

所述OLT还设置为：在将确定的上行突发开销参数集合通知至所述ONU的同时或之后，在为 ONU 的带宽分配的标志域中设置上行突发开销参数的切换索引值，通过下行帧发送给所述 ONU；所述 ONU，还用于接收到所述切换索引值后，在下一帧中使用所述上行突发开销参数。

所述OLT还设置为：在将确定的上行突发开销参数集合通知至所述ONU的同时或之后，向所述 ONU 通知超帧号；所述 ONU 还设置为：在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数。

所述ONU还设置为：在将确定的上行突发开销参数集合通知至所述OLT的同时或之后，向所述 OLT 通知超帧号，并在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数。

基于上述系统，本发明还提供了一种管理上行突发开销参数的光网络单元（ONU），其包括：第一参数获取模块和切换模块；其中：

所述第一参数获取模块设置为：

检测光线路终端（OLT）和所述 ONU 之间的下行链路的传输质量或接收 OLT 发送的所述 OLT 检测得到的下行链路的传输质量，根据所述传输质量确定所述 ONU 适用的上行突发开销参数，并将所述 ONU 适

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用的上行突发开销参数发送至所述 OLT；或者，

检测所述 OLT 和所述 ONU 之间的下行链路的传输质量，将所述传输质量发送至所述 OLT，并接收所述 OLT 发送的根据所述传输质量确定的 ONU 适用的上行突发开销参数；或者，

直接从所述 OLT 接收所述 OLT 确定的 ONU 适用的上行突发开销参数；以及，

将确定的所述 ONU 适用的上行突发开销参数通知至所述 OLT 的同时或之后，或者，接收 OLT 发送的所述 ONU 适用的上行突发开销参数的同时或之后，指示所述切换模块；

所述切换模块设置为：

收到所述第一参数获取模块的指示的同时或之后，确定切换时间或接收所述 OLT 指示的切换时间，在自身确定的切换时间或者所述 OLT 指示的切换时间后开始使用所述 ONU 适用的上行突发开销参数。

所述 ONU 还包括突发开销参数集合接收模块；

所述突发开销参数集合接收模块设置为：在等待状态下接收所述 OLT 针对不同级别的链路质量确定的 N 种上行突发开销参数集合并进行标识后向所述 ONU 发送的默认的一种上行突发开销参数集合的参数值或上行突发开销参数集合的标识，并使用此上行突发开销参数集合；或者，

在等待状态下接收所述 OLT 针对不同级别的链路质量确定的 N 种上行突发开销参数集合并进行标识后向所述 ONU 发送的一种以上上行突发开销参数集合的参数值或上行突发开销参数集合标识，并使用其中一种上行突发开销参数集合；

其中，N 为大于零的整数。

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所述切换模块还设置为：收到所述第一参数获取模块的指示的同时或之后，接收所述 OLT 通过下行帧向所述 ONU 发送的所述 OLT 为 ONU 的带宽分配的标志域中设置的上行突发开销参数的切换索引值；以及，所述切换模块是设置为按如下方式在所述 OLT 指示的切换时间后开始使用所述上行突发开销参数：接收到所述切换索引值后，在下一帧中使用所述上行突发开销参数；或者

所述切换模块还设置为：收到所述第一参数获取模块的指示的同时或之后，接收所述 OLT 向所述 ONU 通知的超帧号；以及，所述切换模块是设置为按如下方式在所述 OLT 指示的切换时间后开始使用所述上行突发开销参数：在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数；或者

所述切换模块还设置为：收到所述第一参数获取模块的指示的同时或之后，向所述 OLT 通知超帧号；以及，所述 ONU 是设置为按如下方式在自身确定的切换时间后开始使用所述上行突发开销参数：在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数。

基于上述系统，本发明还提供了一种管理上行突发开销参数的光线路终端（OLT），其包括：第二参数获取模块和切换时间收发模块，其中：

所述第二参数获取模块设置为：

检测所述 OLT 与光网络单元（ONU）之间的下行链路的传输质量，将所述传输质量发送给所述 ONU，并接收所述 ONU 根据所述 OLT 发送的传输质量所确定的 ONU 适用的上行突发开销参数；或者，

检测所述 OLT 与 ONU 之间的下行链路的传输质量，并根据所述传输质量确定 ONU 适用的上行突发开销参数，并将确定的所述 ONU 适用的上行突发开销参数通知至所述 ONU；或者

接收所述 ONU 发送的所述 ONU 检测得到的下行链路的传输质量，根据所述传输质量确定 ONU 适用的上行突发开销参数，并将确定的所述 ONU 适用的上行突发开销参数通知至所述 ONU；或者

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接收所述ONU发送的根据所述ONU自身检测得到的下行链路的传输质量所确定的ONU适用的上行突发开销参数；以及

将确定的所述ONU适用的上行突发开销参数通知至所述ONU的同时或之后，或者，接收到ONU发送的所述ONU适用的上行突发开销参数的同时或之后，指示所述切换时间收发模块；

所述切换时间收发模块设置为：

收到所述第二参数获取模块的指示的同时或之后，向所述 ONU 指示切换时间或者接收所述ONU发送的切换时间，以使所述ONU在所述切换时间后开始使用所述上行突发开销参数。

所述 OLT 还包括：

上行突发开销参数集合获取模块，其设置为：针对不同级别的链路质量确定 N 种上行突发开销参数集合并进行标识；其中，N 为大于零的整数；以及将默认的一种上行突发开销参数集合的参数值或标识发送至所述 ONU，或者，将一种以上上行突发开销参数集合的参数值或标识发送至所述 ONU，

以使所述 ONU 在等待状态下接收一种上行突发开销参数集合的参数值或上行突发开销参数的标识，并使用此上行突发开销参数集合；或者，在等待状态下接收所述一种以上上行突发开销参数集合的参数值或上行突发开销参数标识后，使用其中一种上行突发开销参数集合。

所述切换时间收发模块是设置为按如下方式向所述ONU指示切换时间：在为 ONU 的带宽分配的标志域中设置上行突发开销参数的切换索引值，通过下行帧发送给所述 ONU，以使所述 ONU 接收到所述切换索引值后，在下一帧中使用所述上行突发开销参数；或者

所述切换时间收发模块是设置为按如下方式向所述ONU指示切换时间：向所述 ONU 通知超帧号，以使所述 ONU 在所述 OLT 在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数；或者

所述切换时间收发模块是设置为按如下方式接收所述 ONU 发送的切换时间：接收所述 ONT 通知的超帧号，以使所述 ONU 在所述超帧号指示的帧

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到达后，开始使用所述上行突发开销参数。

以上所述仅为本发明的优选实施例而已，并不用于限制本发明，对于本领域的技术人员来说，本发明可以有各种更改和变化。凡在本发明的精神和原则之内，所作的任何修改、等同替换、改进等，均应包含在本发明的保护范围之内。

工业实用性

本发明可以提高带宽利用率，还可以降低 PON 系统中指示上行突发开销参数的复杂度，使 ONU 和 OLT 能灵活且简单的选择上行突发开销参数。

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权 利 要 求 书

1、一种管理上行突发开销参数的方法，包括:

光线路终端（OLT）或光网络单元（ONU）检测所述 OLT 和所述 ONU 之间的下行链路的传输质量;

所述 OLT 或所述 ONU 根据所述传输质量确定所述 ONU 适用的上行突发开销参数; 以及

所述 ONU 在自身确定的或所述 OLT 指示的切换时间后开始使用所述 ONU 适用的上行突发开销参数。

2、如权利要求 1 所述的方法，其中，OLT 或 ONU 检测所述 OLT 和所述 ONU 之间的下行链路的传输质量的步骤之前，所述方法还包括:

所述 OLT 针对不同级别的链路质量确定 N 种上行突发开销参数集合并进行标识; 其中，N 为大于零的整数; 以及

所述 OLT 将默认的一种上行突发开销参数集合的参数值或上行突发开销参数集合的标识发送至所述 ONU，所述 ONU 在等待状态下接收所述上行突发开销参数集合的参数值或上行突发开销参数集合标识，并使用此上行突发开销参数集合; 或者，

所述 OLT 将一种以上上行突发开销参数集合的参数值或上行突发开销参数集合标识发送至所述 ONU，所述 ONU 在等待状态下接收所述一种以上上行突发开销参数集合的参数值或上行突发开销参数集合标识，并使用其中一种上行突发开销参数集合。

3、如权利要求 2 所述的方法，其中:

ONU 接收上行突发开销参数集合的参数值或上行突发开销参数集合标识的步骤之后，所述方法还包括: 所述 ONU 进入序列号状态;

ONU 检测所述 OLT 和所述 ONU 之间的下行链路的传输质量的步骤包括: 在 ONU 的序列号状态下，所述 OLT 检测所述 ONU 与所述 OLT 之间的

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下行链路，获知所述下行链路的质量信息；

所述 OLT 根据所述传输质量确定所述 ONU 适用的上行突发开销参数的步骤包括：所述 OLT 根据所述下行链路的质量信息确定所述 ONU 适用的上行突发开销参数集合，通过单播消息或多播消息将所述 ONU 适用的上行突发开销参数集合中参数值或者 ONU 适用的上行突发开销参数集合的标识通知至所述 ONU。

4、如权利要求 2 所述的方法，其中：

ONU 接收上行突发开销参数集合的参数值或上行突发开销参数集合标识的步骤之后，所述方法还包括：所述 ONU 进入序列号状态；

ONU 检测所述 OLT 和所述 ONU 之间的下行链路的传输质量的步骤包括：在 ONU 的序列号状态下，所述 ONU 检测所述 ONU 与所述 OLT 之间的下行链路，获知所述下行链路的质量信息；

获知所述下行链路的质量信息的步骤之后，所述方法还包括：所述 ONU 将所述下行链路的质量信息通知至所述 OLT；

所述 OLT 根据所述传输质量确定所述 ONU 适用的上行突发开销参数的步骤包括：所述 OLT 根据所述下行链路的质量信息确定所述 ONU 适用的上行突发开销参数集合，通过单播消息或多播消息将所述 ONU 适用的上行突发开销参数集合中参数值或者 ONU 适用的上行突发开销参数集合的标识通知至所述 ONU。

5、如权利要求 2 所述的方法，其中：

ONU 接收上行突发开销参数集合的参数值或上行突发开销参数集合标识的步骤之后，所述方法还包括：所述 ONU 进入序列号状态；

ONU 检测所述 OLT 和所述 ONU 之间的下行链路的传输质量的步骤包括：在 ONU 的序列号状态下，所述 ONU 检测所述 ONU 与所述 OLT 之间的下行链路，获知此下行链路的质量信息；

所述 ONU 根据所述传输质量确定所述 ONU 适用的上行突发开销参数的

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步骤包括：所述 ONU 根据所述下行链路的质量信息确定所述 ONU 适用的上行突发开销参数集合，通过单播消息或多播消息将所述 ONU 适用的上行突发开销参数集合中参数值或者 ONU 适用的上行突发开销参数集合的标识通知至所述 OLT。

6、如权利要求 3、4 或 5 所述的方法，其中：

所述 OLT 在将确定的上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 ONU 的步骤的同时或之后，或者，所述 ONU 将所述上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 OLT 的步骤的同时或之后，所述方法还包括：所述 OLT 在为 ONU 的带宽分配的标志域中设置上行突发开销参数的切换索引值，通过下行帧发送给所述 ONU；所述 ONU 在所述 OLT 指示的切换时间后开始使用所述上行突发开销参数的步骤包括：所述 ONU 接收到所述切换索引值后，在下一帧中使用所述 ONU 适用的上行突发开销参数；或者

所述 OLT 在将确定的上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 ONU 的步骤的同时或之后，或者，所述 ONU 将所述上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 OLT 的步骤的同时或之后，所述方法还包括：所述 OLT 向所述 ONU 通知超帧号；所述 ONU 在所述 OLT 指示的切换时间后开始使用所述上行突发开销参数的步骤包括：所述 ONU 接收到所述超帧号后，在所述超帧号指示的帧到达后，开始使用所述 ONU 适用的上行突发开销参数；或者

所述 OLT 在将确定的上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 ONU 的步骤的同时或之后，或者，所述 ONU 在将确定的上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 OLT 的步骤的同时或之后，所述方法还包括：所述 ONU 向所述 OLT 通知超帧号；所述 ONU 在自身确定的切换时间后开始使用所述上行突发开销参数的步骤包括：所述 ONU 在所述超帧号指示的帧到达后，开始使用所述 ONU 适用的上行突发开销参数。

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7、如权利要求 3、4 或 5 所述的方法，其中：

所述上行突发开销参数集合包括：前向纠错状态，定界符参数，前导码参数和保护带宽参数。

8、如权利要求 2 所述的方法，其中：

所述 OLT 将一种以上上行突发开销参数集合的参数值或上行突发开销参数集合标识发送至所述 ONU 的步骤中，所述 OLT 是将一种或多种上行突发开销参数集合的参数值或上行突发开销参数集合的标识发送至与之相通信的所有 ONU 或其中一个或几个 ONU。

9、一种管理上行突发开销参数的光网络单元（ONU），其包括：第一参数获取模块和切换模块；其中：

所述第一参数获取模块设置为：

检测所述光线路终端（OLT）和所述 ONU 之间的下行链路的传输质量或接收光线路终端（OLT）发送的所述 OLT 检测得到的下行链路的传输质量，根据所述传输质量确定 ONU 适用的上行突发开销参数，并将所述 ONU 适用的上行突发开销参数发送至所述 OLT；或者，

检测所述 OLT 和所述 ONU 之间的下行链路的传输质量，将所述传输质量发送至所述 OLT，并接收所述 OLT 发送的根据所述传输质量确定的 ONU 适用的上行突发开销参数；或者，

直接从所述 OLT 接收所述 OLT 确定的 ONU 适用的上行突发开销参数；以及，

将确定的所述 ONU 适用的上行突发开销参数通知至所述 OLT 的同时或之后，或者，接收 OLT 发送的所述 ONU 适用的上行突发开销参数的同时或之后，指示所述切换模块；

所述切换模块设置为：

收到所述第一参数获取模块的指示的同时或之后，确定切换事件或接收所述 OLT 指示的切换时间，在自身确定的切换时间或者所述 OLT

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指示的切换时间后开始使用所述 ONU 适用的上行突发开销参数。

10、如权利要求 9 所述的 ONU，其还包括：

突发开销参数集合接收模块，其设置为：

在等待状态下接收所述 OLT 针对不同级别的链路质量确定的 N 种上行突发开销参数集合并进行标识后向所述 ONU 发送的默认的一种上行突发开销参数集合的参数值或上行突发开销参数集合的标识，并使用此上行突发开销参数集合；或者，

在等待状态下接收所述 OLT 针对不同级别的链路质量确定的 N 种上行突发开销参数集合并进行标识后向所述 ONU 发送的一种以上上行突发开销参数集合的参数值或上行突发开销参数集合标识，并使用其中一种上行突发开销参数集合；

其中，N 为大于零的整数。

11、如权利要求 9 所述的 ONU，其中：

所述切换模块还设置为：收到所述第一参数获取模块的指示的同时或之后，接收所述 OLT 通过下行帧向所述 ONU 发送的所述 OLT 为 ONU 的带宽分配的标志域中设置的上行突发开销参数的切换索引值；以及，所述切换模块是设置为按如下方式在所述 OLT 指示的切换时间后开始使用所述上行突发开销参数：接收到所述切换索引值后，在下一帧中使用所述上行突发开销参数；或者

所述切换模块还设置为：收到所述第一参数获取模块的指示的同时或之后，接收所述 OLT 向所述 ONU 通知的超帧号；以及，所述切换模块是设置为按如下方式在所述 OLT 指示的切换时间后开始使用所述上行突发开销参数：在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数；或者

所述切换模块还设置为：收到所述第一参数获取模块的指示的同时或之后，向所述 OLT 通知超帧号；以及，所述 ONU 是设置为按如下方式在自身确定的切换时间后开始使用所述上行突发开销参数：在所述超帧号指示的帧

到达后，开始使用所述上行突发开销参数。

12、一种管理上行突发开销参数的光线路终端（OLT），其包括：第二参数获取模块和切换时间收发模块，其中：

所述第二参数获取模块设置为：

检测所述 OLT 与光网络单元（ONU）之间的下行链路的传输质量，将所述传输质量发送给所述 ONU，并接收所述 ONU 根据所述 OLT 发送的传输质量所确定的 ONU 适用的上行突发开销参数；或者，

检测所述 OLT 与光网络单元（ONU）之间的下行链路的传输质量，并根据所述传输质量确定所述 ONU 适用的上行突发开销参数，并将确定的所述 ONU 适用的上行突发开销参数通知至所述 ONU；或者

接收所述 ONU 发送的所述 ONU 检测得到的下行链路的传输质量，根据所述传输质量确定 ONU 适用的上行突发开销参数，并将确定的所述 ONU 适用的上行突发开销参数通知至所述 ONU；或者

接收所述ONU发送的根据所述ONU自身检测得到的下行链路的传输质量所确定的 ONU 适用的上行突发开销参数；以及

将确定的所述ONU适用的上行突发开销参数通知至所述ONU的同时或之后，或者，接收到 ONU 发送的所述 ONU 适用的上行突发开销参数的同时或之后，指示所述切换时间收发模块；

所述切换时间收发模块设置为：

收到所述第二参数获取模块的指示的同时或之后，向所述 ONU 指示切换时间或者接收所述 ONU 发送的切换时间，以使所述 ONU 在所述切换时间后开始使用所述上行突发开销参数。

13、如权利要求 12 所述的 OLT，其还包括：

上行突发开销参数集合获取模块，其设置为：针对不同级别的链路质量确定 N 种上行突发开销参数集合并进行标识；其中，N 为大于零的整数；以及将默认的一种上行突发开销参数集合的参数值或标识发送至所述 ONU，或

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者，将一种以上上行突发开销参数集合的参数值或上行突发开销参数集合标识发送至所述 ONU，

以使所述 ONU 在等待状态下接收一种上行突发开销参数集合的参数值或上行突发开销参数的标识，并使用此上行突发开销参数集合；或者，在等待状态下接收所述一种以上上行突发开销参数集合的参数值或上行突发开销参数集合上行突发开销参数标识后，使用其中一种上行突发开销参数集合。

14、如权利要求 12 所述的 OLT，其中：

所述切换时间收发模块是设置为按如下方式向所述 ONU 指示切换时间：在为 ONU 的带宽分配的标志域中设置上行突发开销参数的切换索引值，通过下行帧发送给所述 ONU，以使所述 ONU 接收到所述切换索引值后，在下一帧中使用所述上行突发开销参数；或者

所述切换时间收发模块是设置为按如下方式向所述 ONU 指示切换时间：向所述 ONU 通知超帧号，以使所述 ONU 在所述 OLT 在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数；或者

所述切换时间收发模块是设置为按如下方式接收所述 ONU 发送的切换时间：接收所述 ONT 通知的超帧号，以使所述 ONU 在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数。

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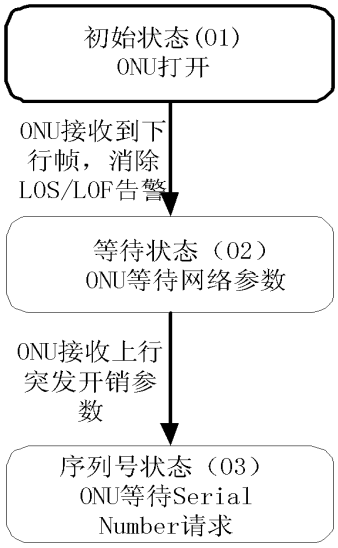

初始状态(01)
ONU打开
ONU接收到下行帧，消除LOS/LOF告警
等待状态（02）
ONU等待网络参数
ONU接收上行突发开销参数
序列号状态（03）
ONU等待Serial Number请求

图 1

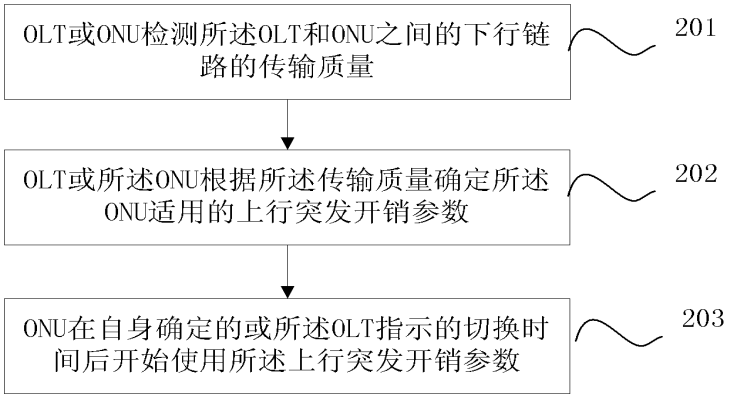

OLT或ONU检测所述OLT和ONU之间的下行链路的传输质量
201
OLT或所述ONU根据所述传输质量确定所述ONU适用的上行突发开销参数
202
ONU在自身确定的或所述OLT指示的切换时间后开始使用所述上行突发开销参数
203

图 2

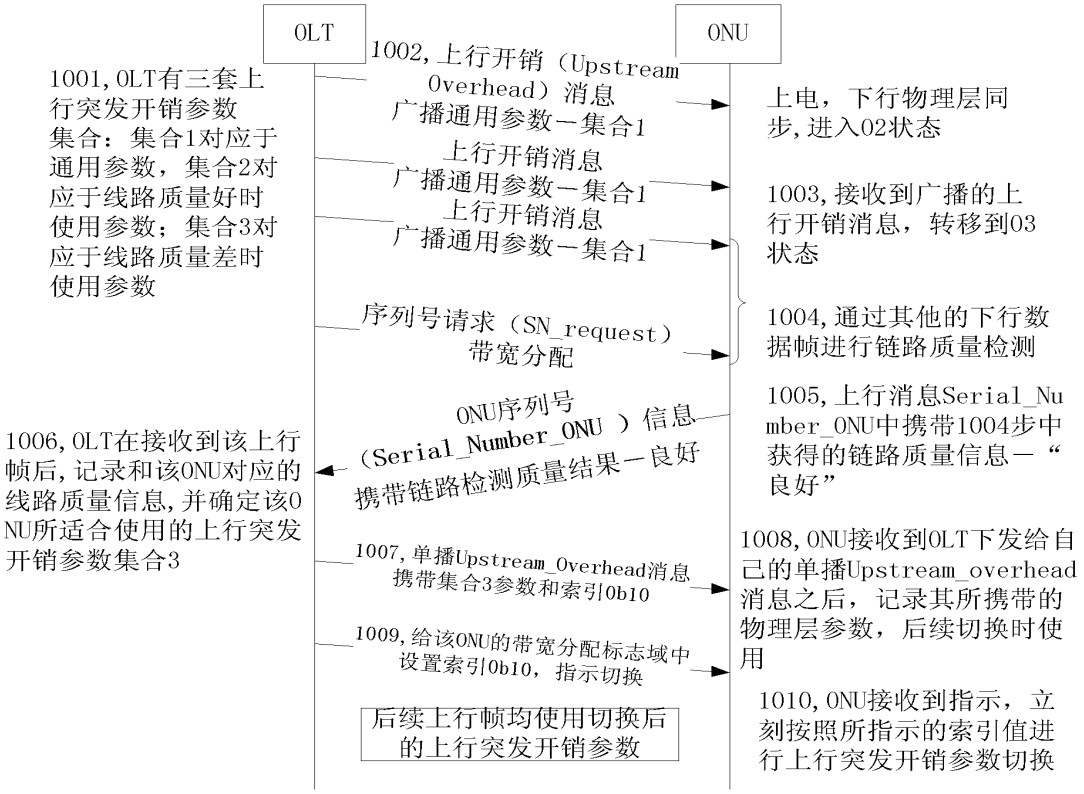


图 3

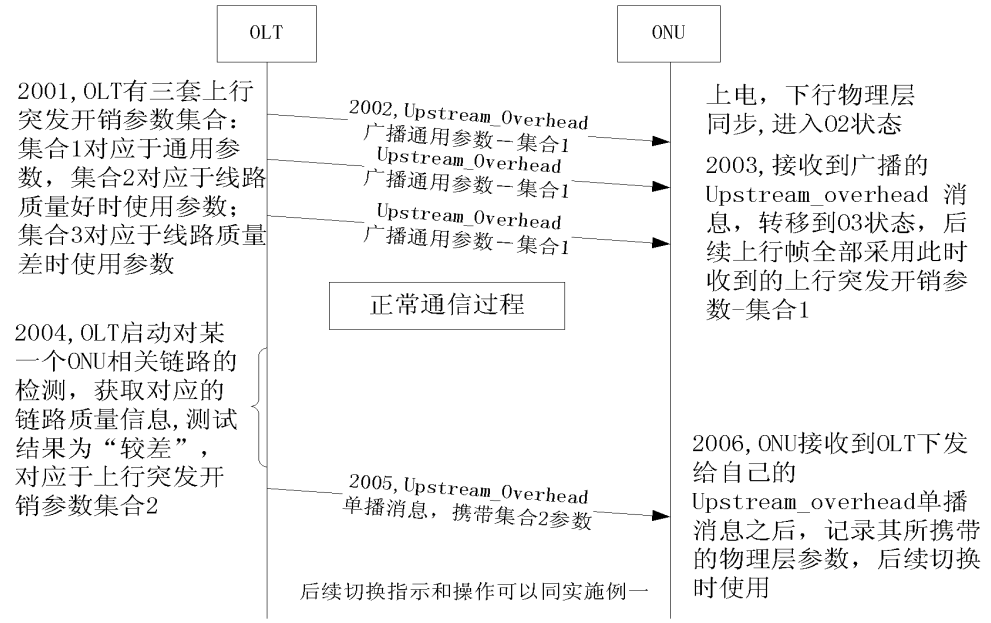


图 4

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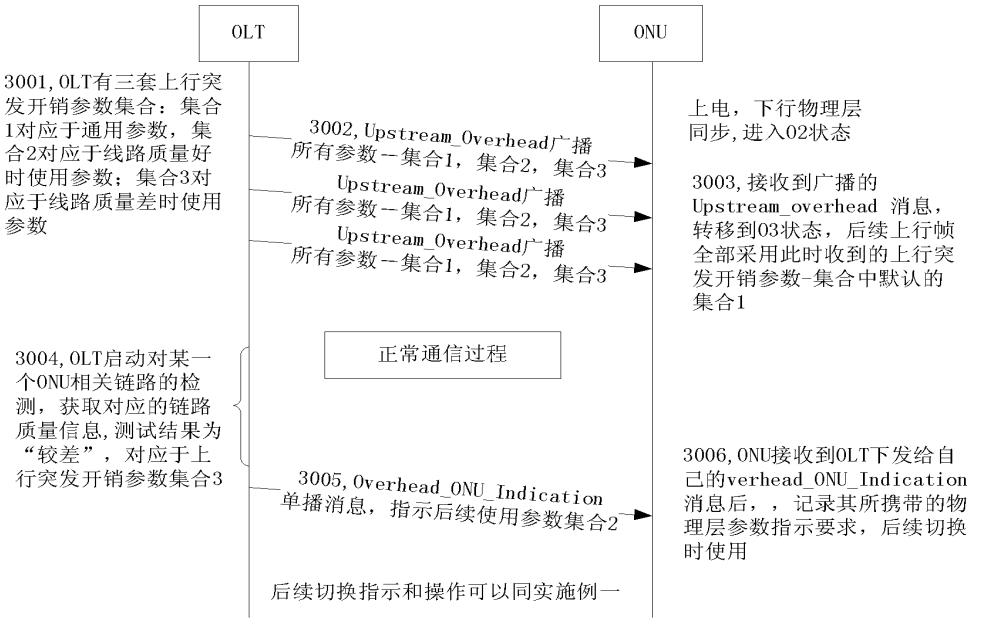


图 5

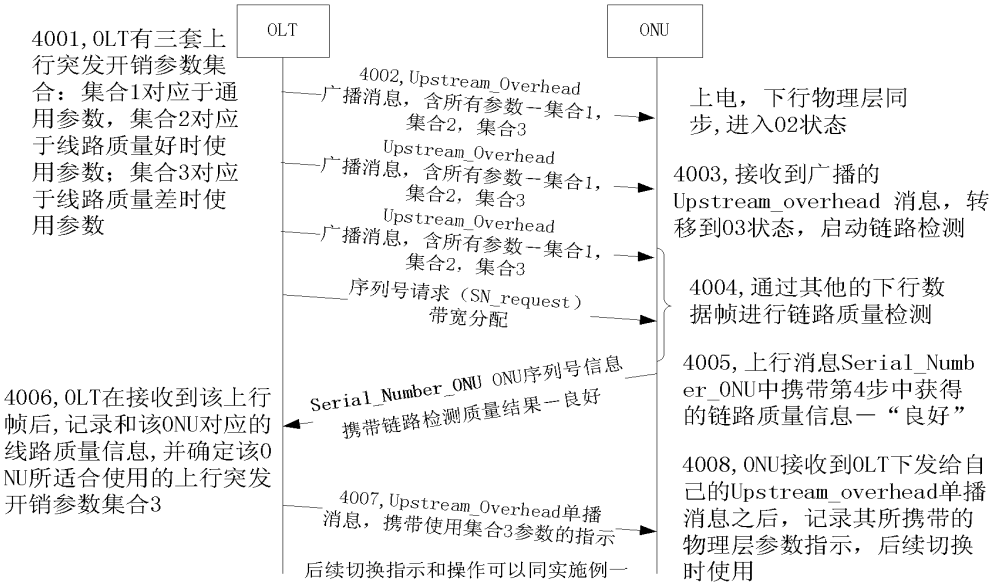


图 6

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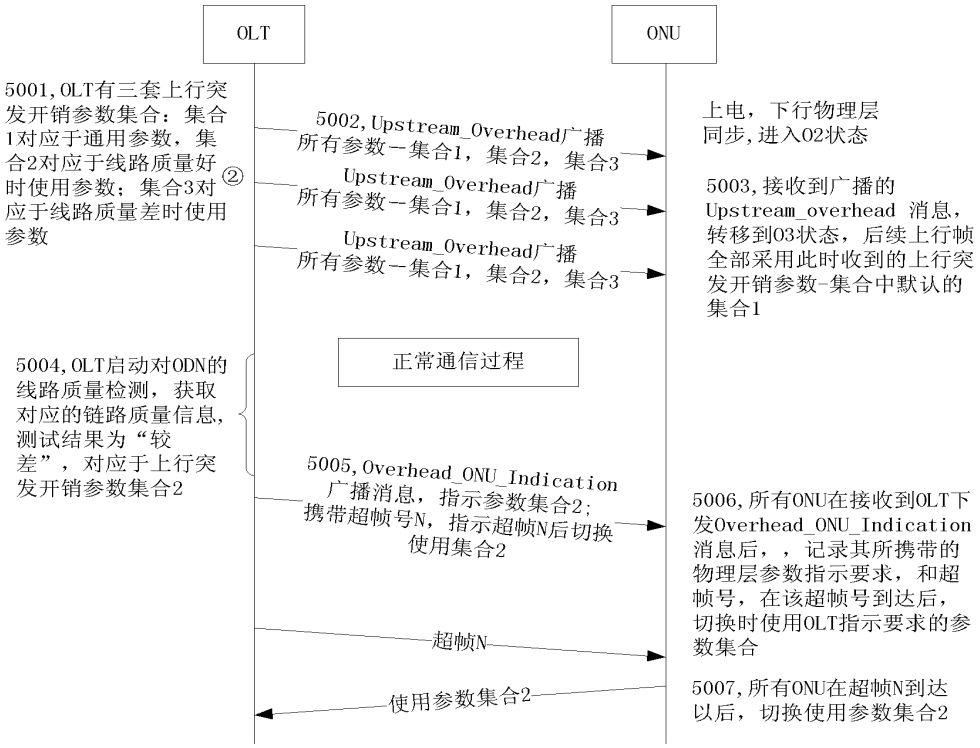

OLT
ONU
5001,OLT有三套上行突发开销参数集合：集合1对应于通用参数，集合2对应于线路质量好时使用参数；集合3对应于线路质量差时使用参数 ②
5002,Upstream_Overhead广播所有参数－集合1，集合2，集合3
Upstream_Overhead广播所有参数－集合1，集合2，集合3
Upstream_Overhead广播所有参数－集合1，集合2，集合3
上电，下行物理层同步,进入O2状态
5003,接收到广播的Upstream_overhead 消息，转移到O3状态，后续上行帧全部采用此时收到的上行突发开销参数-集合中默认的集合1
正常通信过程
5004,OLT启动对ODN的线路质量检测，获取对应的链路质量信息,测试结果为“较差”，对应于上行突发开销参数集合2
5005,Overhead_ONU_Indication广播消息，指示参数集合2;携带超帧号N，指示超帧N后切换使用集合2
5006,所有ONU在接收到OLT下发Overhead_ONU_Indication消息后，，记录其所携带的物理层参数指示要求，和超帧号，在该超帧号到达后，切换时使用OLT指示要求的参数集合
超帧N
使用参数集合2
5007,所有ONU在超帧N到达以后，切换使用参数集合2

图 7

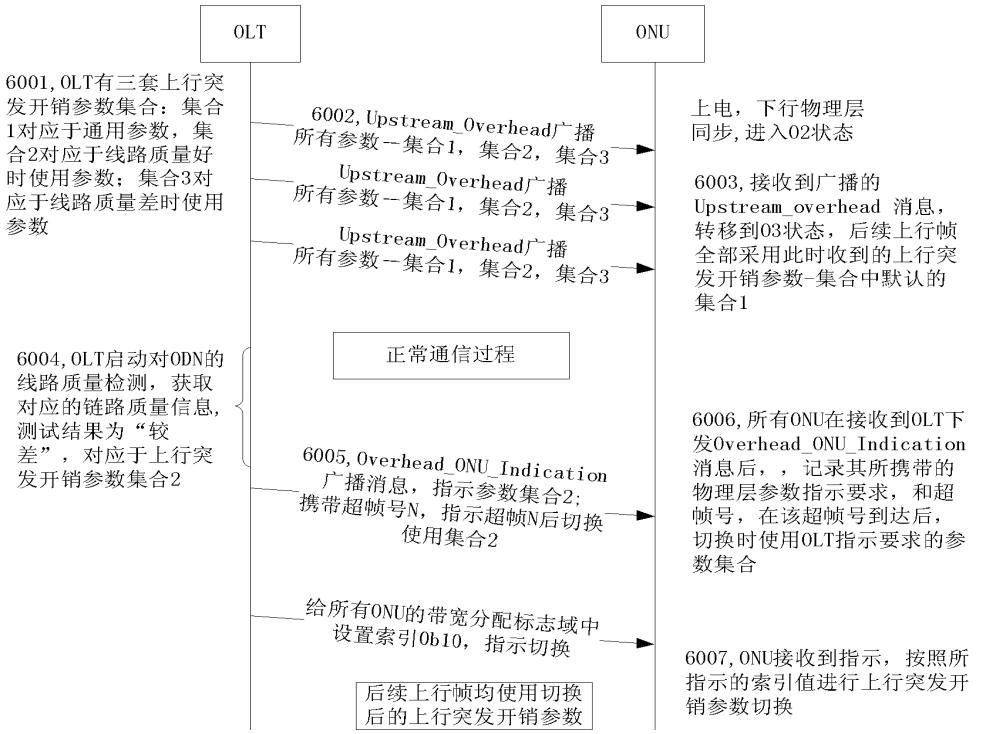


图 8

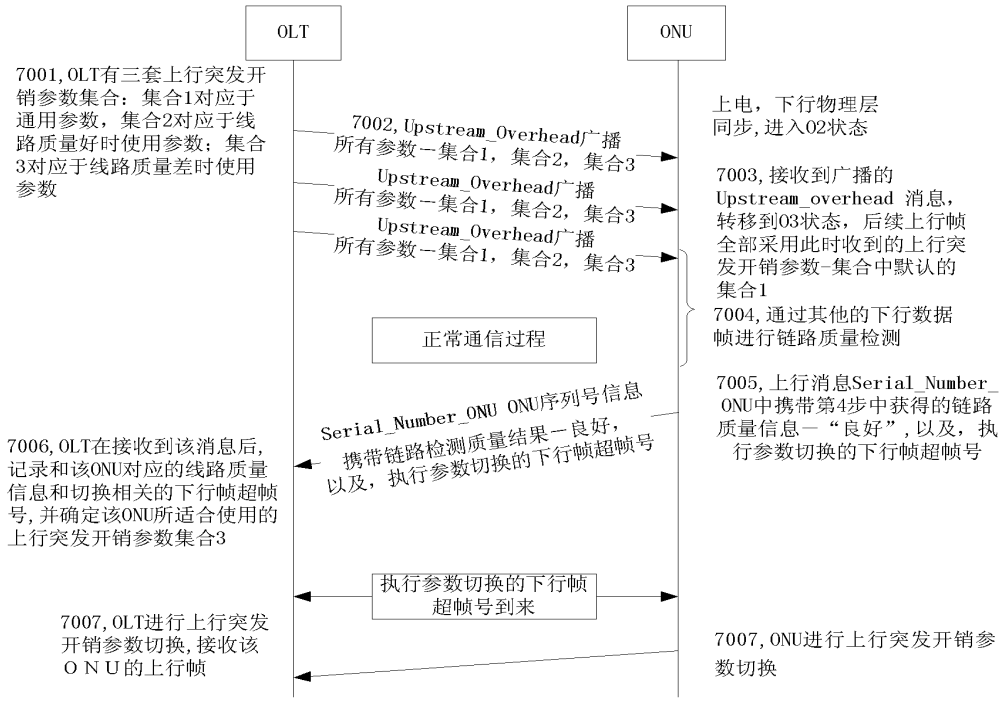


图 9

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2010/073773

A. CLASSIFICATION OF SUBJECT MATTER

H04L 29/06 (2006.01) 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: 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)

CNKI, CNPAT, WPI, EPODOC: OLT, ONU, parameter, transmi+, communicat???, quality, status, monitor???, detect???, PON, overhead, burst, optical, network?, terminal, state

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CN101346958A (NTT DOCOMO INC) 14 Jan. 2009 (14.01.2009) The whole document	1-14
A	CN1677898A (HITACHI INTERNAT ELECTRIC K K) 05 Oct. 2005 (05.10.2005) The whole document	1-14
A	US2002051455A1 (KOREA ELECTRONICS&TELECOM RES INST) 02 May 2002 (02.05.2002) The whole document	1-14

☐ 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
24 Aug. 2010 (24.08.2010)	**23 Sep. 2010 (23.09.2010)**
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 YIN, Yue Telephone No. (86-10)62411226

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

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2010/073773

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN101346958A	14.01.2009	WO2007052812A1	10.05.2007
		JP2007151056A	14.06.2007
		TW200729791A	01.08.2007
		EP1953977A1	06.08.2008
		KR20080074915A	13.08.2008
		INKOLNP200801711E	26.12.2008
		US2009247180A1	01.10.2009
		JP2009273172A	19.11.2009
		RU2008119078A	10.12.2009
CN1677898A	05.10.2005	US2005213674A1	29.09.2005
		JP2005286446A	13.10.2005
		JP2006217663A	17.08.2006
		JP3898192B2	28.03.2007
		CN100414856C	27.08.2008
		JP4206104B2	07.01.2009
		US2009296852A1	03.12.2009
US2002051455A1	02.05.2002	KR20020033362A	06.05.2002

国际检索报告

国际申请号 **PCT/CN2010/073773**

A. 主题的分类

H04L 29/06（2006.01）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：H04L

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）)

CNKI, CNPAT, WPI, EPODOC: 突发开销, 光网络单元, 光线路终端, 传输, 链路, 通信, 质量, 状态, 参数, 检测, OLT, ONU, parameter, transmi+, communicat???, quality, status, monitor???, detect???, PON

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
A	CN101346958A（株式会社 NTT 都科摩） 14.1 月 2009（14.01.2009）全文	1-14
A	CN1677898A（株式会社日立国际电气） 05.10 月 2005（05.10.2005）全文	1-14
A	US2002051455A1（KOREA ELECTRONICS&TELECOM RES INST） 02.5 月 2002（02.05.2002）全文	1-14

☐ 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
24.8 月 2010 (24.08.2010)	**23.9 月 2010 (23.09.2010)**
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 殷跃 电话号码：(86-10) **62411226**

PCT/ISA/210 表(第 2 页) (2009 年 7 月)

国际检索报告
关于同族专利的信息

国际申请号
PCT/CN2010/073773

检索报告中引用的专利文件	公布日期	同族专利	公布日期
CN101346958A	14.01.2009	WO2007052812A1	10.05.2007
		JP2007151056A	14.06.2007
		TW200729791A	01.08.2007
		EP1953977A1	06.08.2008
		KR20080074915A	13.08.2008
		INKOLNP200801711E	26.12.2008
		US2009247180A1	01.10.2009
		JP2009273172A	19.11.2009
		RU2008119078A	10.12.2009
CN1677898A	05.10.2005	US2005213674A1	29.09.2005
		JP2005286446A	13.10.2005
		JP2006217663A	17.08.2006
		JP3898192B2	28.03.2007
		CN100414856C	27.08.2008
		JP4206104B2	07.01.2009
		US2009296852A1	03.12.2009
US2002051455A1	02.05.2002	KR20020033362A	06.05.2002

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DOCUMENT MADE AVAILABLE UNDER THE PATENT COOPERATION TREATY (PCT)

International application number:		**PCT/CN2010/073773**
International filing date:		**10 June 2010 (10.06.2010)**
Document type:		**Certified copy of priority document**
Document details:	Country/Office:	**CN**
	Number:	**200910212093.3**
	Filing date:	**04 November 2009 (04.11.2009)**
Date of receipt at the International Bureau:		**02 September 2010 (02.09.2010)**

Remark: Priority document submitted or transmitted to the International Bureau in compliance with Rule 17.1(a),(b) or (b-*bis*)

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1211 Geneva 20, Switzerland
www.wipo.int

证　明

本证明之附件是向本局提交的下列专利申请文件副本。

申　　请　　日： 2009.11.04

申　　请　　号： 200910212093.3

申　请　类　别： 发明专利

发明 创造 名称： 一种管理上行突发开销参数的方法及无源光网络系统

申　　请　　人： 中兴通讯股份有限公司

发明人或设计人： 张德智、马瑞克·海德杰尼、袁立权、张伟良

中华人民共和国
国家知识产权局局长

2010年08月30日

09.11.06

权 利 要 求 书 010907652

1、一种管理上行突发开销参数的方法，其特征在于，

光线路终端OLT或光网络单元ONU检测所述OLT和所述ONU之间的下行链路的传输质量，所述OLT或所述ONU根据所述传输质量确定所述ONU适用的上行突发开销参数，所述ONU在自身确定的或所述OLT指示的切换时间后开始使用所述上行突发开销参数。

2、如权利要求1所述的方法，其特征在于，

所述OLT针对不同级别的链路质量确定N种上行突发开销参数集合并进行标识；N为大于零的整数；

所述OLT将默认的一种上行突发开销参数集合的参数值或标识发送至所述ONU，所述ONU在等待状态下接收所述上行突发开销参数集合的参数值或标识，并使用此上行突发开销参数集合；或者，

所述OLT将一种以上上行突发开销参数集合的参数值或标识发送至所述ONU，所述ONU在等待状态下接收所述一种以上上行突发开销参数集合的参数值或标识后，使用其中一种上行突发开销参数集合。

3、如权利要求2所述的方法，其特征在于，

在ONU的序列号状态下，所述OLT检测所述ONU与所述OLT之间的下行链路，获知此下行链路的质量信息，并根据所述下行链路的质量信息确定所述ONU使用的上行突发开销参数集合，通过单播消息或多播消息将所述上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述ONU。

4、如权利要求2所述的方法，其特征在于，

在ONU的序列号状态下，所述ONU检测所述ONU与所述OLT之间的下行链路，获知此下行链路的质量信息，并将所述下行链路的质量信息通知至所述OLT，所述OLT根据所述下行链路的质量信息确定所述ONU使用的上行突发开销参数集合，通过单播消息或多播消息将所述上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述ONU。

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09.11.06

5、如权利要求 2 所述的方法，其特征在于，

在 ONU 的序列号状态下，所述 ONU 检测所述 ONU 与所述 OLT 之间的下行链路，获知此下行链路的质量信息，并根据所述下行链路的质量信息确定所述 ONU 使用的上行突发开销参数集合，通过单播消息或多播消息将所述上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 OLT。

6、如权利要求 3、4 或 5 所述的方法，其特征在于，

所述 OLT 在将确定的上行突发开销参数集合通知至所述 ONU 的同时或之后，在为 ONU 的带宽分配的标志域中设置上行突发开销参数的切换索引值，通过下行帧发送给所述 ONU，所述 ONU 接收到所述切换索引值后，在下一帧中使用所述上行突发开销参数。

7、如权利要求 3、4 或 5 所述的方法，其特征在于，

所述 OLT 在将确定的上行突发开销参数集合通知至所述 ONU 的同时或之后，向所述 ONU 通知超帧号，所述 ONU 接收到后，在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数。

8、如权利要求 3、4 或 5 所述的方法，其特征在于，

所述 ONU 在将确定的上行突发开销参数集合通知至所述 OLT 的同时或之后，向所述 OLT 通知超帧号，所述 ONU 在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数。

9、如权利要求 3、4 或 5 所述的方法，其特征在于，

所述上行突发开销参数集合包括以下参数：前向纠错状态，定界符参数，前导码参数， 保护带宽参数。

10、如权利要求 2 所述的方法，其特征在于，

所述 OLT 将一种或多种上行突发开销参数集合的参数值或标识发送至与之相通信的所有 ONU 或其中一个或几个 ONU。

11、一种管理上行突发开销参数的无源光网络系统，其特征在于，

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包括光线路终端 OLT 或光网络单元 ONU;

所述光线路终端 OLT，用于检测所述 OLT 与所述 ONU 之间的下行链路的传输质量，根据此传输质量确定所述 ONU 适用的上行突发开销参数，并通知至所述 ONU；还用于向所述 ONU 指示切换时间;

所述光网络单元 ONU，用于检测所述 OLT 和所述 ONU 之间的下行链路的传输质量，根据所述传输质量确定适用的上行突发开销参数；或者，直接从所述 OLT 接收所述 OLT 确定的下行链路传输质量；还用于在自身确定的切换时间或者所述 OLT 指示的切换时间后开始使用所述上行突发开销参数。

12、如权利要求 11 所述的无源光网络系统，其特征在于，

所述 OLT，还用于针对不同级别的链路质量确定 N 种上行突发开销参数集合并进行标识；N 为大于零的整数；还用于将默认的一种上行突发开销参数集合的参数值或标识发送至所述 ONU，或者，将一种以上上行突发开销参数集合的参数值或标识发送至所述 ONU;

所述 ONU，还用于在等待状态下接收一种上行突发开销参数集合的参数值或标识，并使用此上行突发开销参数集合；或者，在等待状态下接收所述一种以上上行突发开销参数集合的参数值或标识后，使用其中一种上行突发开销参数集合。

13、如权利要求 11 所述的无源光网络系统，其特征在于，

所述 OLT，还用于在将确定的上行突发开销参数集合通知至所述 ONU 的同时或之后，在为 ONU 的带宽分配的标志域中设置上行突发开销参数的切换索引值，通过下行帧发送给所述 ONU;

所述 ONU，还用于接收到所述切换索引值后，在下一帧中使用所述上行突发开销参数。

14、如权利要求 11 所述的无源光网络系统，其特征在于，

所述 OLT，还用于在将确定的上行突发开销参数集合通知至所述 ONU 的同时或之后，向所述 ONU 通知超帧号;

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所述 ONU，还用于在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数。

15、如权利要求 11 所述的无源光网络系统，其特征在于，

所述 ONU，还用于在将确定的上行突发开销参数集合通知至所述 OLT 的同时或之后，向所述 OLT 通知超帧号，并在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数。

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说 明 书 010907652

一种管理上行突发开销参数的方法及无源光网络系统

技术领域

本发明涉及光通讯技术领域，尤其涉及一种用于无源光网络（Passive Optical Network，简称 PON）系统中光线路终端（Optical Line Terminal，简称 OLT）和光网络单元（Optical Network Unit，简称 ONU）之间针对所使用的上行突发开销参数的一种分配及管理方法及无源光网络系统。

背景技术

在 PON 技术中，OLT 和 ONU 之间，都需要有双方一致的上行突发开销参数：ONU 按照确定好的上行突发开销参数发送上行帧；OLT 也按照确定好的上行突发开销参数正确的接收上行帧，基于这样的前提条件，PON 才能正常的工作。一般这样的上行突发开销参数包含：

（1）前向纠错（Forward Error Correction，简称 FEC）状态（开或者关）。

（2）定界符（Delimiter）参数，可变长，适应于不同的光纤链路质量。

（3）前导码（Preamble）参数，通常为固定值，但是可以几种固定值供选择，也和不同光纤链路质量以及光模块的性能相关。

（4）保护带宽（Guard time）参数，保护带宽的比特位数，一般是固定长度。

现有 ITU G.984.3 GPON 技术标准中，这些上行突发开销参数在 OLT 和 ONU 之间是按照下面的方法进行确定的：OLT 在周期性启动的注册过程中，对与之通信的所有 ONU 广播 OLT 所需要使用的部分上行突发开销参数，包括上述上行突发开销参数中的参数（2）（3）（4）。如图 1 所示，ONU 在取得下行物理层同步并进入等待状态（即 O2 状态）后，一直在侦听下行 OLT 广播的携带部分上行突发开销参数的消息，一旦成功接收到，则记录所携带的上行突发开销参数，并迁移到序列号状态（即 O3 状态），且在后

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续上行工作过程中一直使用所接收到的这些上行突发开销参数，不再更改。

另外，在GPON现有标准中，上行突发开销参数中参数（1）FEC的状态通知机制也独立于上述（2）（3）（4）参数的沟通机制。参数（1）FEC的开关通知是通过下行帧的带宽分配域中每个ONU的每个上行突发带宽分配的标志域中固定指示位进行实时指示。

因此实际实现中有两个问题：

复杂度问题：GPON系统中对于上行突发开销参数的指示是分开进行的，复杂度较高。

效率问题：GPON系统中ONU在确定前导码、定界符等上行突发开销参数后都不再更新，在某些链路质量提升后，允许使用较短的前导参数来进行上行通讯时，也没有提供相应的机制进行协商，被迫使用原先的上行突发开销参数进行上行通讯，这样不够灵活，且带宽效率也无法随着线路质量好转进行提升。

发明内容

本发明要解决的技术问题是提供一种光接入节点之间上行突发开销参数的管理方法，提高带宽利用率。

为了解决上述问题，本发明提供了一种管理上行突发开销参数的方法，包括：光线路终端OLT或光网络单元ONU检测所述OLT和所述ONU之间的下行链路的传输质量，所述OLT或所述ONU根据所述传输质量确定所述ONU适用的上行突发开销参数，所述ONU在自身确定的或所述OLT指示的切换时间后开始使用所述上行突发开销参数。

进一步地，上述方法还具有以下特点：

所述OLT针对不同级别的链路质量确定N种上行突发开销参数集合并进行标识；N为大于零的整数；所述OLT将默认的一种上行突发开销参数集合的参数值或标识发送至所述ONU，所述ONU在等待状态下接收所述上行突发开销参数集合的参数值或标识，并使用此上行突发开销参数集合；或者，所述OLT将一种以上上行突发开销参数集合的参数值或标识发送至所

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述 ONU，所述 ONU 在等待状态下接收所述一种以上上行突发开销参数集合的参数值或标识后，使用其中一种上行突发开销参数集合。

进一步地，上述方法还具有以下特点：

在 ONU 的序列号状态下，所述 OLT 检测所述 ONU 与所述 OLT 之间的下行链路，获知此下行链路的质量信息，并根据所述下行链路的质量信息确定所述 ONU 使用的上行突发开销参数集合，通过单播消息或多播消息将所述上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 ONU。

进一步地，上述方法还具有以下特点：

在 ONU 的序列号状态下，所述 ONU 检测所述 ONU 与所述 OLT 之间的下行链路，获知此下行链路的质量信息，并将所述下行链路的质量信息通知至所述 OLT，所述 OLT 根据所述下行链路的质量信息确定所述 ONU 使用的上行突发开销参数集合，通过单播消息或多播消息将所述上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 ONU。

进一步地，上述方法还具有以下特点：

在 ONU 的序列号状态下，所述 ONU 检测所述 ONU 与所述 OLT 之间的下行链路，获知此下行链路的质量信息，并根据所述下行链路的质量信息确定所述 ONU 使用的上行突发开销参数集合，通过单播消息或多播消息将所述上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 OLT。

进一步地，上述方法还具有以下特点：

所述OLT在将确定的上行突发开销参数集合通知至所述ONU的同时或之后，在为 ONU 的带宽分配的标志域中设置上行突发开销参数的切换索引值，通过下行帧发送给所述 ONU，所述 ONU 接收到所述切换索引值后，在下一帧中使用所述上行突发开销参数。

进一步地，上述方法还具有以下特点：

所述OLT在将确定的上行突发开销参数集合通知至所述ONU的同时或之后，向所述 ONU 通知超帧号，所述 ONU 接收到后，在所述超帧号指示

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的帧到达后，开始使用所述上行突发开销参数。

进一步地，上述方法还具有以下特点：

所述ONU在将确定的上行突发开销参数集合通知至所述OLT的同时或之后，向所述OLT通知超帧号，所述ONU在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数。

进一步地，上述方法还具有以下特点：

所述上行突发开销参数集合包括以下参数：前向纠错状态，定界符参数，前导码参数， 保护带宽参数。

进一步地，上述方法还具有以下特点：

所述 OLT 将一种或多种上行突发开销参数集合的参数值或标识发送至与之相通信的所有 ONU 或其中一个或几个 ONU。

为了解决上述技术问题，本发明还提供了一种管理上行突发开销参数的无源光网络系统，包括光线路终端 OLT 或光网络单元 ONU；所述光线路终端 OLT，用于检测所述 OLT 与所述 ONU 之间的下行链路的传输质量，根据此传输质量确定所述 ONU 适用的上行突发开销参数，并通知至所述 ONU；还用于向所述 ONU 指示切换时间；所述光网络单元 ONU，用于检测所述 OLT 和所述 ONU 之间的下行链路的传输质量，根据所述传输质量确定适用的上行突发开销参数；或者，直接从所述 OLT 接收所述 OLT 确定的下行链路传输质量；还用于在自身确定的切换时间或者所述 OLT 指示的切换时间后开始使用所述上行突发开销参数。

进一步地，上述无源光网络系统还具有以下特点：

所述 OLT，还用于针对不同级别的链路质量确定 N 种上行突发开销参数集合并进行标识；N 为大于零的整数；还用于将默认的一种上行突发开销参数集合的参数值或标识发送至所述 ONU，或者，将一种以上上行突发开销参数集合的参数值或标识发送至所述 ONU；所述 ONU，还用于在等待状态下接收一种上行突发开销参数集合的参数值或标识，并使用此上行突发开销参数集合；或者，在等待状态下接收所述一种以上上行突发开销参数集合

的参数值或标识后，使用其中一种上行突发开销参数集合。

进一步地，上述无源光网络系统还具有以下特点：

所述 OLT，还用于在将确定的上行突发开销参数集合通知至所述 ONU 的同时或之后，在为 ONU 的带宽分配的标志域中设置上行突发开销参数的切换索引值，通过下行帧发送给所述 ONU；所述 ONU，还用于接收到所述切换索引值后，在下一帧中使用所述上行突发开销参数。

进一步地，上述无源光网络系统还具有以下特点：

所述 OLT，还用于在将确定的上行突发开销参数集合通知至所述 ONU 的同时或之后，向所述 ONU 通知超帧号；所述 ONU，还用于在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数。

进一步地，上述无源光网络系统还具有以下特点：

所述 ONU，还用于在将确定的上行突发开销参数集合通知至所述 OLT 的同时或之后，向所述 OLT 通知超帧号，并在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数。

本发明可以提高带宽利用率，还可以降低 PON 系统中指示上行突发开销参数的复杂度，使 ONU 和 OLT 能灵活且简单的选择上行突发开销参数。

附图说明

图 1 是现有技术中 GPON 系统中 OLT 周期性广播上行突发开销参数的示意图；

图 2 是实施例中光接入节点之间上行突发开销参数的管理方法的示意图；

图 3 是实施例一中上行突发开销参数的管理方法示意图；

图 4 是实施例二中上行突发开销参数的管理方法示意图；

图 5 是实施例三中上行突发开销参数的管理方法示意图；

图 6 是实施例四中上行突发开销参数的管理方法示意图；

图 7 是实施例五中上行突发开销参数的管理方法示意图;

图 8 是实施例六中上行突发开销参数的管理方法示意图;

图 9 是实施例七中上行突发开销参数的管理方法示意图。

具体实施方式

如图 2 所示，光接入节点之间上行突发开销参数的管理方法包括以下步骤:

步骤 201，在 ONU 处于序列号状态（即 O3 状态）时，OLT 或 ONU 检测所述 OLT 和所述 ONU 之间的下行链路的传输质量。

步骤 202，OLT 或 ONU 根据所述传输质量确定所述 ONU 适用的上行突发开销参数。

步骤 203，所述 ONU 在自身确定的或所述 OLT 指示的切换时间后开始使用所述上行突发开销参数。

下面详细描述本发明的方法。

本发明的方法中，在 ONU 处于初始状态（即 O1 状态）时，OLT 针对不同级别的链路质量确定 N 种上行突发开销参数集合并进行标识；N 为大于零的整数。每个上行突发开销参数集合均包括以下参数：前向纠错状态，定界符参数，前导码参数， 保护带宽参数。

OLT 将默认的一种上行突发开销参数集合的参数值或标识发送至 ONU，ONU 在等待状态（即 O2 状态）下接收上行突发开销参数集合的参数值或标识，并使用此上行突发开销参数集合；或者，OLT 将一种以上上行突发开销参数集合的参数值或标识发送至 ONU，ONU 在 O2 状态下接收所述一种以上上行突发开销参数集合的参数值或标识后，使用其中一种上行突发开销参数集合。上行突发开销参数集合的个数为多个时，可以设定其中一个为默认的集合，ONU 收到一个以上突发开销参数集合参数后，可以选用默认的集合，或者从多个中任意选择一个使用。

OLT 可以将上行突发开销参数集合单播到特定的 ONU，还可以广播到

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所有 ONU。

在步骤 201 和步骤 202 中，OLT 检测下所述 ONU 与所述 OLT 之间的下行链路的情况下，OLT 通过检测下行链路，获知此下行链路的质量信息，并根据此下行链路的质量信息确定所述 ONU 使用的上行突发开销参数集合，通过单播消息或多播消息将所述上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 ONU。

在步骤 201 和步骤 202 中，ONU 检测下所述 ONU 与所述 OLT 之间的下行链路的情况下，ONU 通过检测下行链路，获知此下行链路的质量信息，并将所述下行链路的质量信息通知至所述 OLT，所述 OLT 根据所述下行链路的质量信息确定所述 ONU 使用的上行突发开销参数集合，通过单播消息或多播消息将所述上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 ONU。

在步骤 201 和步骤 202 中，ONU 检测下所述 ONU 与所述 OLT 之间的下行链路的情况下，还可以由 ONU 确定其使用的上行突发开销参数集合。ONU 通过检测下行链路，获知此下行链路的质量信息，并根据所述下行链路的质量信息确定所述 ONU 使用的上行突发开销参数集合，通过单播消息或多播消息将所述上行突发开销参数集合中参数值或者上行突发开销参数集合的标识通知至所述 OLT。

在步骤 203 中，可以由 OLT 通过切换索引值通知 ONU 切换。具体的，OLT 在将确定的上行突发开销参数集合通知至所述 ONU 的同时或之后，在为 ONU 的带宽分配的标志域中设置上行突发开销参数的切换索引值，通过下行帧发送给所述 ONU，所述 ONU 接收到所述切换索引值后，在下一帧中使用所述上行突发开销参数。

在步骤 203 中，还可以由 OLT 通过指示超帧号的方式通知 ONU 切换。具体的，OLT 在将确定的上行突发开销参数集合通知至所述 ONU 的同时或之后，向所述 ONU 通知超帧号，所述 ONU 接收到后，在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数。

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在步骤 203 中，还可以由 ONU 确定超帧号并通知至 OLT。ONU 在将确定的上行突发开销参数集合通知至所述 OLT 的同时或之后，向所述 OLT 通知超帧号，所述 ONU 在所述超帧号指示的帧到达后，开始使用所述上行突发开销参数。

下面通地过具体实施例来说明本发明的方法。下述各实施例中，假设 OLT 针对线路质量确定了三种上行突发开销参数集合，其中集合 1 是通用的上行开销突发参数，属于默认使用的参数，也对应于一般链路质量的所要求使用的参数，索引值设置为 0b00；集合 2 是增强的上行突发开销参数，对应于线路质量比一般链路质量恶劣时所使用的参数，索引值设置为 0b01；集合 3 是减弱的上行突发开销参数，对应于线路质量比一般链路质量良好时所使用的参数，索引值设置为 0b10。(此处举例只有三种集合，可以按照线路质量的实际情况定义多种对应的参数等级，以及设定一一对应的多种上行突发开销参数集合，后续实施例中设置参数集合也可以这样考虑进行设置)。

具体实施例一：

具体实施例一中，OLT 向 ONU 广播默认的上行突发开销参数集合，ONU 在进入 O3 状态后，检测 ONU 与 OLT 间的下行链路质量，并将检测的链路质量信号通知至 OLT，OLT 根据此质量信号确定适合所述 ONU 使用的上行突发开销参数集合，并通过单播消息通知至所述 ONU，还在为 ONU 的带宽分配标志域中指示切换，ONU 收到后，在后续上行帧中使用收到的此上行突发开销参数集合参数。

如图 3 所示，具体实施例一中具体包括：

步骤 1001，OLT 确定各上行突发开销参数集合；

步骤 1002，OLT 在下行方向上广播发送 Upstream_overhead 消息，携带通用的上行突发开销集合参数（即集合 1）。可以携带此集合的参数也可以携带此集合 1 的标识。此消息可发送一次或多次，本发明中不作限制。

步骤 1003，ONU 上电启动，在 O2 状态接收到 OLT 下发的

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Upstream_overhead 消息并成功获取所携带的上行物理层突发开销参数后，转移到 O3 状态。

步骤 1004，从 O3 状态开始，ONU 启动对针对下行链路的传输质量分析，可以采用目前通用的 BIP（比特间插奇偶校验）检测方法获取结果，也可以采用常用的 FEC（前向错误纠错）结果和校正位数来来获取结果。本发明中，不排除 ONU 采用其他类似的检测手段，来获取下行链路的传输质量信息。假定 ONU 测量的链路质量的结果是良好。

步骤 1005，ONU 在后续上行帧携带 ONU 对下行链路质量检测（或者是评估）的结果（此时上行帧使用在第 1003 步中接收到的通用上行突发开销参数）上报给 OLT。

例如 ONU 在 O3 状态中响应 OLT 下发的序列号请求带宽分配（SN_Request）时，在上行消息 Serial_Number_ONU 中携带第 1004 步中获得的链路质量信息－“良好”。如下表 1 所示：

表 1

Serial_Number_ONU ONU序列号信息		
Octet	**Content**	**Description**
1	11111111 ONU-ID	=11111111：ONU-ID尚未分配，，广播消息 如果已分配，则填入ONU-ID数值，单播消息
2	00000001	消息类型：“ONU序列号信息”
3-6	VID1-VID4	设备商标识 字节1-字节4
7-10	VID2	设备商定义的序列号信息字节1-字节4
11	RRRRRRRR	随机试验的高位8bit

Serial_Number_ONU ONU序列号信息		
Octet	**Content**	**Description**
12	RRRRAATT	RRRR =随机试验的低4位bit AA : ONU向OLT通知的链路质量测量结果,此时设置为"01",对应于"良好" (00- OLT忽略 01-线路质量良好 10-线路质量一般 11-线路质量较差) TT = ONU发射功率 TT = 00 – Low Power TT = 01 – Medium Power TT = 10 – High Power TT = 11 – Reserved
13-20	Reserve	保留

使用 Serial_number_ONU 消息携带该信息仅仅是举例，也可以使用其他上行帧消息中的空闲位，赋予上述表格“AA”类似的定义，用来通知 OLT 链路检测的结果，或者使用专门定义的消息来传递该检测结果。

步骤 1006，OLT 在接收到该上行帧后,记录和该 ONU 对应的线路质量信息,并确定该 ONU 所适合使用的上行突发开销参数集合 3.

步骤 1007，在 ONU 被分配好 ONU-ID 之后，OLT 通过单播消息 Upstream_overhead 将该 ONU 所将要使用的参数集合以及对应的索引传递给该 ONU。如下表 2 所示，

表 2

Upstream_Overhead message 上行突发开销参数		
Octet	**Content**	**Description**
1	ONU-ID	ONU标识
2	00000001	消息标识 "上行突发开销参数".
3	000000ss	ss是该消息中所包含参数集合的索引值 00：参数集合1 01：参数集合2 **10：参数集合3** 11：保留

Upstream_Overhead message 上行突发开销参数		
Octet	**Content**	**Description**
4	Gggggggg	保护带宽的比特位数
5	Xxxxxxxx	前导码位数.
6-8	Bbbbbbbb bbbbbbbb Bbbbbbbb	定界符 字节1-字节3
9-10	Xxxxxxxx xxxxxxxx Xxxxxxxx	xx = reserved:
11-12	Ddddddddd Ddddddddd	预分配延迟参数
13-20	Reserve	保留

步骤 1008，ONU 接收到 OLT 下发给自己的 Upstream_overhead 单播消息之后，记录其所携带的物理层参数和索引 0b10。

步骤 1009，OLT 在给该 ONU 的带宽分配的标志域中设置上行突发开销参数的切换索引值，并通过下行帧发给该 ONU。

步骤 1010，ONU 一旦接收到第 1009 步中切换指示，立刻在下一帧按照所指示的索引值进行上行突发开销参数切换，在后续上行传输时使用。

具体实施例二:

具体实施例二中，OLT 向 ONU 广播默认的上行突发开销参数集合，ONU 在进入 O3 状态后，OLT 检测 ONU 与 OLT 间的下行链路质量，并根据此质量信号确定适合所述 ONU 使用的上行突发开销参数集合，并通过单播消息通知至所述 ONU，还在为 ONU 的带宽分配标志域中指示切换，ONU 收到后，在后续上行帧中使用收到的此上行突发开销参数集合参数。

如图 4 所示，具体实施例二中具体包括:

步骤 2001，OLT 确定各上行突发开销参数集合;

步骤 2002，OLT 在下行方向上广播发送 Upstream_overhead 消息，携带通用的上行突发开销参数（即集合 1）。可以携带此集合的参数也可以携带

此集合 1 的标识。此消息可发送一次或多次，本发明中不作限制。

步骤 2003，ONU 上电启动，在 O2 状态接收到 OLT 下发的 Upstream_overhead 消息并成功获取所携带的上行物理层突发开销参数后，转移到 O3 状态。并与 OLT 按照标准（现有技术）制定的规范，进行正常的数据通信。

步骤 2004，OLT 启动对某一个 ONU 对应链路的检测，获取其链路质量信息,测试结果为“较差”，对应于上行突发开销参数集合 2。（检测启动的条件可以是很多种：可以是上行帧误码增多，也可以是上行帧丢失，也可以是运营商主动要求检测）。OLT 的检测方法可以采用目前通用的 BIP，也可以采用常用的 FEC，不排除其他类似的检测手段，只要能获取相关信息即可。

步骤 2005，OLT 通过单播消息 Upstream_overhead 将该 ONU 所将要使用的上行开销参数集合 2 传递给该 ONU。如表 3 所示。

表 3

Upstream_Overhead message 上行突发开销参数		
Octet	**Content**	**Description**
1	ONU-ID	ONU标识
2	00000001	消息标识 "上行突发开销参数".
3	gggggggg	保护带宽的比特位数
4	xxxxxxxx	前导码位数.
5-7	bbbbbbbb bbbbbbbb bbbbbbbb	定界符 字节1-字节3
8-10	xxxxxxxx xxxxxxxx xxxxxxxx	xx = reserved:
11-12	dddddddd dddddddd	预分配延迟参数
13-20	Reserve	保留

步骤 2006，ONU 接收到 OLT 下发给自己的 Upstream_overhead 单播消息之后，记录其所携带的物理层参数，后续切换时使用。

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后续切换指示和操作可以与实施例一中的相同。

具体实施例三:

具体实施例三与具体实施例二不同之处在于 OLT 事先向 ONU 广播所有参数集合。

如图 5 所示，具体实施例三中具体包括:

步骤 3001 与步骤 2001 相同;

步骤 3002，OLT 在下行方向上广播发送 Upstream_overhead 消息，携带所有的上行突发开销参数（即集合 1，2，3 都在一个消息中发送）。如表 4 所示，此消息可发送一次或多次，本发明中不作限制。

表 4

Upstream_Overhead message 上行突发开销参数		
Octet	**Content**	**Description**
1	11111111	广播消息类型
2	00000001	消息标识 "上行突发开销参数".
3-7	gggggggg gggggggg gggggggg gggggggg gggggggg	上行突发开销参数一集合1，也是默认使用的参数集合
8-12	xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx	上行突发开销参数一集合2:对应于传输质量恶劣的链路使用
13-17	bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb	上行突发开销参数一集合3:对应于传输质量优良的链路使用
18-19	dddddddd dddddddd	预分配延迟参数
20	Reserve	保留

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步骤 3003，ONU 上电启动，在 O2 状态接收到 OLT 下发的 Upstream_overhead 消息并成功获取所携带的所有上行物理层突发开销参数集合后，转移到 O3 状态。在没有明确指示的情况下，默认使用其中的参数集合 1。ONU 按照标准（现有技术）制定的规范，进行正常的数据通信。

步骤 3004 与步骤 2004 相同；

步骤 3005，OLT 通过单播消息 Upstream_overhead 将该 ONU 所将要使用的上行开销参数集合 2 传递给该 ONU。如表 5 所示的消息格式，其中 BB 应该赋值为“01”。

表 5

Overhead_ONU_Indication message 上行突发开销参数指示消息		
Octet	**Content**	**Description**
1	ONU-ID	ONU标识
2	00000001	消息标识 "上行突发开销参数指示".
3	000000BB	BB: OLT指示ONU采用的何种上行突发开销参数集合 00: 集合1 **01: 集合2** 10: 集合3 11: 保留
4-20	Reserve	保留

步骤 3006，ONU 接收到 OLT 下发给自己的 Overhead_ONU_Indication 单播消息之后，记录其所携带的物理层参数 BB(01)，后续按照指示进行参数切换。后续切换指示和操作可以同实施例一。

具体实施例四：

具体实施例三与具体实施例二不同之处在于 OLT 事先向 ONU 广播所有参数集合。

如图 6 所示，具体实施例四中具体包括：

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步骤 4001 与步骤 1001 相同；

步骤 4002，OLT 在下行方向上广播发送 Upstream_overhead 消息，携带所有的上行突发开销参数集合（即集合 1，2，3 都在一个消息中发送）。如表 6 所示。此消息可发送一次或多次，本发明中不作限制。

表 6

Upstream_Overhead message 上行突发开销参数		
Octet	**Content**	**Description**
1	11111111 ONU-ID	=11111111：ONU-ID尚未分配，广播消息 如果已分配，则填入ONU-ID数值,单播消息
2	00000001	消息标识 "上行突发开销参数".
3	000000xx	xx：本消息为单播消息，OLT指示ONU采用的何种上行突发开销参数集合 00: 集合1 01: 集合2 10: 集合3 11: 保留。 在本消息为广播消息时，xx值无效，ONU忽略
4-8	gggggggg gggggggg gggggggg gggggggg gggggggg	上行突发开销参数一集合1，也是默认使用的参数集合
9-13	xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx	上行突发开销参数一集合2:对应于传输质量恶劣的链路使用
14-18	bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb	上行突发开销参数一集合3:对应于传输质量优良的链路使用
19-20	dddddddd dddddddd	预分配延迟参数

步骤 4003 与步骤 1003 相同；

步骤 4004 与步骤 1004 相同；

步骤 4005 与步骤 1005 相同；ONU 在 O3 状态中响应 OLT 下发的序列号请求带宽分配（SN_Request）时，在上行消息 Serial_Number_ONU 中携带第 1004 步中获得的链路质量信息－“良好”。如表 7 所示：

表 7

Serial_Number_ONU ONU序列号信息		
Octet	**Content**	**Description**
1	11111111 ONU-ID	=11111111：ONU-ID尚未分配 如果已经分配，则填入ONU-ID数值
2	00000001	消息类型： "ONU序列号信息"
3-6	VID1-VID4	设备商标识 字节1-字节4
7-10	VID2	设备商定义的序列号信息字节1-字节4
11	RRRRRRRR	随机试验的高位8bit
12	RRRRAATT	RRRR =随机试验的低4位bit **AA：ONU向OLT通知的链路质量测量结果,此时设置为"01",对应于"良好"** **(00- OLT忽略** **01-线路质量良好** **10-线路质量一般** **11-线路质量较差)** TT = ONU发射功率 TT = 00 – Low Power TT = 01 – Medium Power TT = 10 – High Power TT = 11 – Reserved
13-20	Reserve	保留

（使用 Serial_number_ONU 消息携带该信息仅仅是举例，也可以使用其他上行帧消息中的空闲位，赋予上述表格“AA”类似的定义，用来通知 OLT 链路检测的结果，或者使用专门定义的消息来传递该检测结果）。

步骤 4006 与步骤 1006 相同；

步骤 4007，在 ONU 被分配好 ONU-ID 之后，OLT 通过单播消息 Upstream_overhead 指示 ONU 所将要使用的上行突发开销参数是集合 3. (单播消息中 xx 设置为"10")。如表 8 所示。

表 8

Upstream_Overhead message 上行突发开销参数		
Octet	**Content**	**Description**
1	11111111 ONU-ID	=11111111：ONU-ID尚未分配，广播消息 如果已分配，则填入ONU-ID数值,单播消息
2	00000001	消息标识 "上行突发开销参数".
3	000000xx	xx：本消息为单播消息，OLT指示ONU采用的何种上行突发开销参数集合 00: 集合1 01: 集合2 **10: 集合3** 11: 保留。 在本消息为广播消息时，xx值无效，ONU忽略
4-8	gggggggg gggggggg gggggggg gggggggg gggggggg	上行突发开销参数－集合1，也是默认使用的参数集合
9-13	xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx xxxxxxxx	上行突发开销参数－集合2:对应于传输质量恶劣的链路使用
14-18	bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb bbbbbbbb	上行突发开销参数－集合3:对应于传输质量优良的链路使用
19-20	dddddddd dddddddd	预分配延迟参数

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步骤 4008，ONU 接收到 OLT 下发给自己的 Upstream_overhead 单播消息之后，记录其所携带的上行突发开销参数指示，后续切换时使用。后续切换指示和操作可以同实施例一。

具体实施例五：

具体实施例五与具体实施例三的不同之处是，OLT 检测下行链路质量后，通过广播通道消息 Overhead_ONU_indication 通知 ONU 记录需要切换的上行突发开销参数和切换的超帧号，在超帧号对应的帧来临之后，所有 ONU 切换使用 OLT 指示的上行突发开销参数进行上行传输。

如图 7 所示，具体实施例五中具体包括：

步骤 5001 至步骤 5004 与步骤 3001 至步骤 3004 相同；

步骤 5005，OLT 通过广播消息 Overhead_ONU_Indication 传递给所有 ONU 将要切换使用的上行开销参数集合 2，以及执行参数切换的超帧号. 按照下面的消息格式，其中 BB 应该赋值为“01”。超帧号域（4-7）填入 OLT 要求切换的超帧号的值。如表 9 所示。

表 9

Overhead_ONU_Indication message 上行突发开销参数指示消息		
Octet	**Content**	**Description**
1	**11111111**	**广播消息类型**
2	00000001	消息标识 "上行突发开销参数指示".
3	000000BB	BB: OLT指示ONU采用的何种上行突发开销参数集合 00: 集合1 **01: 集合2** 10: 集合3 11: 保留
4—7	ssssssss ssssssss ssssssss ssssssss	OLT要求所有ONU执行切换的超帧号，在该超帧到来之后，所有ONU切换使用OLT指示的上行突发开销参数进行上行传输
8-20	Reserve	保留

步骤 5006，所有 ONU 接收到 OLT 广播的的 Overhead_ONU_Indication 消息之后，记录其所携带的物理层参数 BB(01)，和指示切换时刻的超帧号，后续按照指示进行参数切换。

步骤 5007，在后续超帧号所对应的下行帧到来后，ONU 进行上行突发开销参数切换操作，将切换后的值用于上行传输。

本实施例可以经过简单的修改，将第 5005-5006 步中消息设计成单播消息，这样就可以支持单个 ONU 进行切换，而不是所有 ONU 一起进行切换。

具体实施例六：

具体实施例六与具体实施例五的不同之处是，OLT 检测下行链路质量后，通过广播通道消息 Overhead_ONU_indication 通知 ONU 记录需要切换的上行突发开销参数和切换的超帧号后，OLT 在给所有 ONU 的带宽分配的标志域中设置上行突发开销参数的切换索引值，ONU 接收到此切换指示后，在下下一帧按照所指示的索引值进行上行突发开销参数切换。

如图 8 所示，具体实施例六中具体包括：

步骤 6001 至步骤 6006 与步骤 5001 至步骤 5006 相同；

步骤 6007，OLT 在给所有 ONU 的带宽分配的标志域中设置上行突发开销参数的切换索引值，并通过下行帧发给所有 ONU。

所有的 ONU 一旦接收到第 6007 步中切换指示，立刻在下一帧按照所指示的索引值进行上行突发开销参数切换，在后续上行传输时使用。

本实施例可以经过简单的修改，将第 6005/6006/6007 步中消息设计成单播消息且针对某个 ONU 进行设置，这样就可以支持单个 ONU 进行切换，而不是所有 ONU 一起进行切换。

具体实施例七：

具体实施例七中，ONU 测试线路质量，并根据链路质量确定其使用的

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上行突发开销参数，ONU通知OLT此上行突发开销参数并指示切换超帧号。

如图9所示，具体实施例七中具体包括：

步骤7001-步骤7002与步骤6001-步骤6002相同；

步骤7003，ONU上电启动，在O2状态接收到OLT下发的Upstream_overhead消息并成功获取所携带的上行物理层突发开销参数后，转移到O3状态。

步骤7004，从O3状态开始，ONU启动对针对下行链路的传输质量分析，可以采用目前通用的BIP（比特间插奇偶校验）检测方法获取结果，也可以采用常用的FEC（前向错误纠错）结果和校正位数来来获取结果。（不排除ONU采用其他类似的检测手段，来获取下行链路的传输质量信息，只要方法可行就可以），假定测量的结果是良好。

步骤7005，ONU在得到第4步中信息后，后续上行帧携带ONU对下行链路质量检测结果"良好"，并根据链路质量确定上行突发开销参数集合即集合3，ONU将其确定的上行突发开销参数集合3和准备切换使用参数集合3的超帧号上报给OLT。例如ONU在O3状态中响应OLT下发的序列号请求带宽分配（SN_Request）时，在上行消息Serial_Number_ONU中携带第4步中获得的链路质量信息－"良好"。如下表10所示。

表10

Serial_Number_ONU ONU序列号信息		
Octet	**Content**	**Description**
1	11111111 ONU-ID	=11111111：ONU-ID尚未分配，，广播消息 如果已分配，则填入ONU-ID数值，单播消息
2	00000001	消息类型：" ONU序列号信息"
3-6	VID1-VID4	设备商标识 字节1-字节4
7-10	VID2	设备商定义的序列号信息字节1-字节4
11	RRRRRRRR	随机试验的高位8bit

Serial_Number_ONU ONU序列号信息		
Octet	**Content**	**Description**
12	RRRRAATT	RRRR =随机试验的低4位bit AA : ONU向OLT通知的链路质量测量结果,此时设置为"01",对应于"良好" (00- OLT忽略 01-线路质量良好 10-线路质量一般 11-线路质量较差) TT = ONU发射功率 TT = 00 – Low Power TT = 01 – Medium Power TT = 10 – High Power TT = 11 – Reserved
13-16	ssssssss ssssssss ssssssss ssssssss	ONU准备切换使用参数集合3的下行帧超帧号.OLT在发送了该超帧号对应的下行帧之后，对该ONU上行帧使用新的上行突发开销参数进行接收。
17-20	Reserve	保留

使用 Serial_number_ONU 消息携带该信息仅仅是举例，也可以使用其他上行帧消息中的空闲位，赋予上述表格中相关域的类似定义，用来通知 OLT 链路检测的结果和切换相关的下行帧超帧号，或者使用专门定义的消息来传递该检测结果。

步骤 7006，OLT 在接收到该消息后,记录和该 ONU 对应的线路质量信息和切换相关的下行帧超帧号,并确定该 ONU 所适合使用的上行突发开销参数集合 3。

步骤 7007，某一时刻 OLT 在发送了该超帧号对应的下行帧之后，ONU 在此时切换使用参数集合 3 发送上行帧，OLT 使用参数集合 3 接收该 ONU 的上行帧。

上述方法可以提高带宽利用率，还可以降低 PON 系统中指示上行突发开销参数的复杂度,使ONU和OLT能灵活且简单的选择上行突发开销参数。

本发明中管理上行突发开销参数的无源光网络系统包括光线路终端OLT或光网络单元ONU，此两个实体的功能与上述方法中描述的功能相同，此处不再重复说明。

以上所述仅为本发明的优选实施例而已，并不用于限制本发明，对于本领域的技术人员来说，本发明可以有各种更改和变化。凡在本发明的精神和原则之内，所作的任何修改、等同替换、改进等，均应包含在本发明的保护范围之内。

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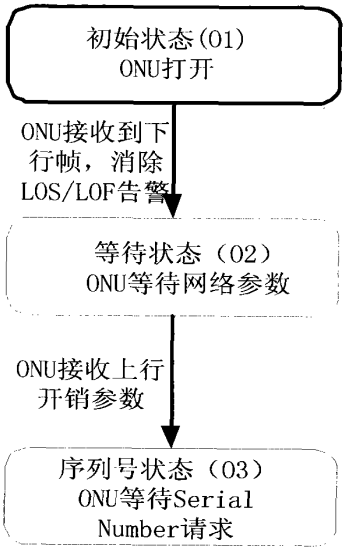


图 1

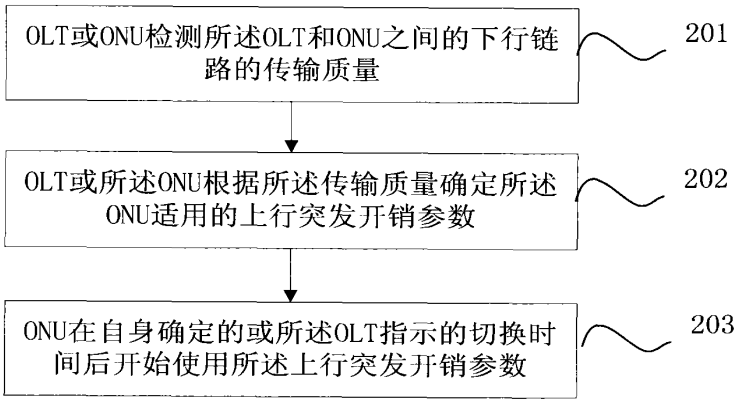


图 2

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09.11.06

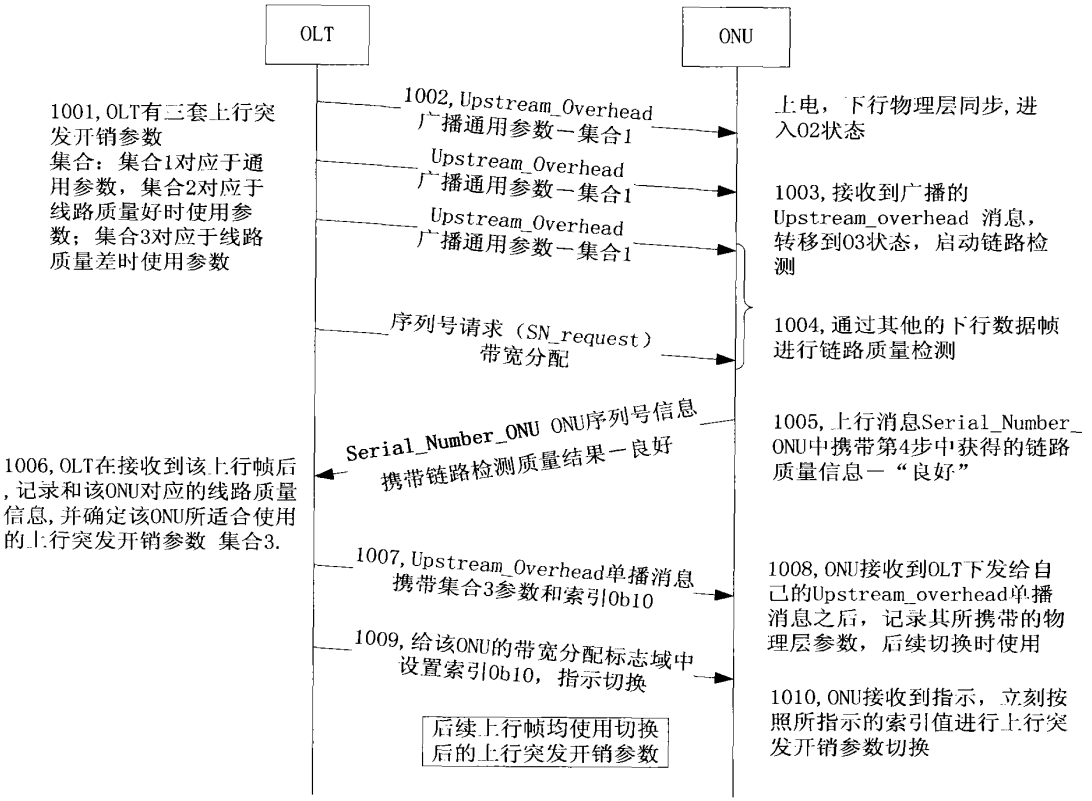


图 3

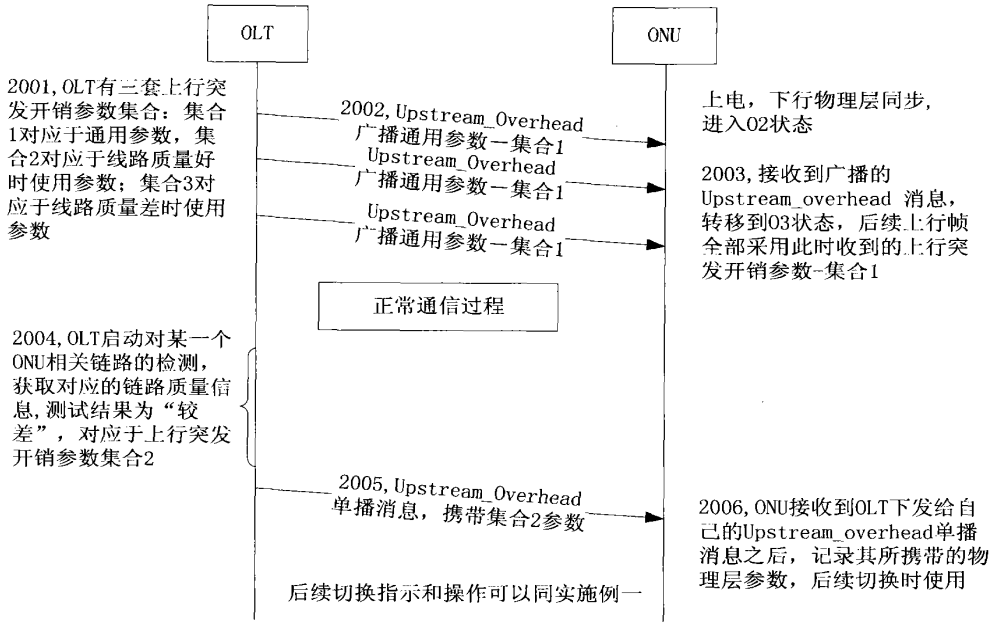


图 4

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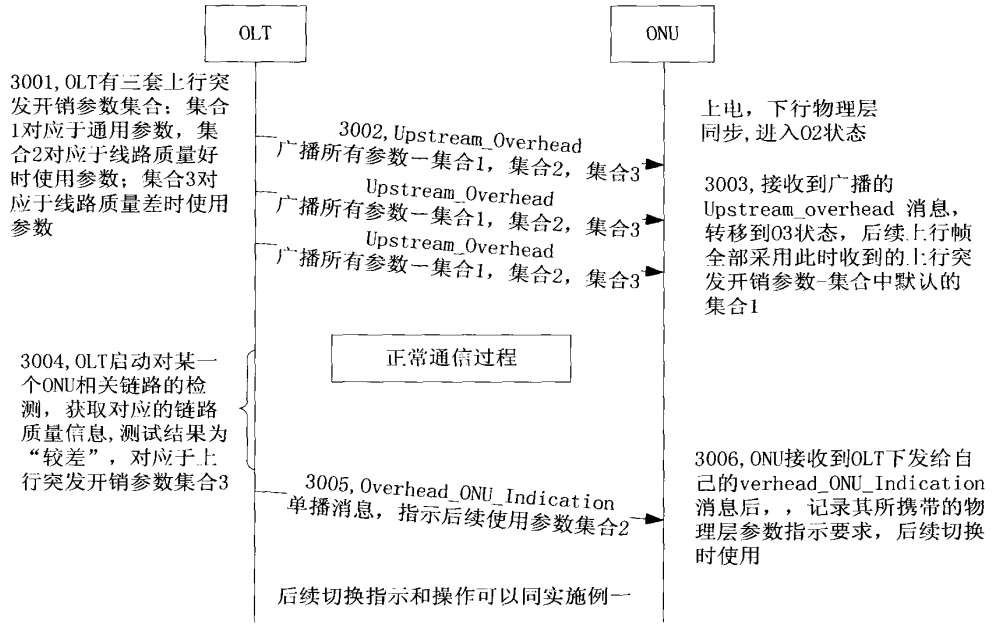


图 5

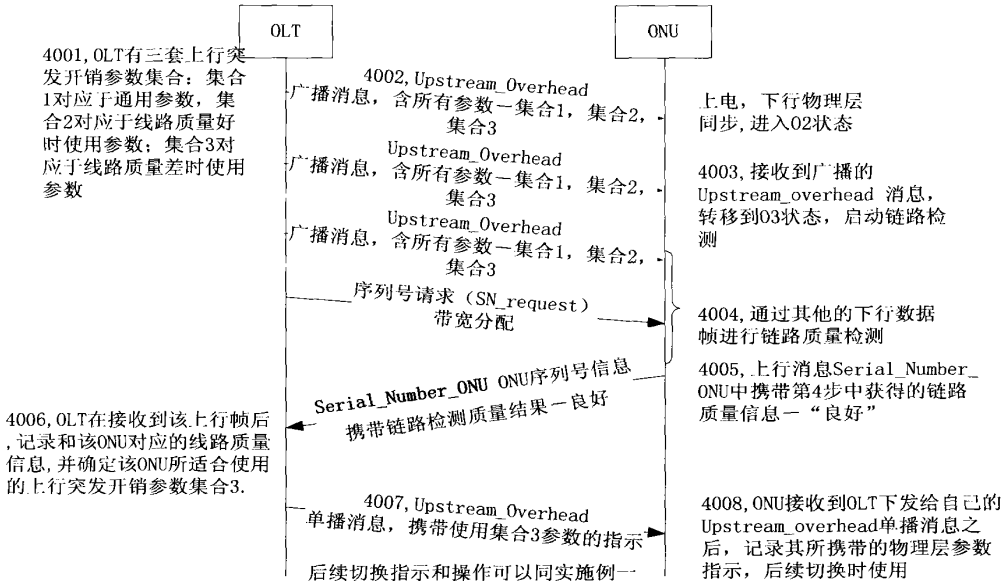


图 6

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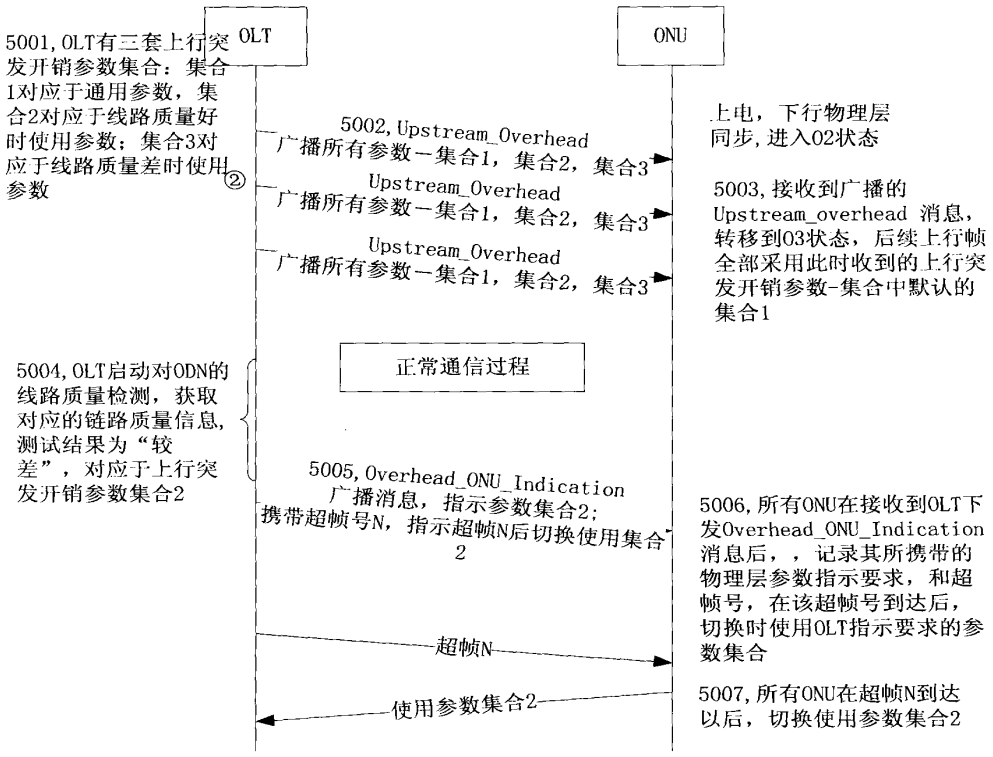


图 7

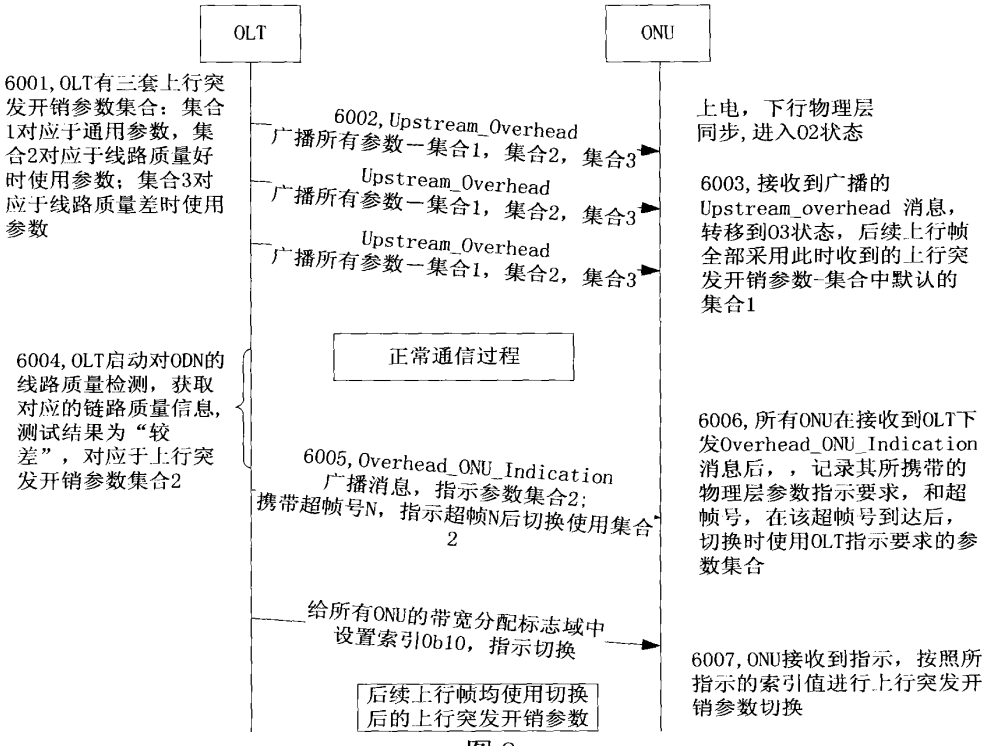


图 8

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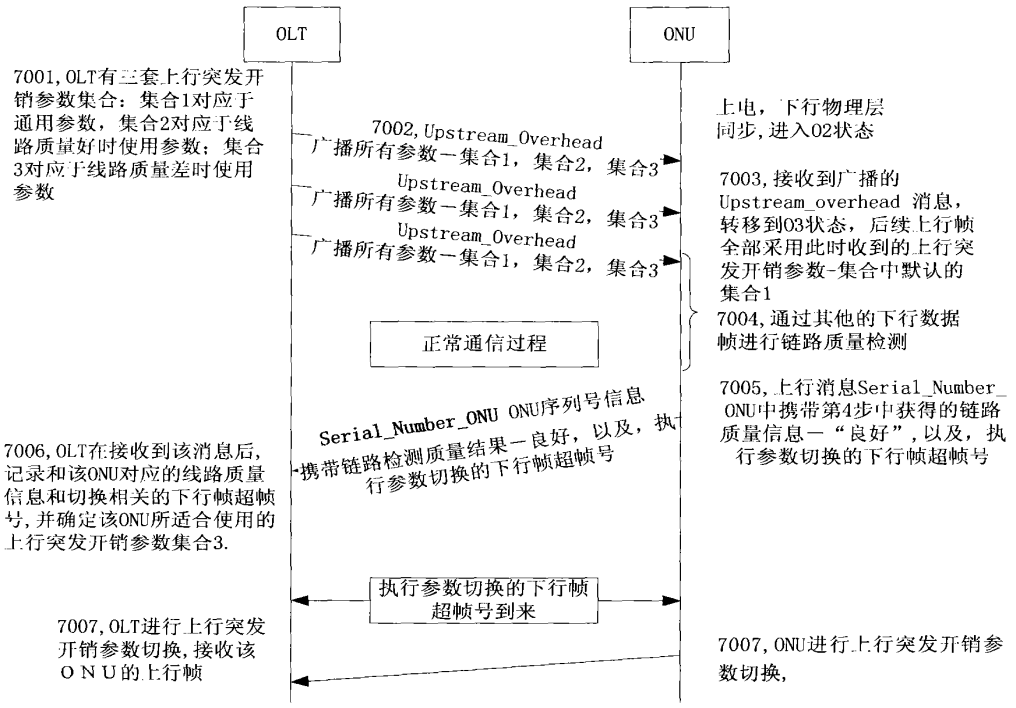


图 9

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