

AO 120 (Rev. 08/10)

TO: Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
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In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Eastern District of Texas on the following

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

DOCKET NO. 2:22-cv-00309	DATE FILED 8/9/2022	U.S. DISTRICT COURT Eastern District of Texas
PLAINTIFF NEXTGEN INNOVATIONS, LLC		DEFENDANT NOKIA OF AMERICA CORPORATION, ET AL.
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1 8,238,754	8/7/2012	NextGen Innovations, LLC
2 9,887,795	2/6/2018	NextGen Innovations, LLC
3 10,263,723	4/16/2019	NextGen Innovations, LLC
4 10,771,181	9/8/2020	NextGen Innovations, LLC
5		

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

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

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

DECISION/JUDGEMENT

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

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AT&T Ex. 1002-1

Nokia of America Corporation

IPR2023-00960, Ex. 1002-1

Ex. 1002-1.001

AO 120 (Rev. 08/10)

TO: Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
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In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Eastern District of Texas on the following

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

DOCKET NO. 2:22-cv-00307	DATE FILED 8/9/2022	U.S. DISTRICT COURT Eastern District of Texas
PLAINTIFF NEXTGEN INNOVATIONS, LLC		DEFENDANT FUJITSU NETWORK COMMUNICATIONS, INC., ET AL.
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1 8,238,754	8/7/2012	NextGen Innovations, LLC
2 9,887,795	2/6/2018	NextGen Innovations, LLC
3 10,263,723	4/16/2019	NextGen Innovations, LLC
4 10,771,181	9/8/2020	NextGen Innovations, LLC
5		

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

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

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

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE
-------	-------------------	------

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

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AT&T Ex. 1002-1

Nokia of America Corporation

IPR2023-00960, Ex. 1002-1

Ex. 1002-1.002

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

II-VI, INC.,
Petitioner,

v.

ALEXANDER SOTO AND WALTER SOTO,
Patent Owner.

IPR2021-01495
Patent 8,238,754 B2

Before PATRICK M. BOUCHER, KEVIN C. TROCK, and
GARTH D. BAER, *Administrative Patent Judges*.

BOUCHER, *Administrative Patent Judge*.

DECISION

Granting Motion to Terminate Proceeding Before Institution
37 C.F.R. § 42.74

With our authorization, the parties filed a Joint Motion to Terminate this proceeding “in light of Patent Owner’s and Petitioner’s settlement of their dispute regarding U.S. Patent No. 8,238,754.” Paper 8, 3. With the Joint Motion, the parties filed a copy of what they describe to be “a true

copy of their written Settlement Agreement (Confidential Exhibit 1023) in connection with this matter as required by statute.” *Id.*; *see* Ex. 1023. In their Joint Motion, the parties “certify that there are no other agreements or understandings, oral or written, between the parties, including any collateral agreements, made in connection with, or in contemplation of, the termination of the present proceeding with respect to Petitioner.” Paper 8, 3. In a separately filed Joint Request to File Settlement Agreement as Business Confidential Information, the parties “jointly request to treat as business confidential information the true copy of the Settlement Agreement (Confidential Exhibit 1023) between the parties.” Paper 9, 3.

“An inter partes review instituted under this chapter shall be terminated with respect to any petitioner upon the joint request of the petitioner and the patent owner, unless the Office has decided the merits of the proceeding before the request for termination is filed.” 35 U.S.C. § 317(a). The settlement agreement appears to be a true copy, and, after reviewing the agreement, we find that it contains confidential business information regarding the terms of settlement. *See* Ex. 1023. This proceeding is at an early stage, with no decision yet having been made whether to institute review of the subject patent. We accordingly determine that it is appropriate to terminate the proceeding and to treat the filed settlement agreement as business confidential information pursuant to 35 U.S.C. § 317(b).

This Order does not constitute a final written decision pursuant to 35 U.S.C. § 318(a).

IPR2021-01495
Patent 8,238,754 B2

It is

ORDERED that the Joint Motion to Terminate is *granted*;

FURTHER ORDERED that this proceeding is hereby terminated as to all parties;

FURTHER ORDERED that the Joint Request to File Settlement Agreement as Business Confidential Information is *granted*;

FURTHER ORDERED that the filed settlement agreement (Ex. 1023) be treated as business confidential information pursuant to 35 U.S.C. § 317(b) and 37 C.F.R. § 42.74(c) and also remain designated as “Parties and Board Only” in the Board’s E2E system.

IPR2021-01495
Patent 8,238,754 B2

For PETITIONER:

Jason Engel
Jason.engel.ptab@klgates.com

Mark Knedeisen
Mark.knedeisen@klgates.com

Erik Halverson
Erik.halverson@klgates.com

Katherine Allor
Katy.allor@klgates.com

For PATENT OWNER:

James Carmichael
jim@carmichaelip.com

Stephen Schreiner
schreiner@carmichaelip.com

Minghui Yang
mitch@carmichaelip.com



UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/982,872	08/07/2012	8238754	UBI-005B	9206

93749 7590 07/18/2012
Alexander Soto
7673 Hazard Center Dr.
San Diego, CA 92108

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 40 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):

Alexander I. Soto, San Diego, CA;
Walter G. Soto, San Clemente, CA;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

IR103 (Rev. 10/09)

Nokia of America Corporation
IPR2023-00960, Ex. 1002-1
Ex. 1002-1.007

AT&T Ex. 1002-1

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)

93749 7590 04/09/2012
Alexander Soto
7673 Hazard Center Dr.
San Diego, CA 92108

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

Certificate of Mailing or Transmission

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

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

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/982,872	12/30/2010	Alexander I. Soto	UBI-005B	9206

TITLE OF INVENTION: SYSTEM AND METHOD FOR PLUGGABLE OPTICAL MODULES FOR PASSIVE OPTICAL NETWORKS

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	\$870	\$300	\$0	\$1170	07/09/2012

EXAMINER	ART UNIT	CLASS-SUBCLASS
LI, SHI K	2613	398-066000

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, 1 _____
- (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. 2 _____
- 3 _____

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

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

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

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

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

- ☒ Issue Fee
- ☒ Publication Fee (No small entity discount permitted)
- ☐ Advance Order - # of Copies _____

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

- ☐ A check is enclosed.
- ☒ Payment by credit card. Form PTO-2038 is attached.
- ☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

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

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

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

Authorized Signature /Alexander Soto/

Date July 8th, 2012

Typed or printed name Alexander Soto

Registration No. _____

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

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

Electronic Patent Application Fee Transmittal				
Application Number:		12982872		
Filing Date:		30-Dec-2010		
Title of Invention:		SYSTEM AND METHOD FOR PLUGGABLE OPTICAL MODULES FOR PASSIVE OPTICAL NETWORKS		
First Named Inventor/Applicant Name:		Alexander I. Soto		
Filer:		Alexander Ivan Soto		
Attorney Docket Number:		UBI-005B		
Filed as Small Entity				
Utility under 35 USC 111(a) 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	2501	1	870	870
Publ. Fee- early, voluntary, or normal	1504	1	300	300

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				1170

Electronic Acknowledgement Receipt	
EFS ID:	13197784
Application Number:	12982872
International Application Number:	
Confirmation Number:	9206
Title of Invention:	SYSTEM AND METHOD FOR PLUGGABLE OPTICAL MODULES FOR PASSIVE OPTICAL NETWORKS
First Named Inventor/Applicant Name:	Alexander I. Soto
Customer Number:	93749
Filer:	Alexander Ivan Soto
Filer Authorized By:	
Attorney Docket Number:	UBI-005B
Receipt Date:	08-JUL-2012
Filing Date:	30-DEC-2010
Time Stamp:	23:32:02
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	\$ 1170
RAM confirmation Number	7458
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
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1	Issue Fee Payment (PTO-85B)	issue_transmittal.pdf	92677 4cd2a1c81e1c8a31129ef35183db56b3fe01ec25	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	31956 097554954deefad30f10b289cf413be6500c8696	no	2
Warnings:					
Information:					
Total Files Size (in bytes):				124633	
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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UNITED STATES DEPARTMENT OF COMMERCE
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www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

93749 7590 04/09/2012
Alexander Soto
7673 Hazard Center Dr.
San Diego, CA 92108

EXAMINER

LI, SHI K

ART UNIT

PAPER NUMBER

2613

DATE MAILED: 04/09/2012

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/982,872	12/30/2010	Alexander I. Soto	UBI-005B	9206

TITLE OF INVENTION: SYSTEM AND METHOD FOR PLUGGABLE OPTICAL MODULES FOR PASSIVE OPTICAL NETWORKS

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	YES	\$870	\$300	\$0	\$1170	07/09/2012

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

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

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

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

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

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

If the SMALL ENTITY is shown as NO:

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

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

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

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

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

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: **Mail** **Mail Stop ISSUE FEE**
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Alexandria, Virginia 22313-1450
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CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

93749 7590 04/09/2012
Alexander Soto
7673 Hazard Center Dr.
San Diego, CA 92108

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.
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12/982,872 12/30/2010 Alexander I. Soto UBI-005B 9206

TITLE OF INVENTION: SYSTEM AND METHOD FOR PLUGGABLE OPTICAL MODULES FOR PASSIVE OPTICAL NETWORKS

APPLN. TYPE	SMALL ENTITY	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
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nonprovisional YES \$870 \$300 \$0 \$1170 07/09/2012

EXAMINER	ART UNIT	CLASS-SUBCLASS
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LI, SHI K 2613 398-066000

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, 1 _____
- (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. 2 _____
- 3 _____

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

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

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

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

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

- ☐ Issue Fee
- ☐ Publication Fee (No small entity discount permitted)
- ☐ Advance Order - # of Copies _____

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

- ☐ A check is enclosed.
- ☐ Payment by credit card. Form PTO-2038 is attached.
- ☐ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

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

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

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

Authorized Signature _____

Date _____

Typed or printed name _____

Registration No. _____

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

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
12/982,872	12/30/2010	Alexander I. Soto	UBI-005B	9206
93749	7590	04/09/2012		
Alexander Soto 7673 Hazard Center Dr. San Diego, CA 92108			EXAMINER LI, SHI K	
			ART UNIT	PAPER NUMBER
			2613	
DATE MAILED: 04/09/2012				

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

The Patent Term Adjustment to date is 40 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 40 day(s).

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

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

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

Privacy Act Statement

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

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

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

Nokia of America Corporation

IPR2023-00960, Ex. 1002-1

AT&T Ex. 1002-1

Ex. 1002-1.016

Notice of Allowability	Application No.	Applicant(s)	
	12/982,872	SOTO ET AL.	
	Examiner	Art Unit	
	Shi K. Li	2613	

-- 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 application filed 30 December 2010.
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 1-65.
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) ☐ All b) ☐ Some* c) ☐ None of the:
 1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. ____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: ____.

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

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
 - (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
 - 1) ☐ hereto or 2) ☐ to Paper No./Mail Date ____.
 - (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date ____.

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

Attachment(s)

1. ☐ Notice of References Cited (PTO-892) 2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948) 3. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date <u>1/11/2011</u> 4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material	5. ☐ Notice of Informal Patent Application 6. ☐ Interview Summary (PTO-413), Paper No./Mail Date ____. 7. ☐ Examiner's Amendment/Comment 8. ☒ Examiner's Statement of Reasons for Allowance 9. ☐ Other ____.
--	--

/Shi K. Li/ Primary Examiner, Art Unit 2613	
--	--

REASONS FOR ALLOWANCE

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

Ethridge et al. (U.S. Patent Application Pub. 2002/0163921 A1) teaches in FIG. 4 a passive optical network with ONUs coupled to a fast Ethernet switch. However, Ethridge et al. fails to teach "an electrical network interface port electrically coupled to the control module and for electrically coupling into the optical module port of the switch or router" as recited in claim 1.

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 Shi K. Li whose telephone number is (571)272-3031. The examiner can normally be reached on Monday-Friday (6:30 a.m. - 4:00 p.m.).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Vanderpuye can be reached on 571 272-3078. 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.

skl
3 April 2012

/Shi K. Li/
Primary Examiner, Art Unit 2613

Issue Classification 	Application/Control No. 12982872	Applicant(s)/Patent Under Reexamination SOTO ET AL.
	Examiner SHI K LI	Art Unit 2613

ORIGINAL						INTERNATIONAL CLASSIFICATION													
CLASS			SUBCLASS			CLAIMED					NON-CLAIMED								
398			100			H	0	4	J	14 / 08 (2006.01.01)									
CROSS REFERENCE(S)																			
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)																		

☒ 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

NONE		Total Claims Allowed:	
		65	
(Assistant Examiner)	(Date)	O.G. Print Claim(s)	O.G. Print Figure
/SHI K LI/ Primary Examiner.Art Unit 2613	04/03/2012	1	7A
(Primary Examiner)	(Date)		

Search Notes 	Application/Control No. 12982872	Applicant(s)/Patent Under Reexamination SOTO ET AL.
	Examiner SHI K LI	Art Unit 2613

SEARCHED			
Class	Subclass	Date	Examiner
398	66-67,98-100	4/3/2012	SK

SEARCH NOTES		
Search Notes	Date	Examiner
EAST search	4/3/2012	SK

INTERFERENCE SEARCH			
Class	Subclass	Date	Examiner
	See interference search history print out	4/3/2012	SK

	/SHI K LI/ Primary Examiner.Art Unit 2613
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EAST Search History**EAST Search History (Prior Art)**

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L3	1	12/982872	US-PGPUB; USPAT	OR	ON	2012/04/03 10:25
S22	3	10/886514	US-PGPUB; USPAT	OR	OFF	2012/04/02 12:37
S23	18	("20020006111" "20020067529" "20020163921" "20030091045" "20030227926" "20030236916" "20040052274" "4701909" "4776041" "5029333" "5572349" "6023467" "6498667" "6778399" "6788833" "6792207" "6970461" "7031343").PN.	US-PGPUB; USPAT	OR	OFF	2012/04/02 13:42
S24	1	S23 and start adj time	US-PGPUB; USPAT	OR	ON	2012/04/02 13:43
S25	18	S23 and time	US-PGPUB; USPAT	OR	ON	2012/04/02 13:43
S26	4035	(switch router) and (PON OLT ONT)	US-PGPUB; USPAT	OR	OFF	2012/04/03 08:00
S27	5540	(switch router) and (PON OLT ONT)	US-PGPUB; USPAT	OR	ON	2012/04/03 08:01
S28	403	S27 and start\$3 adj time	US-PGPUB; USPAT	OR	ON	2012/04/03 08:01
S29	146	S28 and @ad<"20031030"	US-PGPUB; USPAT	OR	ON	2012/04/03 08:02

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L4	306	(switch router).clm. and (PON OLT ONT (passive adj optical)).clm.	US-PGPUB; UPAD	OR	OFF	2012/04/03 10:30
L5	8	4 and start\$3 adj time.clm.	US-PGPUB; UPAD	OR	ON	2012/04/03 10:31
L6	332	(switch router).clm. and (PON OLT ONT (passive adj optical)).clm.	US-PGPUB; UPAD	OR	ON	2012/04/03 10:31
L7	8	6 and start\$3 adj time.clm.	US-PGPUB; UPAD	OR	ON	2012/04/03 10:31

4/3/2012 10:33:51 AM

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		12982872
	Filing Date		2010-12-30
	First Named Inventor	Alexander I. Soto	
	Art Unit		
	Examiner Name		
	Attorney Docket Number		UBI-005B

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	6498667	B1	2002-12-24	Masucci et al.	
	2	6778399	B2	2004-08-17	Medina et al.	
	3	6788833	B1	2004-09-07	Brisson et al.	
	4	6970461	B2	2005-11-29	Unitt et al.	
	5	5572349	A	1996-11-05	Hale et al.	
	6	4776041	A	1998-10-04	Husbands, Charles R.	
	7	4701909	A	1987-10-20	Kavehrad, Mosen	
	8	5029333		1991-07-02	Graves et al	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		12982872	
	Filing Date		2010-12-30	
	First Named Inventor	Alexander I. Soto		
	Art Unit			
	Examiner Name			
	Attorney Docket Number	UBI-005B		

	9	6023467	A	2000-02-08	Abdelhamid et al.	
	10	7031343	B1	2006-04-18	Kuo et al.	
	11	6792207	B2	2004-09-14	Iannone et al.	

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Examiner Initial*	Cite No	Publication Number	Kind Code ¹	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	20030236916	A1	2003-12-25	Adcox et al.	
	2	20020006111		2002-01-17	Akita et al.	
	3	20020067529	A1	2002-06-06	Yokomoto et al.	
	4	20020163921	A1	2002-11-07	Ethridge et al.	
	5	20030091045	A1	2003-05-15	Choi et al.	
	6	20030227926		2003-12-11	Ramamurthy et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		12982872	
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	First Named Inventor	Alexander I. Soto		
	Art Unit			
	Examiner Name			
	Attorney Docket Number		UBI-005B	

	7	20040052274	A1	2004-03-18	Wang et al.	
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Examiner Initial*	Cite No	Foreign Document Number ³	Country Code ² i	Kind Code ⁴	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear	T ⁵
	1							☐

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NON-PATENT LITERATURE DOCUMENTS Remove			
Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵
	1	E. MODIANO et al., "A Novel Medium Access Control Protocol for WDM-Based LAN's and Access Networks Using a...", Journal of Lightwave Tech., Vol 18, No 4, April 2000.	☐
	2	M. SACHES et al., "Fibre Channel and Related Standards", IEEE Communications Magazine, August 1996.	☐
	3	RODOVANOVIC, "Ethernet-Based Passive Optical Local-Area Networks for Fiber-to-the-Desk Application", Journal of Lightwave Tech., Nov 2003, pages 2534-2545 vol 21 no 11.	☐
	4	CHAING et al, "Implementation of STARNET: A WDM Computer Communications Network", Journal on Selected Areas of Communications, June 1996, pages 824-839, vol 14, no 5.	☐
	5	RAWSON, ERIC, "The Fibernet II Ethernet-Compatible Fiber-Optic LAN", IEEE Journal of Lightwave Technology, June 1985, pages 496-501, vol LT-3, No. 3.	☐

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		12982872
	Filing Date		2010-12-30
	First Named Inventor	Alexander I. Soto	
	Art Unit		
	Examiner Name		
	Attorney Docket Number		UBI-005B

	6	E. MODIANO, "WDM-Based Packet Networks", IEEE Communications Magazine, March 1999	☐
	7	E.MODIANO, "Design and Analysis of an Asynchronous WDM Local Area Network Using a Master/Slave Scheduler", IEEE, 1999	☐
	8	R. MAUGER, "The Integration of ATM, SDH and PON Technology in the Access Network, Fourth IEE Conference on Telecommunications 1993.	☐

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EXAMINER SIGNATURE

Examiner Signature	/Shi K. Li/	Date Considered	04/03/2012
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*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.

04/03/2012



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BIB DATA SHEET

CONFIRMATION NO. 9206

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.		
12/982,872	12/30/2010	398	2613	UBI-005B		
RULE						
APPLICANTS Alexander I. Soto, San Diego, CA; Walter G. Soto, San Clemente, CA; ** CONTINUING DATA ***** This application is a CON of 10/886,514 07/06/2004 PAT 7,925,162 which claims benefit of 60/485,072 07/03/2003 and claims benefit of 60/515,836 10/30/2003 ** FOREIGN APPLICATIONS ***** ** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** ** SMALL ENTITY ** 01/13/2011						
Foreign Priority claimed ☐ Yes ☒ No 35 USC 119(a-d) conditions met ☐ Yes ☒ No Verified and /Shi K. Li/ Acknowledged Examiner's Signature		☐ Met after Allowance Initials	STATE OR COUNTRY CA	SHEETS DRAWINGS 14	TOTAL CLAIMS 65	INDEPENDENT CLAIMS 4
ADDRESS Alexander Soto 7673 Hazard Center Dr. San Diego, CA 92108 UNITED STATES						
TITLE System and Method for Pluggable Optical Modules for Passive Optical Networks						
FILING FEE RECEIVED 1742	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:			☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit		

Index of Claims 	Application/Control No. 12982872	Applicant(s)/Patent Under Reexamination SOTO ET AL.
	Examiner SHI K LI	Art Unit 2613

✓	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																																				
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<i>Index of Claims</i> 	Application/Control No. 12982872	Applicant(s)/Patent Under Reexamination SOTO ET AL.
	Examiner SHI K LI	Art Unit 2613

✓	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							
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PLUS Search Results for S/N 12982872, Searched Fri Jul 01 10:04:05 EDT 2011

The Patent Linguistics Utility System (PLUS) is a USPTO automated search system for U.S. Patents from 1971 to the present PLUS is a query-by-example search system which produces a list of patents that are most closely related linguistically to the application searched. This search was prepared by the staff of the Scientific and Technical Information Center, SIRA.

5767995 99	4063084 92
3571579 92	
3584225 92	
3586441 92	
3599147 92	
3621390 92	
3638640 92	
3643099 92	
3662263 92	
3702471 92	
3704950 92	
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/982,872	12/30/2010	Alexander I. Soto	UBI-005B

CONFIRMATION NO. 9206

PUBLICATION NOTICE



OC000000048382288

93749
Alexander Soto
7673 Hazard Center Dr.
San Diego, CA 92108

Title:System and Method for Pluggable Optical Modules for Passive Optical Networks

Publication No.US-2011-0150475-A1

Publication Date:06/23/2011

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 publicly available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently <http://www.uspto.gov/patft/>.

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

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

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

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

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875						Application or Docket Number 12/982,872				
APPLICATION AS FILED - PART I										
(Column 1)		(Column 2)		SMALL ENTITY		OR	OTHER THAN SMALL ENTITY			
FOR	NUMBER FILED	NUMBER EXTRA		RATE(\$)	FEE(\$)		RATE(\$)	FEE(\$)		
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	82		N/A			
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A		N/A	270		N/A			
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	110		N/A			
TOTAL CLAIMS (37 CFR 1.16(j))	65	minus 20 =	*	45	x 26 =	1170	OR			
INDEPENDENT CLAIMS (37 CFR 1.16(h))	4	minus 3 =	*	1	x 110 =	110				
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$270 (\$135 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					
				TOTAL	1742		TOTAL			
* If the difference in column 1 is less than zero, enter "0" in column 2.										
APPLICATION AS AMENDED - PART II										
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
AMENDMENT A	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)	
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=	OR	x	=
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=	OR	x	=
	Application Size Fee (37 CFR 1.16(s))							OR		
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
					TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE		
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
AMENDMENT B	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)	
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=	OR	x	=
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=	OR	x	=
	Application Size Fee (37 CFR 1.16(s))							OR		
	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.										



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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
12/982,872	12/30/2010	2613	1742	UBI-005B	65	4

CONFIRMATION NO. 9206

UPDATED FILING RECEIPT



OC000000046553544

93749

Alexander Soto
7673 Hazard Center Dr.
San Diego, CA 92108

Date Mailed: 03/15/2011

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)

Alexander I. Soto, San Diego, CA;
Walter G. Soto, San Clemente, CA;

Power of Attorney: The patent practitioners associated with Customer Number 93749

Domestic Priority data as claimed by applicant

This application is a CON of 10/886,514 07/06/2004
which claims benefit of 60/485,072 07/03/2003
and claims benefit of 60/515,836 10/30/2003

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.)

If Required, Foreign Filing License Granted: 01/13/2011

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 12/982,872**

Projected Publication Date: 06/23/2011

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

System and Method for Pluggable Optical Modules for Passive Optical Networks

Preliminary Class

398

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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.

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page 2 of 3

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Ex. 1002-1.034

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PATENTS Docket No. UBI-005B	
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE	
In re Application of: Alexander I. Soto et al.	Group Art Unit: Unassigned Examiner: Unknown
Patent Application No.: 12/982,872	
Filed on: December 30, 2010	
For: System and Method for Pluggable Optical Modules for Passive Optical Networks	

Mail Stop Amendment
Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-4150

PRELIMINARY AMENDMENT PER 37 C.F.R. §§1.115 and 1.57(a)

Prior to examination of the above-referenced application, please enter the following amendment pursuant to MPEP §201.17, which incorporates certain inadvertently omitted material copied from the earlier Provisional Application No 60/515,836 that is incorporated by reference in the above-referenced application. No new matter is added. No fees are required.

Respectfully submitted,

/Alexander Soto/

Alexander Soto
Customer No. 93,749
7673 Hazard Center Dr. San Diego, CA 92108
858-527-2397
alexander.i.soto@gmail.com

Amendments to the Specification

Kindly insert the following five new paragraphs immediately after Paragraph [0005] in the **BACKGROUND OF THE INVENTION** section:

[0005.1] Optical modules are used in applications requiring digital optical transmission such as SONET/SDH, 10 Gigabit Ethernet, Fibre Channel and DWDM running across metro access networks, wide area networks, access networks, storage area networks, and local area networks.

[0005.2] Optical modules integrate components used in the transmission and reception of optical signals into a single packaged subsystem. Makers of optical networking systems find optical modules attractive, because the highly integrated packaging approach can cut several months of system development and manufacturing time, consume less power and increase port densities over board-level solutions built from discrete components. But with so much functionality in one module, timely and sufficient component supply becomes even more essential for successful system delivery. Multi-source agreement (MSA) developed so systems vendors can feel more confident about getting the components they need and being able to incorporate them without costly and time-consuming system redesigns. Further with MSA, system vendors can concentrate on system architecture and not optical research and development. Optical modules can be purchased off the shelf from a choice of several suppliers.

[0005.3] A typical optical module 1100, as shown in FIG. 11, is composed of a: laser 1101; laser driver (LD) 1102; photo detector (PD) 1103; transimpedance amplifier (TIA) 1104; limiting amplifier (LA) 1105 and sometimes physical-layer devices 1108 such as a mux/demux with associated clock multiplier unit (CMU) and clock data recovery (CDR) functions in a serializer 1109 and deserializer 1110. A typical optical module 1100 has dual optical fibers for reception 1106 and transmission 1107 of signals and can have serial or parallel input 1111 and output 1112 pins. Optical modules have several levels of integration as shown in FIG. 12. Optical modules that contain only the optical-electrical and electrical-optical (o-e/e-o) components 1204, such as a laser and photo detector, are labeled discrete 1202. Optical modules that contain (o-e/e-o) 1204 and hi speed inte-

grated circuits 1205 such as LD, TIA and LA are called transceivers 1201. Optical modules that contain (o-e/e-o) 1204, hi speed integrated circuits 1205 and Mux/Demux devices 1206 are called transponders 1200. Mux/Demux 1206 devices contain CDR and CMUs. Optical modules are ultimately connected with various interfaces to Framers and Media Access Control (MAC) devices 1207 as shown in FIG. 12.

[0005.5] In FIG. 13, the evolution of MSA 10 Gb/s optical modules is shown. Beginning with discrete components, followed by 300pin, XENPAK, X2, and XPAK transponders and finally with XFP transceivers. The evolution of optical modules has been to reduce the size, power, and number of components in optical modules for the purpose of increasing port densities. The very nature of the intent of the invention is contrary to the evolution of MSA 10 Gb/s optical modules in that an increase in power and number of components result while enabling point-to-multipoint networks.

Kindly insert the following new paragraph immediately after Paragraph [0014] in the **BACKGROUND OF THE INVENTION** section:

[0014.1] Aspects of an embodiment of the invention includes enabling Media Access Control (MAC), Transmission Convergence Layer (TC-Layer) and Physical Layer (PHY-Layer) functionality via a plurality of discrete electronic components in an optical module, which can interface to existing Physical Media Attachment (PMA) layer devices or to devices via the Media Independent Interface (MII). This enables a consolidation of a plurality of network equipment layers resulting in cost savings.

Kindly amend Paragraph [0022] as shown and insert the following seven new paragraphs immediately thereafter in the **BRIEF DESCRIPTION OF THE DRAWINGS** section:

[0022] FIGS. 9A and 9B 10 are block diagrams of switches.

[0022.1] FIG. 11 is a diagram representing a typical optical module and components.

[0022.2] FIG. 12 is a diagram illustrating the basic components of transponder, transceiver and discrete optical modules.

[0022.3] FIG. 13 illustrates the evolutionary history of 10 Gb/s optical modules.

[0022.4] FIG. 14 is a diagram of an optical module with MAC, TC-Layer and PHY-Layer components according to an exemplary embodiment of the invention.

[0022.5] FIG. 15 is an illustration of the location of the invention in the Ethernet OSI model according to an exemplary embodiment of the invention.

[0022.6] FIG. 16 is an illustration of the location of the invention in the Fiber Channel model structure according to an exemplary embodiment of the invention.

[0022.7] FIG. 17 is a diagram of an optical module according to an exemplary embodiment of the invention.

Kindly insert the following new paragraph immediately before Paragraph [0023] as the first paragraph of the **DETAILED DESCRIPTION** section:

[0022.8] Reference will now be made in detail to various embodiments of the invention, examples of which are illustrated in the accompanying drawings. While the invention will be described in conjunction with these embodiments, it will be understood that they are not intended to limit the invention to these embodiments. On the contrary, the invention is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the invention as defined by the appended claims. Furthermore, in the following description of the present invention, numerous specific details are set forth in order to provide a thorough understanding of the present invention. In other instances, well-known methods, procedures, components, and circuits have not been described in detail as not to unnecessarily obscure aspects of the present invention.

Kindly insert the following four new paragraphs immediately after Paragraph [0056] in the **DETAILED DESCRIPTION** section:

[0056.1] FIG. 14 is a diagram of an optical module 1400 with MAC, TC-Layer and PHY-Layer functionality components 1408 according to an exemplary embodiment of the invention. The form factor of the optical module 1400 can comply with any current or future optical module form factor. The preferred embodiment of the invention would

have a form factor that complies with an MSA optical module such as the XENPAK, X2, SFP and XFP MSA optical modules. The optical module 1400 contains the optical-electrical/electrical-optical components such as a laser 1401 and a photo detector 1403 as well as hi speed devices such as the laser driver 1402, TIA 1404 and limiting amp 1405. The MAC, TC-Layer and PHY-Layer functionality component(s) 1408 inside the optical module are the basis of the invention and are not to be confused with replacing the traditional MAC, TC-Layer and PHY-Layer devices that reside outside of optical modules. The MAC and TC-Layer comprise of functionality needed to generate and receive transmission frames and are responsible for the entire overhead associated with the transmission frame for a point-to-multipoint network. The invention is envisioned to enable point-to-multipoint connections in previously point-to-point only connections via passive optical network (PON) implementation. This implies a headend or Optical Line Terminal (OLT) MAC and TC-Layer, which must emulate the functionality of a point-to-point link and is the master of the point-to-multipoint link, with a complementary client or Optical Network Terminal (ONT) MAC and TC-Layer operating in a slave like relationship to the headend MAC & TC-Layer counterpart. The MAC performs the efficient arbitrating of downstream and upstream data by determining bandwidth allocation and packet destination on the point-to-multipoint network. The term TC-Layer originated with ATM protocol but has become and is used here to describe a specification that: bundles and un-bundles sent and received data into packets or frames; manages the transmission of packets or frames on a network via medium access and bandwidth allocation; provides necessary messaging and end point behavior, and checks and corrects for errors. The PHY-Layer comprises the functionality of clock data recovery, analog to digital and digital to analog conversion. The preferred optical module embodiment would also contain a performance monitor 1413, clock generator 1414 and a micro-controller 1415. The performance monitor 1403 contains a photo diode and is used to monitor and correct the extinction ratio of the laser. The clock generator 1414 is a clock source for the various digital components in the preferred optical module embodiment 1400. The micro-controller 1415 enables the optical module 1400 to communicate to an external intelligence the capabilities of the optical module 1400 as well as receive configuration commands from the external intelligence. The input 1411 and output 1412 of the optical module 1400 can be

either serial or parallel pins depending on the type of network apparatus that the optical module 1400 is intended to be connected to.

[0056.2] The optical module 1400 can connect to a plurality of network apparatus according to an exemplary embodiment of this invention. Given today's network infrastructure the invention is preferred to connect to Ethernet and Fibre Channel networks. FIG. 15 is a diagram of the Ethernet OSI model. The embodiment of the invention connects to Ethernet devices at two levels in the OSI model, as Physical Coding Sublayer (PCS) layer 1502 and Physical Media Dependent (PMD) layer 1503 devices. The embodiment connects to Ethernet devices as the PCS layer 1502 via an xMII type interface, which is a generic term for 100Mbit or higher Media Independence Interfaces. FIG. 16 is a diagram of the Fibre Channel model structure and the embodiment of the invention connects to Fibre Channel devices at two levels in this structure model, as FC-1 layer 1602 and FC-0 layer 1603 devices. The embodiment connects to Fibre Channel devices as the FC-1 layer 1602 via the interface specified by the Fibre Channel specification, which as recently adopted an xMII interface as well.

[0056.3] The embodiment connects to Ethernet devices as the PMD layer 1503 and Fibre Channel devices as the FC-0 layer 1603 via an MSA optical module port whereby the embodiment replaces an existing MSA optical module or is an outright substitute for traditional MSA optical modules. The embodiment in this case would have either serial or XAUI interface depending on the MSA form factor of the MSA optical module port. Furthermore, the embodiment in this case has the addition of 8/10 bit decode 1700 functionality as part of the MAC, as shown in FIG. 17. Both Ethernet and Fibre channel employ 8/10 bit encoding at the PCS layer. In order for the MAC to perform its functions part of the incoming data must be decoded to determine the destination of the packet on the point-to-multipoint network. The data is preferred to be sent with the 8/10 bit encoding to reduce the burden of complete decoding and recoding at the destination. Although in particular embodiments 8/10 bit decoding 1700 and encoding 1701 can be desired and done.

[0056.4] Quality of Service (QoS) in network designs has never been as important as it is today. Manageable QoS needs to be available at all levels of a network, including LAN, WAN, campus networks, enterprise networks, and metropolitan networks. QoS management should be provided at all layers of the network protocol, or the QoS is only as good as the weakest link. QoS is usually implemented via Station Management interfaces with Management Information Base (MIB) table of registers to manipulate the network device. The embodiments of the invention enable a new level of QoS management at the PCS and PMD layers or the equivalent thereof. QoS can be enabled via a Station Management interface with the micro-controller 1415 where the MIB resides.

Amendments to the Drawing

Kindly amend the Figure Numbers of FIGS. 9A-9B to make the FIGS. 9-10 substantially as shown in the attached Replacement Sheet and add the new FIGS. 11-17 provided in the attached New Sheets.

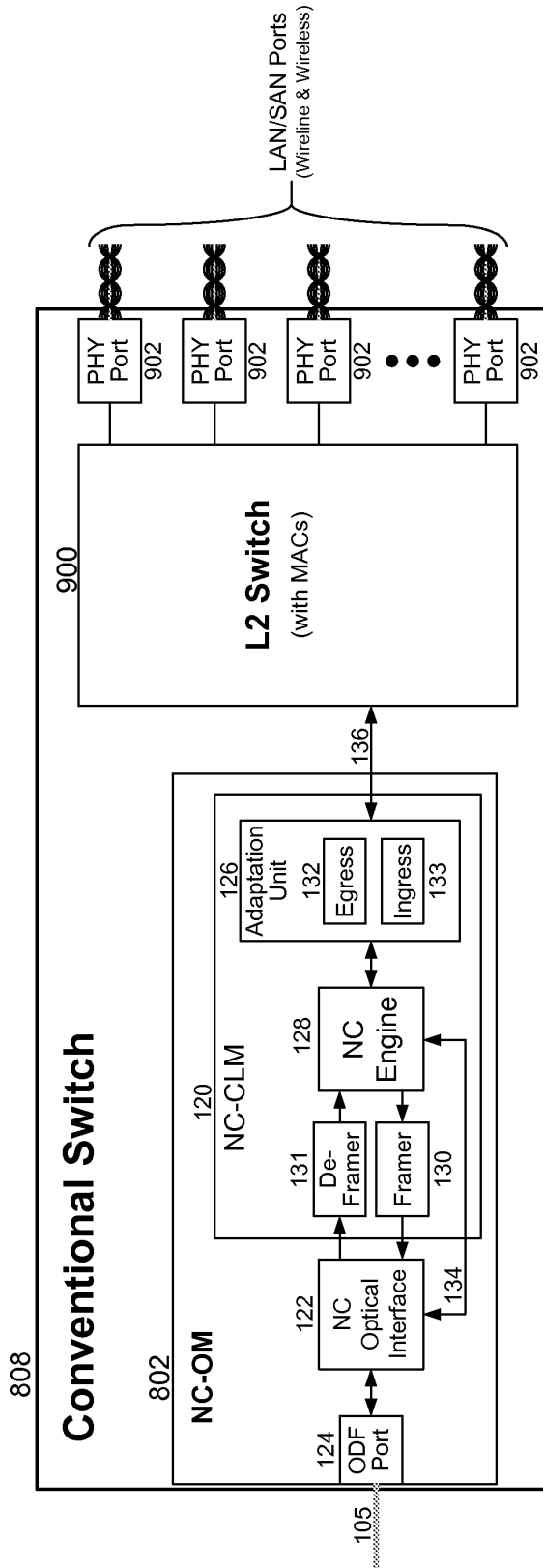


FIG. 9

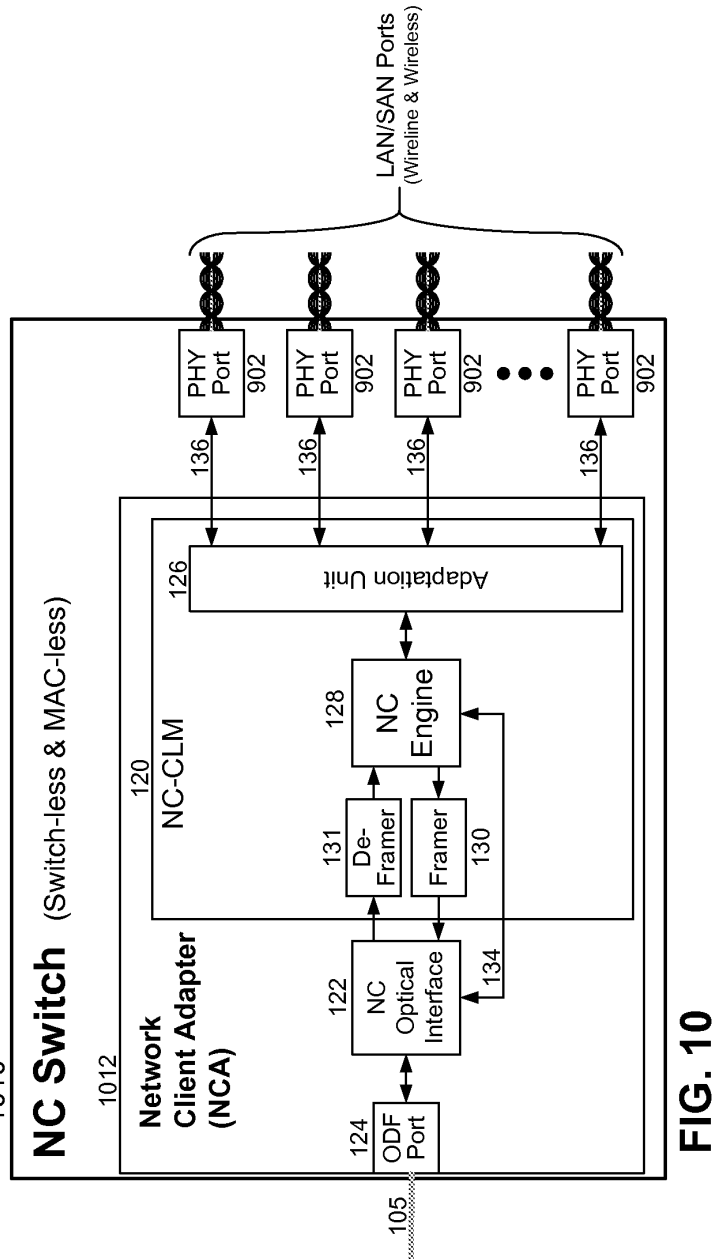


FIG. 10

Prior art

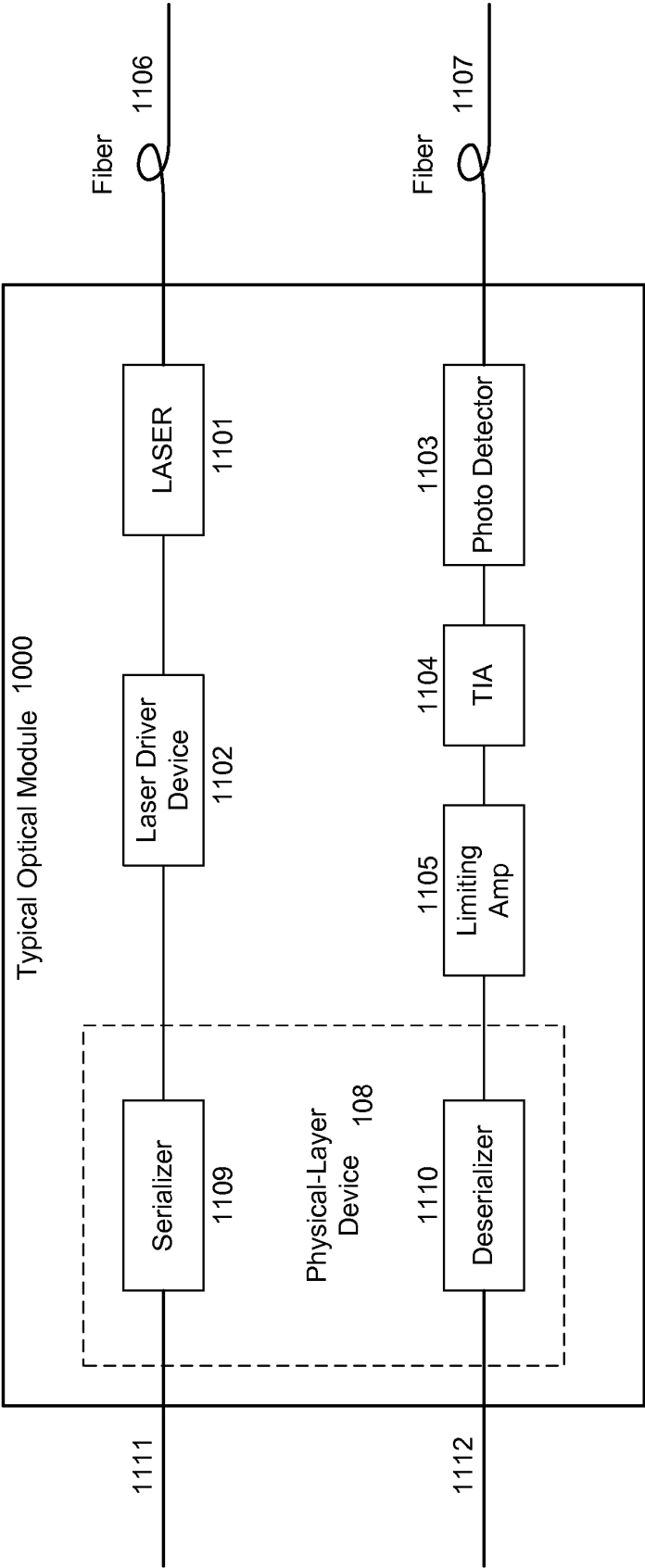


FIG. 11

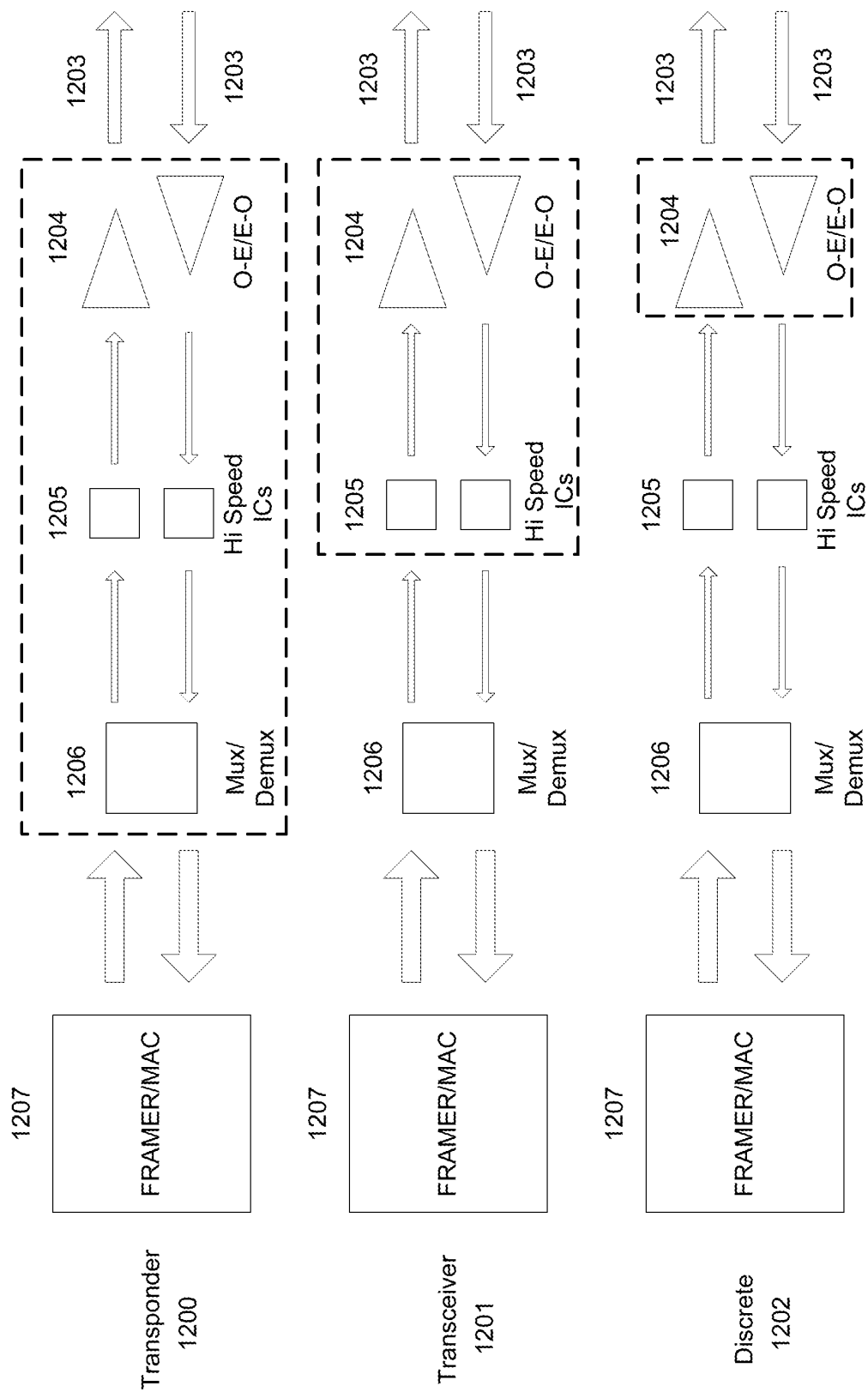


FIG. 12

Prior art

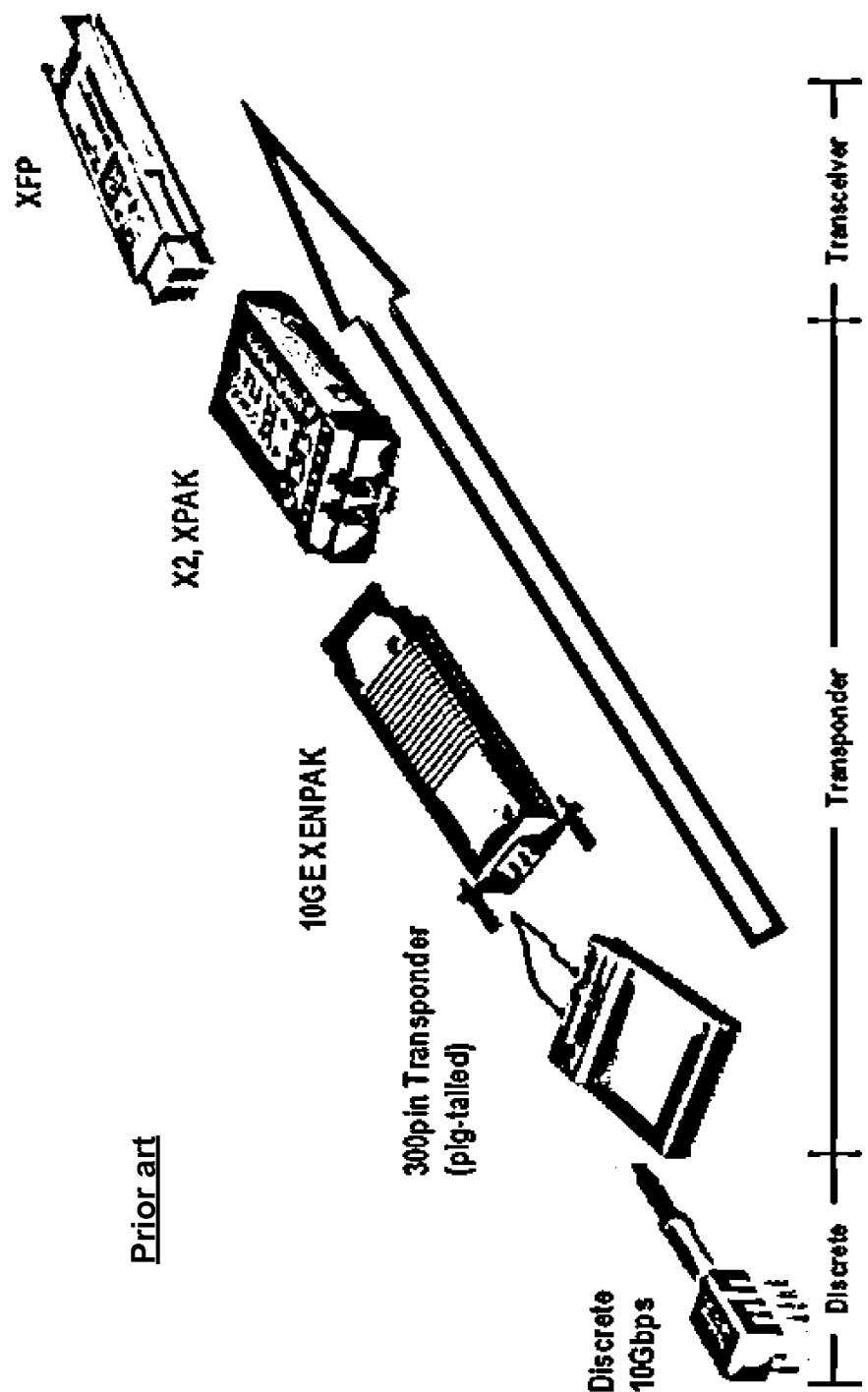


FIG. 13

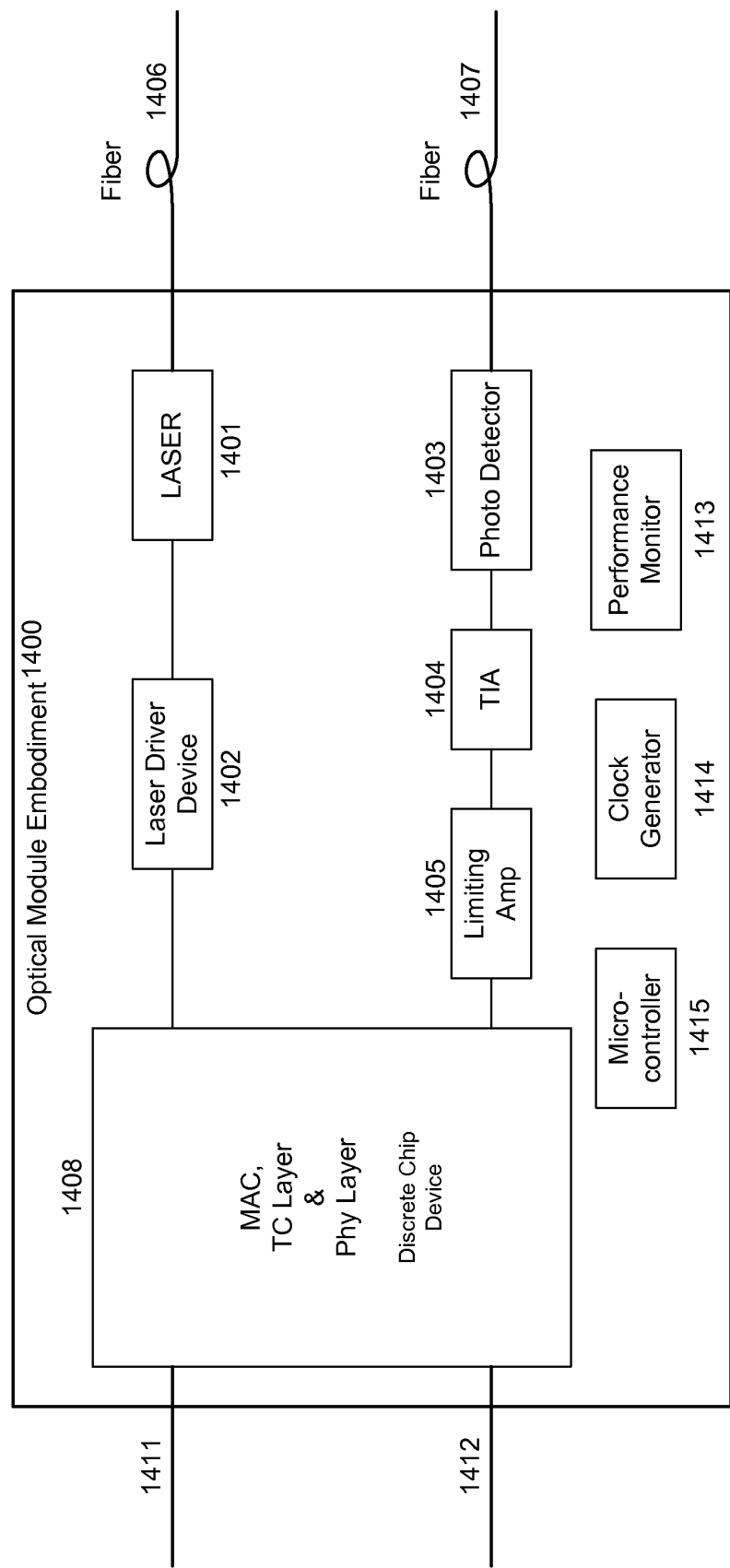


FIG. 14

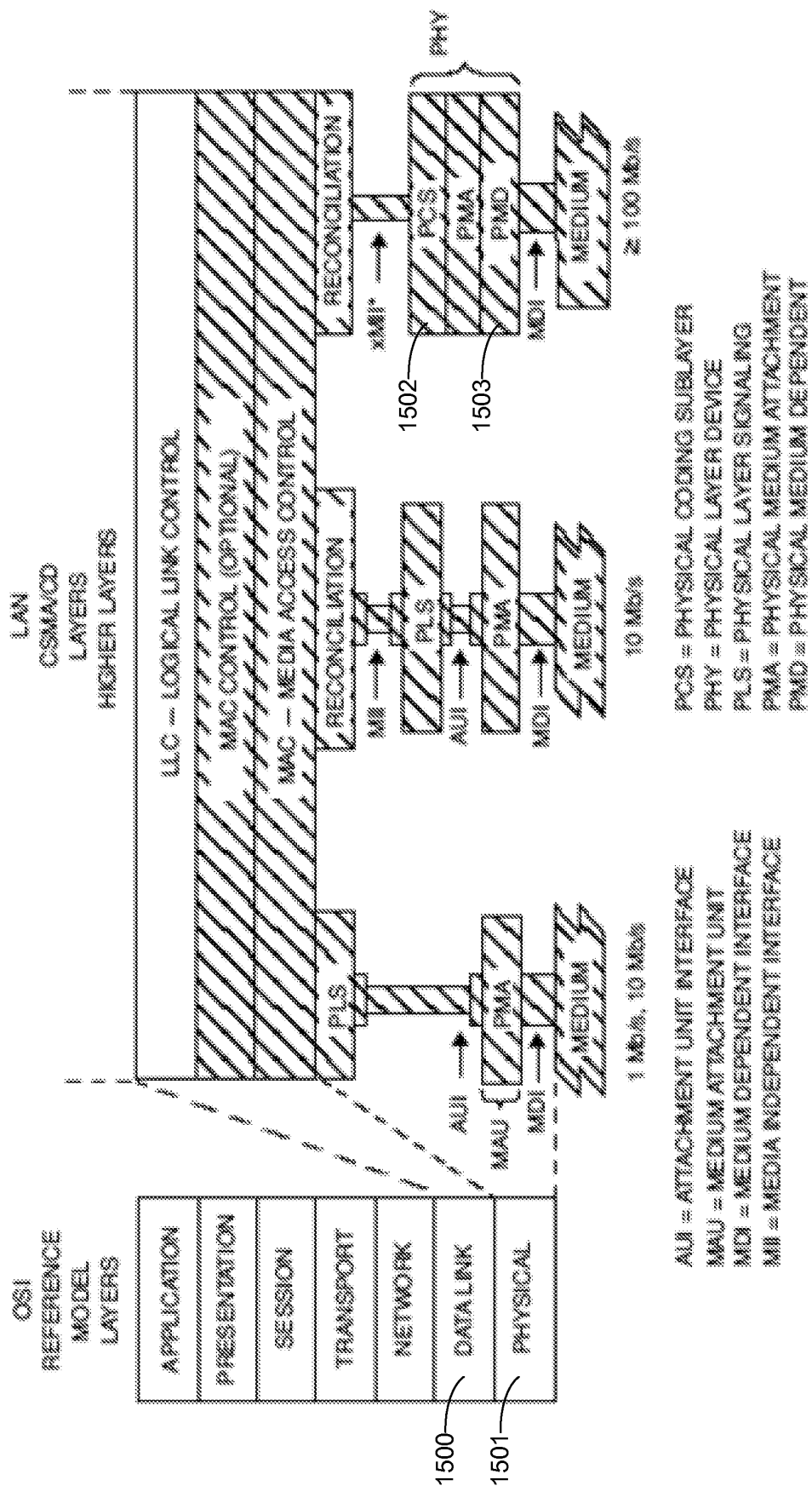


FIG. 15

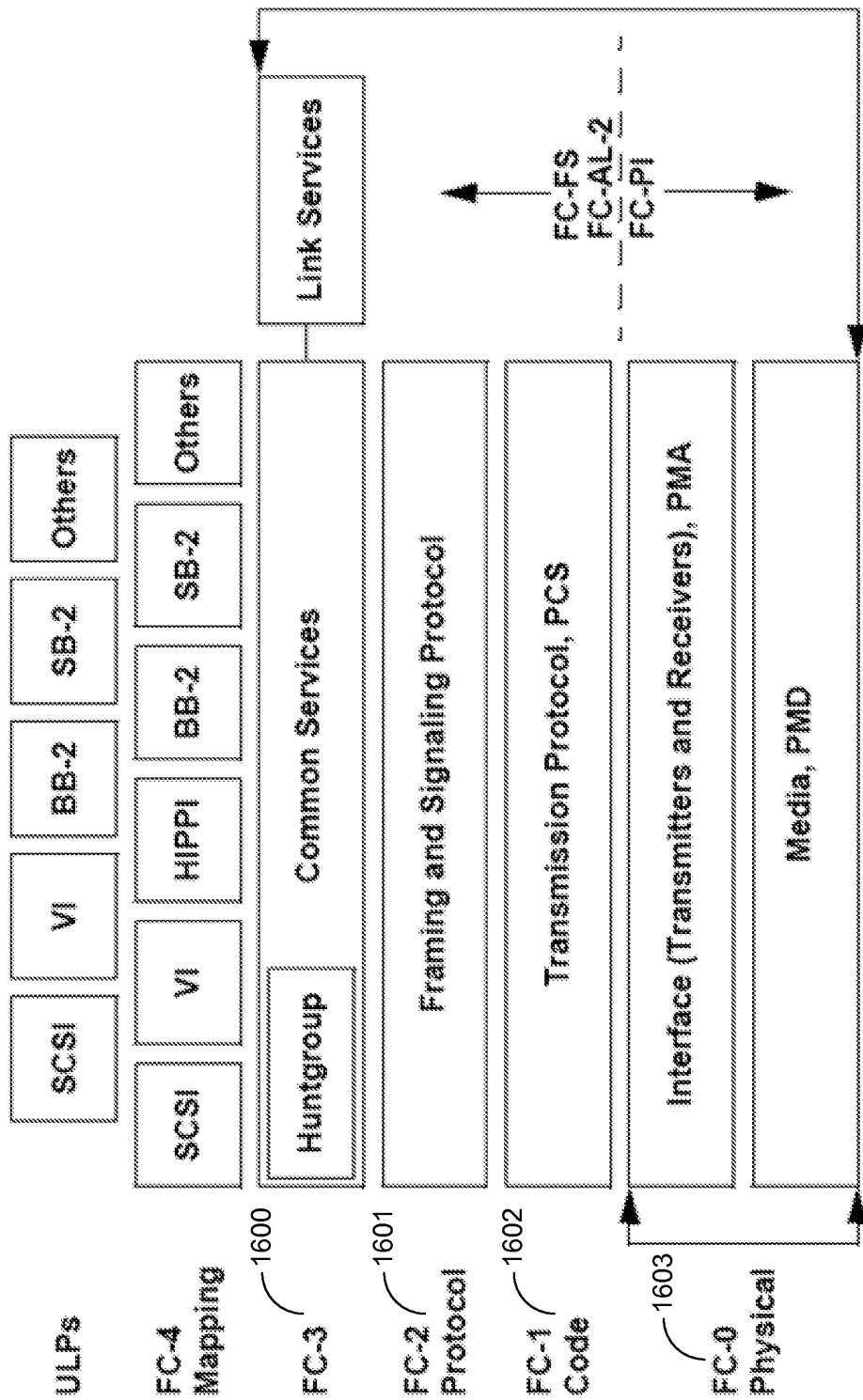


FIG. 16

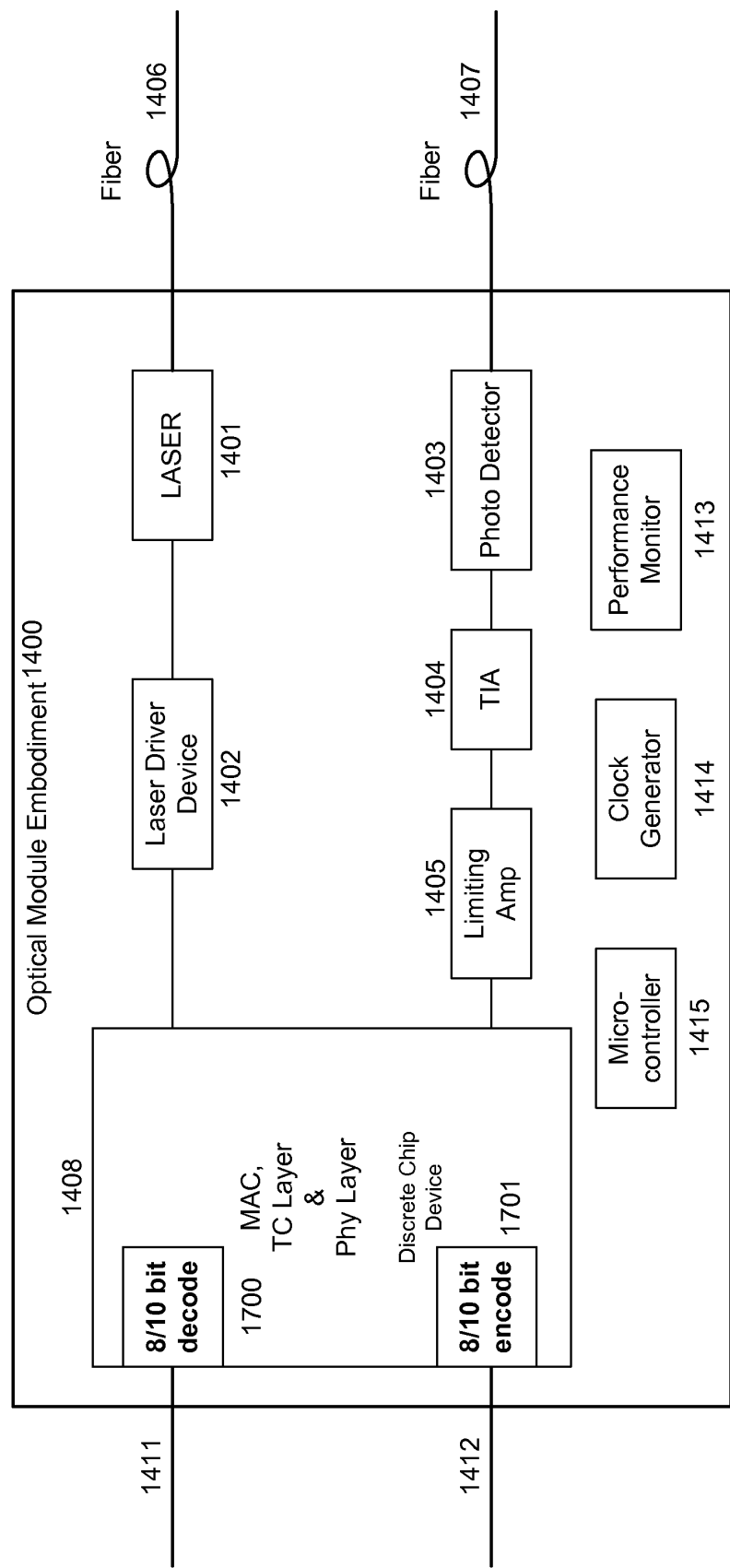


FIG. 17

PATENTS Docket No. UBI-005B	
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE	
In re Application of: Alexander I. Soto et al.	Group Art Unit: Unassigned Examiner: Unknown
Patent Application No.: 12/982,872	
Filed on: December 30, 2010	
For: System and Method for Pluggable Optical Modules for Passive Optical Networks	

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Alexandria, VA 22313-4150

SUBSTITUTE SPECIFICATION FOR PUBLICATION PER 37 C.F.R. §1.215(c)-(d)

Prior to first publication of the above-referenced application, kindly enter the following substitute specification for publication pursuant to 37 C.F.R. §1.215(c)-(d). The following substitute specification includes a clean copy of the specification with renumbered paragraphs as amended by Preliminary Amendment filed on even date herewith, complies with 37 C.F.R. §§1.125(b)-(c), and contains no new matter.

Respectfully submitted,

/Alexander Soto/

Alexander Soto
Customer No. 93,749
7673 Hazard Center Dr. San Diego, CA 92108
858-527-2397
alexander.i.soto@gmail.com

SYSTEM AND METHOD FOR NOVEL OPTICAL MODULES

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is filed under 37 C.F.R. §1.53(b)(1) as a continuation claiming the benefit under 35 U.S.C. §120 of the pending Patent Application No. 10/886,514, “COMMUNICATION SYSTEM AND METHOD FOR AN OPTICAL LOCAL AREA NETWORK”, which was filed by the same inventors on July 6, 2004, claiming the benefit under 35 U.S.C. 119(e) of U.S. Provisional Patent Application No. 60/485,072 filed on Jul 3, 2003 and now expired, incorporated herein by reference, and U.S. Provisional Patent Application No. 60/515,836 filed on Oct. 30, 2003 and now expired, incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The present invention relates to optical fiber networks.

BACKGROUND OF THE INVENTION

[0003] A local-area network (LAN) is a computer network that spans a relatively small area. Most LANs are confined to a single building or group of buildings. However, one LAN can be connected to other LANs over any distance often spanning an area greater than either LAN via telephone lines, coaxial cable, optical fiber, free-space optics and radio waves. A system of LANs connected in this way is commonly referred to as a wide-area network (WAN).

[0004] Optical modules are used in applications requiring digital optical transmission such as SONET/SDH, 10 Gigabit Ethernet, Fibre Channel and DWDM running across metro access networks, wide area networks, access networks, storage area networks, and local area networks.

[0005] Optical modules integrate components used in the transmission and reception of optical signals into a single packaged subsystem. Makers of optical networking systems find optical modules attractive, because the highly integrated packaging approach can cut several months of system development and manufacturing time, consume less power and increase port densities over board-level solutions built from discrete components. But with so much functionality in one module, timely and sufficient component supply becomes even more essential for successful

system delivery. Multi-source agreement (MSA) developed so systems vendors can feel more confident about getting the components they need and being able to incorporate them without costly and time-consuming system redesigns. Further with MSA, system vendors can concentrate on system architecture and not optical research and development. Optical modules can be purchased off the shelf from a choice of several suppliers.

[0006] A typical optical module **1100**, as shown in **FIG. 11**, is composed of a: laser **1101**; laser driver (LD) **1102**; photo detector (PD) **1103**; transimpedance amplifier (TIA) **1104**; limiting amplifier (LA) **1105** and sometimes physical-layer devices **1108** such as a mux/demux with associated clock multiplier unit (CMU) and clock data recovery (CDR) functions in a serializer **1109** and deserializer **1110**. A typical optical module **1100** has dual optical fibers for reception **1106** and transmission **1107** of signals and can have serial or parallel input **1111** and output **1112** pins. Optical modules have several levels of integration as shown in **FIG. 12**. Optical modules that contain only the optical-electrical and electrical-optical (o-e/e-o) components **1204**, such as a laser and photo detector, are labeled discrete **1202**. Optical modules that contain (o-e/e-o) **1204** and hi speed integrated circuits **1205** such as LD, TIA and LA are called transceivers **1201**. Optical modules that contain (o-e/e-o) **1204**, hi speed integrated circuits **1205** and Mux/Demux devices **1206** are called transponders **1200**. Mux/Demux **1206** devices contain CDR and CMUs. Optical modules are ultimately connected with various interfaces to Framers and Media Access Control (MAC) devices **1207** as shown in **FIG. 12**.

[0007] In **FIG. 13**, the evolution of MSA 10 Gb/s optical modules is shown. Beginning with discrete components, followed by 300pin, XENPAK, X2, and XPAK transponders and finally with XFP transceivers. The evolution of optical modules has been to reduce the size, power, and number of components in optical modules for the purpose of increasing port densities. The very nature of the intent of the invention is contrary to the evolution of MSA 10 Gb/s optical modules in that an increase in power and number of components result while enabling point-to-multipoint networks.

SUMMARY OF THE INVENTION

[0008] In general, in one aspect, the invention includes a method for broadcasting data including receiving an incoming optical signal at a first port of a plurality of ports; converting the re-

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ceived incoming optical signal to an electrical signal; processing the electrical signal; converting the processed electrical signal to a broadcast optical signal; and coupling the broadcast optical signal to each of the plurality of ports.

[0009] Aspects of the invention may include one or more of the following features. Processing the electrical signal includes coupling the electrical signal to a device that processes the electrical signal according to an OSI layer-2 protocol. Processing the electrical signal includes coupling the electrical signal to a device that processes the electrical signal according to an OSI layer-3 protocol. The method further includes converting an electrical client signal to the incoming optical signal. The method further includes adapting the electrical client signal from a signal conforming to an OSI layer-2 protocol. The OSI layer-2 protocol includes a media access control protocol. The media access control protocol is Ethernet or Fibre Channel. The method further includes transmitting the incoming optical signal from a network client adapter to one of the plurality of ports over an optical distribution fabric. The method further includes transmitting the broadcast optical signal from one of the plurality of ports over an optical distribution fabric; and receiving the broadcast optical signal at network client adapters in a plurality of clients. The method further includes converting the received broadcast optical signal to a second electrical signal in at least one of the clients. The method further includes selecting a frame within the second electrical signal associated with the network client adapter and adapting data in the selected frame for transmission over a network interface.

[0010] In general, in another aspect, the invention includes an apparatus including a plurality of ports; a passive optical coupler coupled to each of the plurality of ports; an optical-electrical converter in optical communication with the passive optical coupler; and a control module in electrical communication with the optical-electrical converter for scheduling slots for incoming and outgoing signals over the plurality of ports.

[0011] Aspects of the invention may include one or more of the following features. The control module is operable to schedule a slot for receiving a signal over one of the plurality of ports and to schedule a slot for broadcasting a signal over each of the plurality of ports. The apparatus includes only a single optical-electrical converter in optical communication with the passive optical coupler. The control module is coupled to a device that is operable to process an electrical

signal provided by the optical-electrical converter according to an OSI layer-2 protocol. The control module is coupled to a device that is operable to process an electrical signal provided by the optical-electrical converter according to an OSI layer-3 protocol.

[0012] In general, in another aspect, the invention includes an optical local area network including a plurality of optical waveguides; a network manager that includes an optical-electrical converter in optical communication with the plurality of optical waveguides; and a control module in electrical communication with the optical-electrical converter for scheduling slots for incoming and outgoing signals transmitted over the plurality of optical waveguides; and a plurality of network client adapters coupled to the plurality of optical waveguides, each network client adapter including an optical- electrical converter for processing transmitted and received optical signals at a client.

[0013] Aspects of the invention may include one or more of the following features. The optical local area network further includes a passive optical coupler coupled to each of the plurality of optical waveguides. The network manager further includes a passive optical coupler coupled to each of the plurality of optical waveguides. The control module is operable to schedule a slot for receiving a signal over one of the plurality of optical waveguides and to schedule a slot for broadcasting a signal over each of the plurality of optical waveguides. The control module is operable to dynamically schedule a slot for receiving a signal over one of the plurality of optical waveguides in response to a message from one of the network client adapters. The control module is operable to determine a response delay between the optical-electrical converter and one of the network client adapters. The control module is coupled to a device that is operable to process an electrical signal provided by the optical-electrical converter according to an OSI layer-2 protocol. The control module is coupled to a device that is operable to process an electrical signal provided by the optical-electrical converter according to an OSI layer-3 protocol. Each of the network client adapters is operable to convert an electrical client signal to an optical signal for transmission over one of the optical waveguides. Each of the network client adapters is operable to adapt the client signal from a signal conforming to an OSI layer-2 protocol. The OSI layer-2 protocol includes a media access control protocol. The media access control protocol used by a network client adapter is Ethernet or Fibre Channel. Each of the network client adapters is operable to convert a received optical signal to an electrical signal. Each network client adapter is

operable to select a frame within the electrical signal associated with the network client adapter. The optical local area network further includes a client that includes a network interface card, the network interface card including one of the network client adapters. The client is selected from the group consisting of a workstation, a personal computer, a disk storage array, a server, a switch, and a router.

[0014] In general, in another aspect, the invention includes an optical local area network including a passive optical distribution fabric interconnecting a plurality of nodes including a first node and a plurality of remaining nodes; a hub that includes the first node and a control module; and a client network adapter coupled to each of the remaining nodes for responding to the control module; wherein the control module controls timing for each of the client network adapters to transmit signals over the passive optical distribution fabric and distribution of signals to each of the nodes.

[0015] Aspects of the invention may include one or more of the following features. The control module is operable to schedule a slot for receiving a signal from one of the remaining nodes and to schedule a slot for broadcasting a signal to each of the remaining nodes. The control module is operable to dynamically schedule a slot for receiving a signal from one of the remaining nodes in response to a message from one of the network client adapters. The control module is operable to determine a response delay between the hub and one of the network client adapters. The control module is coupled to a device that is operable to process signals according to an OSI layer-2 protocol. The control module is coupled to a device that is operable to process signals according to an OSI layer-3 protocol. Each of the network client adapters is operable to convert an electrical signal to an optical signal for transmission over the passive optical transmission fabric. Each of the network client adapters is operable to adapt a signal conforming to an OSI layer-2 protocol. The OSI layer-2 protocol includes a media access control protocol. The media access control protocol used by a network client adapter is Ethernet or Fibre Channel. Each of the network client adapters is operable to convert a received optical signal to an electrical signal. Each network client adapter is operable to select a frame within the electrical signal associated with the network client adapter. The optical local area network further includes a client that includes a network interface card, the network interface card including one of the net-

work client adapters. The client is selected from the group consisting of a workstation, a personal computer, a disk storage array, a server, a switch, and a router.

[0016] In general, in another aspect, the invention includes an optical local area network including a hub; a plurality of external nodes interconnected by a passive optical distribution fabric, wherein the external nodes are located external to the hub, and the hub is operable to control traffic across all nodes; adaptors at each external node responsive to hub instruction; and an interface coupled to the hub coupling signals received from any individual external node for distribution to all external nodes.

[0017] Aspects of the invention may include one or more of the following features. The hub includes an internal node coupled to the passive optical distribution fabric. The hub is operable to measure response delay between the hub and external nodes. The hub is operable to allocate slots for external nodes dynamically. Slot allocations are made to guarantee external nodes have a minimum bandwidth. The optical local area network further includes splitters coupled between the hub and external nodes. Traffic arriving at one or more external nodes includes Ethernet traffic. Traffic arriving at one or more external nodes includes Fibre channel traffic. The hub includes an optical module. At least one of the external nodes is located within an optical module external to the hub.

[0018] Implementations of the invention may include one or more of the following advantages. A network manager in an optical local area network can provide switching functions of a hub, a switch or a router. A switch configuration in which network managers are aggregated enables a high performance network in a compact apparatus. Connectivity of network managers and network client adapters to existing conventional routers and switches using industry standard form factor optical modules enables a high performance network upgrade with minimal new equipment. A network client switch can support multiple physical layer ports without necessarily requiring a Layer-2 MAC or switching elements and the associated routing tables and packet memory. The number of optical transceivers and switching elements used to sustain the same number of computing nodes in a LAN via a point-to-multipoint optically coupled network configuration is reduced, thus saving the majority of expense described above.

[0019] Aspects of an embodiment of the invention includes enabling Media Access Control (MAC), Transmission Convergence Layer (TC-Layer) and Physical Layer (PHY-Layer) functionality via a plurality of discrete electronic components in an optical module, which can interface to existing Physical Media Attachment (PMA) layer devices or to devices via the Media Independent Interface (MII). This enables a consolidation of a plurality of network equipment layers resulting in cost savings.

BRIEF DESCRIPTION OF THE DRAWINGS

- [0020] FIG. 1 is a block diagram of an optical local area network.
- [0021] FIGS. 2, 3A and 3B are schematic diagrams showing frame structures.
- [0022] FIG. 4 is a flowchart for a network operating process.
- [0023] FIG. 5 is a flowchart for a response delay process.
- [0024] FIGS. 6A - 6C are diagrams of optical local area networks utilizing a hub configuration.
- [0025] FIGS. 7 A-7D are diagrams of optical local area networks utilizing a switch configuration.
- [0026] FIG. 8 is a diagram of an optical local area network.
- [0027] FIGS. 9 and 10 are block diagrams of switches.
- [0028] FIG. 11 is a diagram representing a typical optical module and components.
- [0029] FIG. 12 is a diagram illustrating the basic components of transponder, transceiver and discrete optical modules.
- [0030] FIG. 13 illustrates the evolutionary history of 10 Gb/s optical modules.
- [0031] FIG. 14 is a diagram of an optical module with MAC, TC-Layer and PHY-Layer components according to an exemplary embodiment of the invention.

[0032] FIG. 15 is an illustration of the location of the invention in the Ethernet OSI model according to an exemplary embodiment of the invention.

[0033] FIG. 16 is an illustration of the location of the invention in the Fiber Channel model structure according to an exemplary embodiment of the invention.

[0034] FIG. 17 is a diagram of an optical module according to an exemplary embodiment of the invention.

DETAILED DESCRIPTION

[0035] Reference will now be made in detail to various embodiments of the invention, examples of which are illustrated in the accompanying drawings. While the invention will be described in conjunction with these embodiments, it will be understood that they are not intended to limit the invention to these embodiments. On the contrary, the invention is intended to cover alternatives, modifications and equivalents, which may be included within the spirit and scope of the invention as defined by the appended claims. Furthermore, in the following description of the present invention, numerous specific details are set forth in order to provide a thorough understanding of the present invention. In other instances, well-known methods, procedures, components, and circuits have not been described in detail as not to unnecessarily obscure aspects of the present invention.

[0036] Referring to **FIG. 1**, a high-level schematic of an optical local area network **50** includes a network manager (NM) **100** at the head end of a passive optical distribution fabric (ODF) **102**. The NM **100** acts as a central transmission point and an overall controlling device for the optical local area network **50**. On another end, the ODF **102** is terminated by a plurality of (in one implementation, generally similar) network client adapters (NCAs) **104A**, **104B**, **104C**. Herein the NCA **104A**, NCA **104B**, NCA **104C**, are also referred to collectively as NCAs **104**. Though three NCAs **104** are shown more or fewer NCAs may be included in the optical local area network **50**.

[0037] The NM **100** transmits/receives data to/from the NCAs **104** in the form of modulated optical light signals of known wavelength through the ODF **102**. The transmission mode of the

data sent over the ODF **102** may be continuous, burst or both burst and continuous modes. Both NM **100** and NCAs **104** may transmit light signals having a same wavelength. In one implementation, the light signals are polarized and the polarization of light transmitted by the NM **100** is perpendicular to the polarization of the light transmitted by the NCAs **104**. Alternatively, the transmissions can be made in accordance with a time-division multiplexing scheme or similar protocol.

[0038] In another implementation, bi-directional wavelength-division multiplexing (WDM) may be used. Bi-directional WDM is herein defined as any technique by which two optical signals having different wavelengths may be simultaneously transmitted bi-directionally with one wavelength used in each direction over a single fiber. In yet another implementation, bi-directional dense wavelength division multiplexing (DWDM) may be used. Bi-directional DWDM is herein defined as any technique by which more than two optical signals having different wavelengths may be simultaneously transmitted bi-directionally with more than one wavelength used in each direction over a single fiber with each wavelength unique to a direction. For example, if bi-directional WDM is used, the NM **100** may transmit data to an NCA **104A**,

[0039] **104B, 104C** utilizing a first wavelength of modulated light conveyed via a fiber **105A, 105B, 105C**, respectively, in the ODF **102** and, similarly, the NCAs **104A, 104B, 104C** may transmit data via the same fiber **105A, 105B, 105C**, respectively, in the ODF **102** to the NM **100** utilizing a second wavelength of modulated light. Because only a single fiber is used (e.g., between the NM **100** and each respective NCA **104**), this type of transmission system is commonly referred to as a bi-directional transmission system. Although the optical local area network **50** illustrated in **FIG. 1** includes an NM **100** in communication with a plurality of NCAs **104** using a plurality of fibers, other implementations of optical local area networks **50** may be used. In some implementations, the NCAs **104** are generally similar. In other implementations, the NCAs **104** may differ in one or more aspects.

[0040] The NM **100** includes network management communication logic and memory (NM-CLM) **106** block, a network management optical interface (NM Optical Interface) **108** block and an optical distribution fabric interface (ODF Interface) **110** block. The NM-CLM **106** includes a

network manager engine (NM Engine) **112** block, a transmit framer (Tx Framer) **114** block and a receive framer (Rx Framer) **115** block.

[0041] The NM Engine **112** is a control module that performs various processing and scheduling functions of an NM **100**. The Tx Framer **114** frames outgoing data from the NM Engine **112** in accordance with a framing protocol that is in-use. The Rx Framer **115** receives incoming frames and recovers appropriate data and messages to pass on to the NM Engine **112**. The NM Optical Interface **108** is controlled by the NM-CLM **106** using, for example, bus **109**. The NM Optical Interface **108** converts electrical signals carrying data from the Tx Framer **114** to optical signals, for example, by modulating a laser (not shown) included in the NM Optical Interface **108** and transmitting the laser output to the ODF interface **110**. The NM Optical Interface **108** also receives optical signals from the ODF interface **110** and converts the optical signals to electrical signals carrying data that is then transferred to the Rx Framer **115**. Thus, the NM Optical Interface **108** functions as an "optical-electrical converter" that can convert a signal from an optical signal to electrical signal or from an electrical signal to an optical signal.

[0042] The ODP Interface **110** includes an optical splitter **116** and a plurality of ODF Ports **117A**, **117B**, **117C**, etc. For example, the optical splitter **116** can be a 1: n splitter (where n is at least 2) that splits light coming from the NM Optical Interface **108** into n portions of light coupled into n optical ports, respectively. The optical ports (e.g., ODP Ports **117**) can be coupled to one or more optical waveguides. In one implementation, each ODP Port **117** is coupled to an optical waveguide. The optical waveguides can be, for example, single mode or multimode fibers that guide received/transmitted light to/from respective ODP Ports **117A**, **117B**, **117C**, etc. The 1: n splitter (or equivalently, n :1 combiner) also directs light from any of the ODP Ports **117A**, **117B**, **117C**, etc. received over one of the optical waveguides to the NM Optical Interface **108**. ODP Ports **117A**, **117B**, **117C**, etc. include optical fiber connector sockets (e.g., SC, LC, PC, ST, or MU connector sockets) for coupling to the optical waveguides.

[0043] The ODP **102** can include any of a variety of passive optical components including optical fibers (e.g., single mode fibers, multimode fibers), optical connectors, fiber splices, passive branching components (e.g., passive splitters) and passive optical attenuators.

[0044] In this implementation, the NCAs **104** each include a network client communication logic and memory (NC-CLM) **120** block, a network client optical interface (NC Optical Interface) **122** block and an ODF port **124**. The NC-CLM **120** block includes an Adaptation Unit **126** block, a network client engine (NC Engine) **128** block, a transmit framer (Framer) **130** block and a receiver framer (Deframer) **131** block. The NC Engine **128** is a control module that performs various functions associated with an NCA **104**, such as responding to messages from the NM **100**. The Framer **130** frames outgoing data from the NC Engine **128** in accordance with a framing protocol that is in-use. The Deframer **131** receives incoming frames and recovers appropriate data and messages to pass on to the NC Engine **128**. The adaptation unit **126** receives and transmits data and messages in the form of frames, packets or cells according to one or more external protocol(s). External controls, data and messages can be received using the network interface **136**. The responsibilities of the adaptation unit **126** may include providing buffering, data and/or message filtering and translation between the external protocol(s) and the protocol of the optical local area network **50**. The adaptation Unit **126** includes egress queue **132** block and ingress queue **133** block. Egress and ingress queues **132**, **133** can be of the form of memory and are used for buffering receive and transmit data and messages, respectively. The adaptation unit **126** can filter out or drop data and/or messages that are not intended to egress through its network interface **136**. Filtering can be based on the destination address of the data and/or messages according to the external protocol in-use. Additionally, the adaptation unit **126** can filter out or drop data and/or messages that are not intended to ingress through its network interface **136**. Filtering can be based on equal values for the source and destination addresses of the data and/or messages according to the external protocol in-use. The NC Optical Interface **122** is controlled by the NC-CLM **128** using bus **134**. The NC Optical Interface **122** converts electrical signals carrying data from the Framer **130** block to optical signals, for example, by modulating a laser (not shown) included in the NC Optical Interface **122** and transmitting the laser output to the ODF port **124**. The NC Optical Interface **122** also receives optical signals from the ODF port **124** and converts the optical signals to electrical signals carrying data that is then transferred to the Deframer **131** block. The ODF port **124** includes an optical fiber connector socket (e.g., an SC, LC, FC ST, or MU connector socket).

[0045] The NCAs **104** can be coupled to data link layer devices (not shown) or physical layer devices (not shown) using network interface **136**. The data link layer devices and physical layer devices are network devices that operate at a Layer-2 or Layer-1 respectively, according to the Open Systems Interconnect (OSI) 7-layer reference model. Furthermore, these network devices may comply with industry standard specifications such as IEEE 802.3 and Fibre Channel (incorporated herein by reference). Consequently, the network interface **136** may be an MII, GMII, XGMII, XAUI or SPI type interface. Other Layer-2 and Layer-1 type interface specifications may also be used.

[0046] The optical local area network **50** transfers data between an NM **100** and the NCAs **104** in the form of downstream frames (NM **100** to NCAs **104**) and upstream "virtual frames" (NCAs **100** to NM **104**). Downstream frames from the NM **100** are transmitted into the ODF **102** in an essentially continuous sequence of constant period frames. In one implementation, downstream frames have a period of 125 μ s, and transfer data downstream at a rate of approximately 10 Gb/s, although other periods and rates may be used. The ODP Interface **110** and potentially the ODF **102** split the downstream transmissions passively so that all NCAs **104** receive the frames in a generally broadcast manner. In the upstream direction, separate transmissions from the plurality of NCAs **104** are transmitted as burst transmissions or in slots which are combined in a virtual frame so that the separate burst transmissions do not collide when they arrive at the NM **100**. In one implementation, the virtual upstream frames have essentially the same period as the downstream frames, and upstream data transmissions are transmitted at a rate approximately equal to the downstream rate. Alternatively, different upstream and downstream rates may be used.

[0047] FIG. 2 is a schematic timing and framing diagram, showing overall structure of a downstream frame **200**, and a virtual upstream frame **202** in an implementation of a framing protocol. Referring now to FIG.s 1 and 2, each downstream frame **200** includes a header **204** and a payload section **206**. The downstream header **204** includes a downstream synchronization (DS Sync) **208** section, a station management **210** section, two sections containing the number of NCAs **104** in communication with the NM **100** (# of NCAs) **212**, **214** and an upstream slot allocation (US slot allocation) **216** section. The DS Sync **208** section includes a consecutive sequence of bits that enables receiving NCAs **104** to identify a beginning of the downstream frame

200 and thus acts as starting marker for frame timing throughout the optical local area network **50**. The number of NCAs **104** in communication with the NM is sent twice **212**, **214** to ensure correct interpretation of the US slot allocation section **216**. The order of downstream header sections **210**, **212**, **214**, **216** after a DS Sync **208** may differ in other implementations.

[0048] During each network period **218** defined by respective adjacent downstream headers, each NCA **104** is able to send upstream data. The virtual upstream frame **202** is partitioned into slots, where a "slot" corresponds to a fixed number of bits or a fixed length of time within a virtual frame. For each network period **218**, the NM **100** allocates each NCA **104** respective slots within which an NCA is able to transmit data upstream. Each slot allocation includes a start slot number and end slot number (also referred to as start time and end time), relative to the starting marker defined by a DS Sync **208** from the next network period after an NCA **104** receives a slot allocation. In alternative implementations, a start slot number and a length of time during which a specific NCA **104** is permitted to transmit may be sent instead of a start slot number and an end slot number. Slot allocation start and end numbers are allocated within the virtual upstream frame so that slot allocations do not overlap, ensuring that there are no collisions of data from different NCAs **104** at the NM **100**. The allocations can be determined by the NM Engine **112** based on total upstream bandwidth requests and can be communicated to NCAs **104** in the downstream frame US slot allocation **216** section. The US slot allocation **216** section includes start and end slot numbers pertaining to and identified to specific NCAs **104** (as shown in **220** and **222**). Slot allocations assigned to NCAs **104** can be dynamic and may be changed from network period to network period.

[0049] The upstream frame **224** includes header **226** and payload **228** sections. The header **226** includes a preamble **230** section, a frame delimiter (Delimiter) **232** section and a station management **234** section. The preamble **230** section includes a consecutive sequence of bits designed to aid an NM **100** in synchronizing to the bit clock of a respective transmitting NCA **104**. The Delimiter **232** includes a consecutive sequence of bits designed to aid an NM **100** in synchronizing to and recognizing the beginning of an upstream frame **224**.

[0050] Each downstream frame **200** and upstream frame **224** includes a payload section **206,228** respectively, in which data to and from NCAs **104** (from the network interface **136**) are

transferred. **FIG. 3A** is a schematic showing the payload in downstream and upstream framing, showing that the payload of both upstream and downstream may contain a single adaptation data unit (ADU) **300**. ADUs **300** are output units of data from an adaptation unit **126**, where the adaptation unit **126** has processed data received from the network interface **136** for transfer across the optical local network **50**. For example, in one implementation the adaptation unit **126** receives Ethernet media access control frames (MAC frames) via a GMII interface (as an implementation for the network interface **136**) and removes the MAC frame's preamble and start of frame delimiter (SFD) fields with the remaining fields of the MAC frame encapsulated in an ADU **300**. Additionally, in one implementation the adaptation unit **126** receives Fibre Channel (FC) FC-2 frames through a serial interface (as an implementation of the network interface **136**) and removes the FC-2 frame's start of frame and end of frame fields, with the remaining fields of the FC-2 frame encapsulated in an ADD **300**.

[0051] In another example, the adaptation unit **126** can receive IEEE 802.3 MAC frames via a GMII interface and form an ADD **300** with the entire MAC frame included (i.e., encapsulate the entire MAC frame). In yet another example, the adaptation unit **126** can receive FC-2 frames through a serial interface (as an implementation for the network interface **136**) and form an ADD **300** with the entire FC-2 frame included (i.e., encapsulate the entire FC-2 frame).

[0052] In one implementation, the payload **204**, **232** of downstream frames **200** and upstream frames **224** may include multiple consecutive sub-frames. Referring to **FIG.s 1** and **3B**, a sub-frame includes a sub-frame header **302** section and a sub-frame payload **304** section. A sub-frame header **302** section includes a payload length indicator (PLI) **308** and cyclic redundancy check (CRC) **310** section that covers the PLI **308**. CRC sections, although not shown, may be used in the downstream **200** and upstream **224** frames as well. The sub-frame payload **304** section includes a type **312** section, a CRC **314** that relates to the type **312** section, a payload data unit (PDU) **316** and optionally a CRC **318** that relates to the PDD **316**. The PLI **308** gives an indication of the length, e.g., in bits, of the sub-frame payload **304** section immediately following the sub-frame header **302**. The type **312** section gives an indication of the type of data in the PDU **316**. An adaptation unit **126** may receive data from a mixture of protocols essentially simultaneously (as described below) and the use of sub-frames allows the data to be transferred across the network ensuring quality of service or class of service. An adaptation unit **126** uses

sub-frames by placing received data in the PDU 316, indicating the type of data received in the type 312 section and entering the length of the sub-frame payload 304 in the PLI 308 section.

[0053] The optical local area network 50 operates according to an exemplary process illustrated in FIG. 4. Referring now to FIG.s 1 and 4, after an NM 100 is powered on 400, the NM 100 sends out 402 one or more message(s) requesting new NCAs 104 (NCAs 104 that the NM 100 is unaware of) to identify themselves by reporting to the NM 100 with their respective serial number. The NM 100 also sends out 402 network parameters including initial NCA transmit power levels using, for example, a station management message(s). The NCAs 104 respond using slot allocation(s) given by the NM 100 for new NCAs 104 to respond. After successfully receiving new NCA serial numbers, the NM 100 assigns each new NCA 104 a network identification number (NC-ID) and requests 404 the new NCA 104 to adjust its transmitting power level. In one implementation, the NM 100 sends these requests in a station management message. The respective new NCAs 104 use the assigned NC-ID to interpret specific messages of concern (i.e., addressed) to a given NCA 104. The NM 100 initiates 406 a response delay process to determine the delay in responses between the new NCA and the NM 100. After performing 419 the response delay process, the NM 100 enters normal operation in which network data is transmitted and received 408 across the optical local area network 50.

[0054] When an NCA 104 is powered on 410, the NCA 104 attempts to synchronize 412 to downstream frames by searching for the DS Sync 208. After successful downstream synchronization, the NCA 104 interprets 414 network parameters received via downstream station management messages 404, adjusts its initial transmit power level and awaits instructions (e.g., a message) for new NCAs 104. The instructions include a slot allocation for new NCAs 104 to respond 416 to the NM 100 with the NCA's 104 serial number. Once the NCA 104 has sent its serial number the NCA 104 is then assigned an NC-ID by the NM 100. The NCA 104 then enters a waiting loop (e.g., for a station management message from the NM 100 to adjust its transmit power level). In response to a request to set transmit power level, the NCA 104 adjusts the transmit power level 418. The NCA 104 then enters a waiting loop again (e.g., until receipt of a message from the NM 100 to initiate a response delay process). Upon receipt of an instruction to begin a response delay process, the NCA 104 can, in cooperation with the NM 100, determine the delay between the respective network elements (not shown as part of the process flow). The

details of the response delay process are described in greater detail below. After the NCA 104 and NM 100 complete the response delay process, the NCA 104 may adjust 420 its alignment with the network period to account for downstream and upstream transmission delay. The NCA 104 then enters its normal operation state in which network data is received and transmitted 422.

[0055] FIG. 5 shows one implementation for executing a response delay process 500. The response delay process 500, is a process to determine the delay in NM downstream transmission to NM upstream reception of a message or network data transmission. Referring now to FIG.s 1, 2 and 5, the NM 100 starts 501 the delay process with a new NCA 104 or with an NCA 104 that may cause upstream transmission collisions. The NM 100 assigns one or more slot(s) to the target NCA 104 (i.e., the new NCA or one NCA that may cause a collision in upstream communication) to respond with a response delay message. The NM 100 generates 502 a silence period in the upstream virtual frame 202 (e.g., by not assigning or granting any slots for that period) around the slot(s) assigned to the target NCA 104. The silence period ensures no upstream collisions will occur. The NM 100 sends 504 a message to the NCA 104 to respond with a response delay message and informs the NCA 104 of its slot(s) assignment to respond. Thereafter, the NCA 104 responds 506 to the NM 100 at the appropriate slot time. The NM 100 receives the NCA 104 response delay message and calculates 508 the transmission delay. In one implementation, the NM 100 transmits 510, the result of the response delay calculation to the NCA 104 and the NCA 104 aligns 512 itself to the proper network period.

[0056] The NM 100 may assign, schedule or grant slot allocations in a number of ways (e.g. according to fixed time-division multiplex or statistical time-division multiplex schemes). In one implementation the slot allocations are scheduled to give the NCs 104 a guaranteed minimum upstream transfer rate. The rate may be determined by dividing the maximum upstream data rate by the number of NCAs 104. In another implementation, the NM 100 receives status information about the NCAs 104 egress 132 and ingress 133 queue status. The NM 100 can schedule slot allocations that best minimize the depth of the egress 132 and ingress 133 queues to minimize transmission delays ensuring quality of service (QOS) or class of service (COS).

[0057] FIG.s 6A - 6C, 7A - 7C and 8 are illustrations of implementations of the optical local area network 50. In one implementation shown in FIG. 6A, an NM 100 may function in a hub

configuration **600** networking clients including workstations **602**, personal computers (PC) **604** and Ethernet switches **618** together using the Ethernet protocol. The workstations **602** and PCs **604** are connected to the hub configuration **600** with a network interface card (NIC) **606** containing an NCA **104** and a NIC controller **608**. In one implementation of the NIC **606**, the NIC controller **608** includes a GMII interface, an Ethernet MAC and a peripheral component interconnect (PCI) bus interface. The NCA **104** communicates to the NIC controller **608** through the GMII interface. Ethernet switches **618** are connected to the hub configuration **600** with a network adaptor **621A** containing an NCA **104**. Ethernet switches **618** can be conventional Ethernet switches. In one implementation of the network adaptor **621A**, the network interface **136** is a GMII interface.

[0058] In another implementation shown in **FIG. 6B**, the hub configuration **600** can network disk storage array devices **612**, servers **614** and FC switches **619** together using the Fibre Channel (FC) protocol. This implementation may be described as a Storage Area Network (SAN). The disk storage array devices **612** and servers **614** are connected to the hub configuration **600** with a host bus adaptor (HBA) **607**. In one implementation of HBA **607**, the HBA controller **609** includes a serial interface, FC controller and a PCI bus interface. FC switches **619** are connected to the hub configuration **600** with a network adaptor **621B** containing an NCA **104**. FC switches **619** can be conventional FC switches. In one implementation of the network adaptor **621B**, the network interface **136** is a serial interface.

[0059] In yet another implementation of the optical local area network **50** shown in **FIG. 6C**, the hub configuration **600** may network clients such as workstations **602**, PCs **604**, disk storage array devices **612**, servers **614** and switches **618**, **619** (**FIG. 6B**) using both Ethernet and FC protocols concurrently. NICs **606** can connect a particular client to the hub configuration **600** using the Ethernet protocol. HBAs **607** can connect a particular client to the hub configuration **600** using the FC protocol. For example, workstations **602**, PCs **604** and switches **618** can communicate with the hub configuration **600** using Ethernet protocol while disk storage array devices **612** and servers **614** can communicate with the hub configuration **600** using FC protocol. The ODF **102** (not shown) of the optical local area network **50** can include splitters **620**. Hub configuration **600** can also connect to a switch **618** using an adaptor card **621A**. Adaptor card **621A** in-

cludes an NCA **104** with a respective network interface **136** (e.g., GMII, XAUI, Serial). Switch **618** may be, for example, a switch in a conventional Ethernet LAN **622**.

[0060] One or more NMs **100** can interface to a switching device (e.g., a Layer-2 switch or a Layer-3 switch) to process frames from the various NCAs **104** according to a communication protocol of the switching device. Referring to **FIG. 7A**, a switch configuration **704** includes multiple NMs **100A**, **100B**, **100C** in communication with a Layer-2 switch device **700** which is in further communication with an uplink port **702**. In alternative implementations, the Layer-2 switch device **700** may be in communication with a plurality of uplink ports (not shown). Though three NMs **100A**, **100B**, **100C** are shown more or fewer NMs **100** may be in communication with a Layer-2 switch device **700** included in the switch configuration **704**. Each NM **100A**, **100B**, **100C** includes an adaptation unit **706** in communication with a NM Engine (not shown). The adaptation unit **706** receives and transmits data and messages in the form of frames, packets or cells according to the Layer-2 switch device **700** via a switch interface **708**. Adaptation unit **706** can provide buffering, data and/or message filtering and translation between the protocol of the Layer-2 switch device **700** and the protocol of the optical local area network **50**. The adaptation unit **706** includes an egress queue block (not shown) and an ingress queue block (not shown). Egress and ingress queues can be of the form of memory and are used for buffering receive and transmit data and messages, respectively. In one implementation of the NMs **100A**, **100B**, **100C**, all upstream traffic received by an NM **100** is passed through the switch interface **708** to the Layer-2 switch device **700**. All downstream traffic transmitted by an NM **100** is received by the NM **100** through the switch interface **708**. In another implementation upstream traffic received by an NM **100** can be filtered based on destination address to either pass data and/or messages back to one or more NCAs **104** multiplexed in downstream traffic (e.g. hairpinning) or to the Layer-2 switch device **700** through the switch interface **708**. The fiber connections **105** form a first ODF for connecting NM **100A** with one or more NCAs. The fiber connections **710** form a second ODF for connecting NM **100B** with one or more NCAs. The fiber connections **712** form a third ODF for connecting NM **100C** with one or more NCAs.

[0061] In one implementation of an optical local area network **50** shown in **FIG. 7A**, the switch configuration **704** is used to network workstations **602**, PCs **604** and a Ethernet switch **618** together using the Ethernet protocol with appropriate NICs **606** as described above. The

switch configuration **704** includes a Layer-2 switch (e.g., Layer-2 switch device **700**) that implements an Ethernet MAC and switching functions. The optical fibers **105**, **710**, **712** connecting the workstations **602**, PCs **604** and Ethernet switches **618** to the switch configuration **704** can be associated with different NMs **100A**, **100B**, **100C** depending on which fiber connections are used. The uplink port **702** of switch configuration **704** can connect to an Ethernet switch and/or router (not shown).

[0062] In another implementation of an optical local area network **50** shown in **FIG. 7B**, the switch configuration **704** is used to network one or more disk storage array devices **612**, servers **614** and FC-2 switches **619** using, for example, the FC protocol with appropriate HBAs **607** as described above. This implementation may also be described as a Storage Area Network (SAN). The switch configuration **704** includes a Layer-2 switch (e.g., Layer-2 switch device **700**) that implements an FC-2 controller and switching functions. The optical fibers **105**, **710**, **712** connecting the disk storage array devices **612**, servers **614** and FC-2 switch **619** to the switch configuration **704** can be associated with different NMs **100A**, **100B**, **100C** depending on which fiber connections are used. The uplink port **702** of switch configuration **704** may connect to an FC-2 switch and/or router (not shown). FC-2 switches **619** can be a conventional FC-2 switch.

[0063] In yet another implementation of an optical local area network **50** shown in **FIG. 7C**, a switch configuration **704** is used to network workstations **602**, PCs **604**, disk storage array devices **612**, servers **614** and other switches (e.g. an Ethernet switch **618**) together using, for example, both Ethernet and FC protocols concurrently in a manner described previously. The switch configuration **704** includes a Layer-2 switch (e.g. Layer-2 switch device **700**) that implements both an Ethernet MAC and FC-2 controller with switching functions. Layer-2 switch device **700** can be implemented by a packet processor or network processor. The optical fibers **105**, **710**, **712** connecting the workstations **602**, PCs **604**, disk storage array devices **612**, servers **614** and other switches to the switch configuration **704** can be associated with different NMs **100A**, **100B**, **100C** depending on which fiber connections are used. The uplink port **702** of switch configuration **704** may connect to an Ethernet or FC-2 switch and/or router (not shown).

[0064] In yet another implementation of an optical local area network **50**, an implementation of switch configuration **705** containing an NM **100**, an adaptation unit **706** and an uplink port

702 is shown in **FIG. 7D**. Switch configuration **705** can be used to network workstations **602**, PCs **604** and other switches **618** in a manner described previously. The NM **100** is in communication with a Layer-2 switch device (not shown) through the uplink port **702** that is connected to a switch. The connection between uplink port **702** and switch **618** can be a physical layer connection **714** (e.g., 1000 BASE-SX, 1000 BASE-LX). Ethernet switch **618** can be a conventional Ethernet switch.

[0065] In some implementations of switch configurations **704**, **705** the uplink port **702** can be an NCA adaptor (not shown) similar to **621A**, **621B** wherein the network interface **136** and switch interface **708** are coupled using the same interface standard (e.g., XAUI, Serial, Parallel), thus enabling the uplink port **702** to connect to other hub configurations **600** and switch configurations **704** (**FIG.s 7 A-7C**), **705** (**FIG. 7D**).

[0066] In another implementation of an optical local area network **50** shown in **FIG. 8**, NM **100** and NCA **104** may be implemented in optical modules. A network manager in an optical module (NM-OM) **800** is provided that, in one implementation, conforms to an industry standard form factor and includes an NM-CLM **803** that includes an adaptation unit **706** to transfer data into and out of a network interface (e.g., switch interface **708**). The NM-OM **800** also includes a NM Optical interface **108** and an ODF port **117A**. In one implementation, the optical module NM -OM **800** conforms to an industry standard Multi-source agreement (MSA) form factor (e.g., 300pin, XENPAK, X2, XPAK, XFP or SFP). A network client adaptor in an optical module (NC-OM) **802** can be provided that, in one implementation, also conforms to an industry standard form factor and includes an NCA **104**. For example, the optical module NC-OM may conform to an MSA form factor (e.g., 300pin, XENPAK, X2, XPAK, XFP or SFP).

[0067] The NM-OM **800** can connect to a conventional router **804** that has optical module ports **806** using the router's switch interface (e.g., XAUI or Serial). The NM-OM **800** is in optical communication with an optical splitter **810** that splits light among and collects light from workstations **602**, PCs **604**, disk storage array devices **612**, servers **614** and switches using appropriate NICs **606** and/or NC-OM **802** as previously described. The Ethernet Layer-2/3 switch **808** may be of conventional design and include an uplink port, that in one implementation, conforms to an industry standard optical module form factor. The Ethernet Layer-2/3 switch **808**

can communicate with the NM-OM **800** in router **804** by using an NC-OM **802** via network interface **136** (e.g., XAUI or Serial).

[0068] The Ethernet Layer-2/3 switch **808** is further detailed in **FIG. 9**. In the Ethernet Layer-2/3 switch **808**, an NC-OM **802** is in communication with a Layer-2 switch **900** by means of a MAC (not shown) using a network interface **136** (e.g., XAUI or Serial). Ethernet Layer-2/3 switch **808** also includes physical layer ports (PHY ports) **902** that, in one implementation, form a conventional Ethernet LAN (e.g., Ethernet LAN **622** of **FIG. 8**) connecting network clients such as workstations **602** and PCs **604**.

[0069] An implementation of an alternative configuration for a switch is shown in **FIG. 10**. **FIG. 10** is an illustration of an NC-Switch **1010**, in which no conventional Layer-2 switch and MAC is used. NC-Switch **1010** includes an NCA **1012** and multiple PHY ports **902**. Each PHY port may perform wireline (e.g., 10/100/1000 BASE-T, DSL) or wireless (e.g., IEEE 802.11, IEEE 802.16) physical layer communications with conventional LAN clients. In this implementation, the adaptation unit **126** supports multiple network interfaces **136**. The switching function previously performed by the Layer-2 switch (e.g., Layer-2 switch **900** of **FIG. 9**) is consolidated to the switch or router in communication with an NM **100** in a switch configuration **704** (as described above) or an NM-OM **800** (e.g. as illustrated in **FIG. 8** an NC-Switch **910** in communication with an NM-OM **800**). Alternatively, the switching function previously performed by the Layer-2 switch is consolidated to Layer-2 switches (not shown) in communication with other NCAs **104** networked in a hub configuration **600**.

[0070] In hub configuration **600** (e.g. **FIGS. 6A-6C**) of the optical local area network **50**, flow control, denial of service and other network administration functions are dependent on external Layer-2 devices in communication with NCAs **104** (for example, the Ethernet MAC or FC-2 controller in the NIC controller **608** dependent on the implementation as previously discussed). In switch configurations **704** (e.g. **FIG.s 7A-7C**) of the optical local area network **50**, flow control, denial of service and other network administration functions are further dependent on the external Layer-2 device **700** in communication with NMs **100**, in addition to the Layer-2 devices external and in communication with NCAs **104** as previously mentioned.

[0071] FIG. 14 is a diagram of an optical module 1400 with MAC, TC-Layer and PHY-Layer functionality components 1408 according to an exemplary embodiment of the invention. The form factor of the optical module 1400 can comply with any current or future optical module form factor. The preferred embodiment of the invention would have a form factor that complies with an MSA optical module such as the XENPAK, X2, SFP and XFP MSA optical modules. The optical module 1400 contains the optical-electrical/electrical-optical components such as a laser 1401 and a photo detector 1403 as well as hi speed devices such as the laser driver 1402, TIA 1404 and limiting amp 1405. The MAC, TC-Layer and PHY-Layer functionality component(s) 1408 inside the optical module are the basis of the invention and are not to be confused with replacing the traditional MAC, TC-Layer and PHY-Layer devices that reside outside of optical modules. The MAC and TC-Layer comprise of functionality needed to generate and receive transmission frames and are responsible for the entire overhead associated with the transmission frame for a point-to-multipoint network. The invention is envisioned to enable point-to-multipoint connections in previously point-to-point only connections via passive optical network (PON) implementation. This implies a headend or Optical Line Terminal (OLT) MAC and TC-Layer, which must emulate the functionality of a point-to-point link and is the master of the point-to-multipoint link, with a complementary client or Optical Network Terminal (ONT) MAC and TC-Layer operating in a slave like relationship to the headend MAC & TC-Layer counterpart. The MAC performs the efficient arbitrating of downstream and upstream data by determining bandwidth allocation and packet destination on the point-to-multipoint network. The term TC-Layer originated with ATM protocol but has become and is used here to describe a specification that: bundles and unbundles sent and received data into packets or frames; manages the transmission of packets or frames on a network via medium access and bandwidth allocation; provides necessary messaging and end point behavior, and checks and corrects for errors. The PHY-Layer comprises the functionality of clock data recovery, analog to digital and digital to analog conversion. The preferred optical module embodiment would also contain a performance monitor 1413, clock generator 1414 and a micro-controller 1415. The performance monitor 1413 contains a photo diode and is used to monitor and correct the extinction ratio of the laser. The clock generator 1414 is a clock source for the various digital components in the preferred optical module embodiment 1400. The micro-controller 1415 enables the optical module 1400 to communicate to an external intelligence the capabilities of the optical module 1400 as well as

receive configuration commands from the external intelligence. The input **1411** and output **1412** of the optical module **1400** can be either serial or parallel pins depending on the type of network apparatus that the optical module **1400** is intended to be connected to.

[0072] The optical module **1400** can connect to a plurality of network apparatus according to an exemplary embodiment of this invention. Given today's network infrastructure the invention is preferred to connect to Ethernet and Fibre Channel networks. **FIG. 15** is a diagram of the Ethernet OSI model. The embodiment of the invention connects to Ethernet devices at two levels in the OSI model, as Physical Coding Sublayer (PCS) layer **1502** and Physical Media Dependent (PMD) layer **1503** devices. The embodiment connects to Ethernet devices as the PCS layer **1502** via an xMII type interface, which is a generic term for 100Mbit or higher Media Independence Interfaces. **FIG. 16** is a diagram of the Fibre Channel model structure and the embodiment of the invention connects to Fibre Channel devices at two levels in this structure model, as FC-1 layer **1602** and FC-0 layer **1603** devices. The embodiment connects to Fibre Channel devices as the FC-1 layer **1602** via the interface specified by the Fibre Channel specification, which as recently adopted an xMII interface as well.

[0073] The embodiment connects to Ethernet devices as the PMD layer **1503** and Fibre Channel devices as the FC-0 layer **1603** via an MSA optical module port whereby the embodiment replaces an existing MSA optical module or is an outright substitute for traditional MSA optical modules. The embodiment in this case would have either serial or XAUI interface depending on the MSA form factor of the MSA optical module port. Furthermore, the embodiment in this case has the addition of 8/10 bit decode **1700** functionality as part of the MAC, as shown in **FIG. 17**. Both Ethernet and Fibre channel employ 8/10 bit encoding at the PCS layer. In order for the MAC to perform its functions part of the incoming data must be decoded to determine the destination of the packet on the point-to-multipoint network. The data is preferred to be sent with the 8/10 bit encoding to reduce the burden of complete decoding and recoding at the destination. Although in particular embodiments 8/10 bit decoding **1700** and encoding **1701** can be desired and done.

[0074] Quality of Service (QoS) in network designs has never been as important as it is today. Manageable QoS needs to be available at all levels of a network, including LAN, WAN, campus

networks, enterprise networks, and metropolitan networks. QoS management should be provided at all layers of the network protocol, or the QoS is only as good as the weakest link. QoS is usually implemented via Station Management interfaces with Management Information Base (MIB) table of registers to manipulate the network device. The embodiments of the invention enable a new level of QoS management at the PCS and PMD layers or the equivalent thereof. QoS can be enabled via a Station Management interface with the micro-controller **1415** where the MIB resides.

[0075] Although the invention has been described in terms of particular implementations, one of ordinary skill in the art, in light of this teaching, can generate additional implementations and modifications without departing from the spirit of or exceeding the scope of the claimed invention. Accordingly, it is to be understood that the drawings and descriptions herein are proffered by way of example to facilitate comprehension of the invention and should not be construed to limit the scope thereof.

Electronic Acknowledgement Receipt	
EFS ID:	9616157
Application Number:	12982872
International Application Number:	
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Title of Invention:	System and Method for Pluggable Optical Modules for Passive Optical Networks
First Named Inventor/Applicant Name:	Alexander I. Soto
Customer Number:	93749
Filer:	Alexander Ivan Soto
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Attorney Docket Number:	UBI-005B
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Application Type:	Utility under 35 USC 111(a)

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File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Preliminary Amendment	Preliminary_Amendment_UBI-005B_08Mar11.pdf	957089	no	16
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Warnings:					
Information:					

2	Specification	Substitute_Specification_per_3 7CFR121_UBI-005B_07Mar11. pdf	176749 346004b1e26d20e39af36af68a49d8cb98 83b92	no	25
Warnings:					
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PATENTS Docket No. UBI-005B	
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE	
In re Application of: Alexander I. Soto et al.	Group Art Unit: Unassigned Examiner: Unknown
Patent Application No.: 12/982,872	
Filed on: December 30, 2010	
For: SYSTEM AND METHOD FOR NOVEL OPTICAL MODULES	

Mail Stop Missing Parts
Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-4150

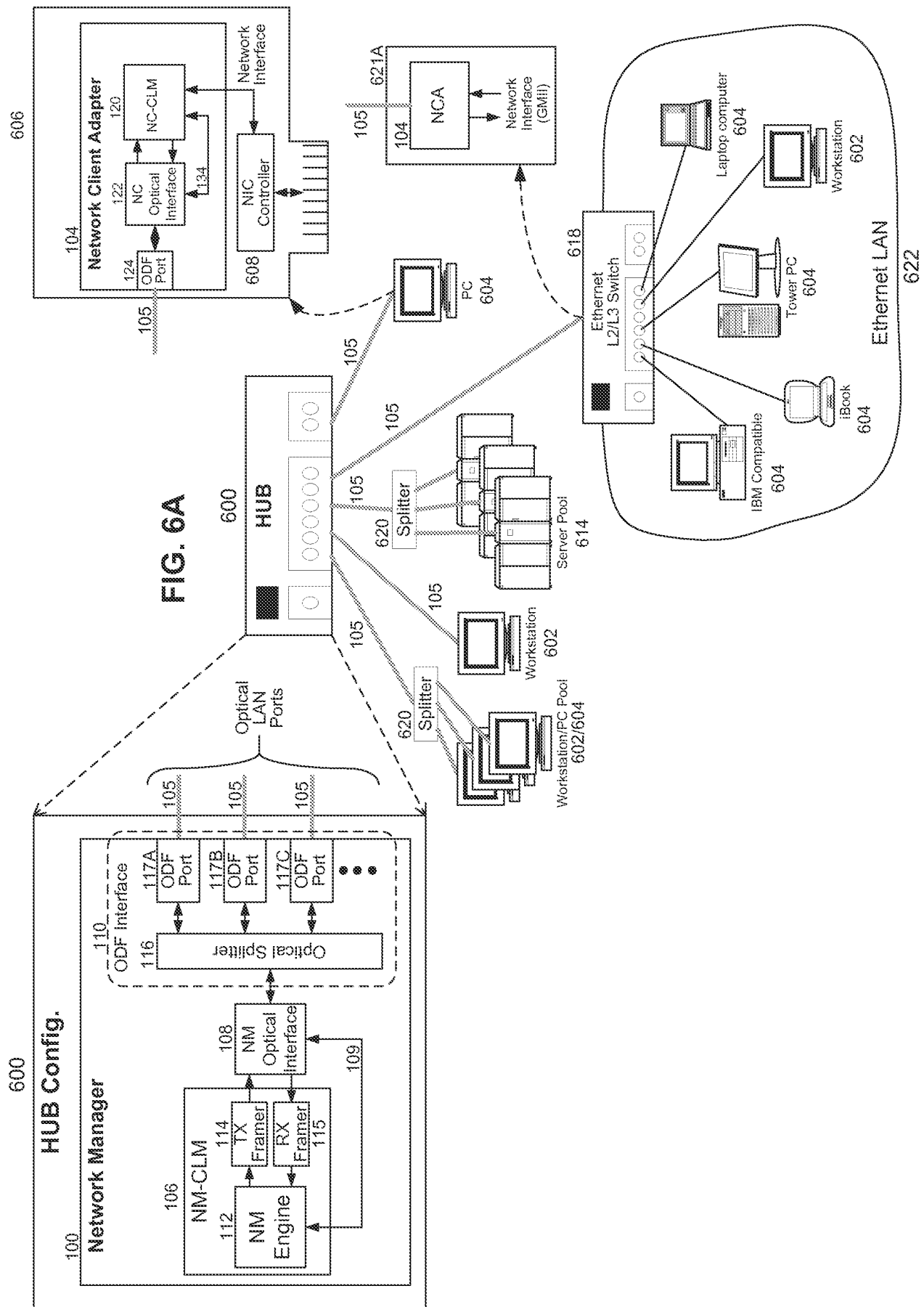
REPLACEMENT DRAWINGS PER 37 C.F.R. §1.54

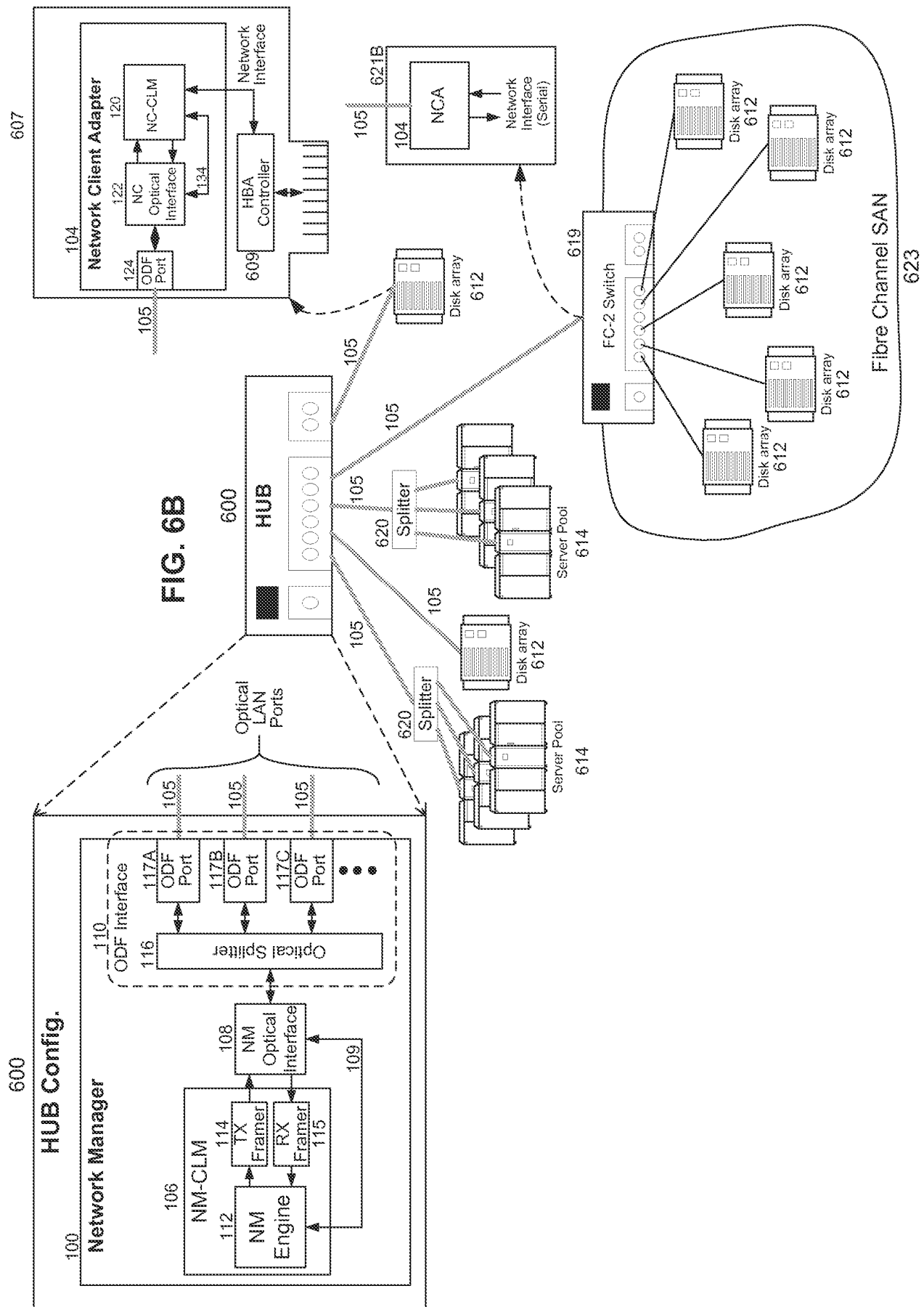
Responsive to the Notice to File Corrected Application Papers mailed on January 18, 2011, please enter the following Replacement Sheets in the above-entitled Patent Application. FIGS. 6A-7D and FIG. 8 are corrected to remove all shading traces and contain no new matter.

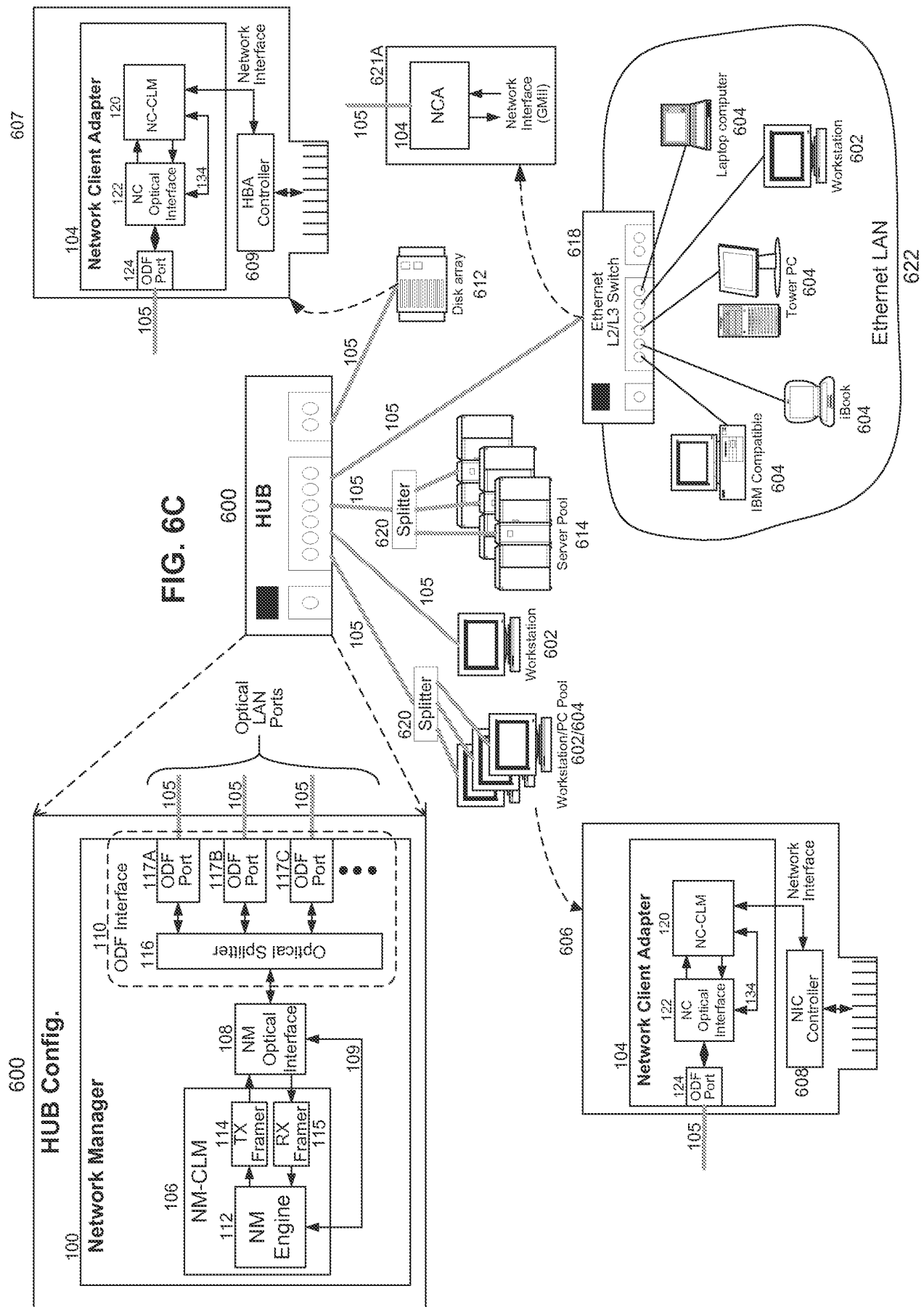
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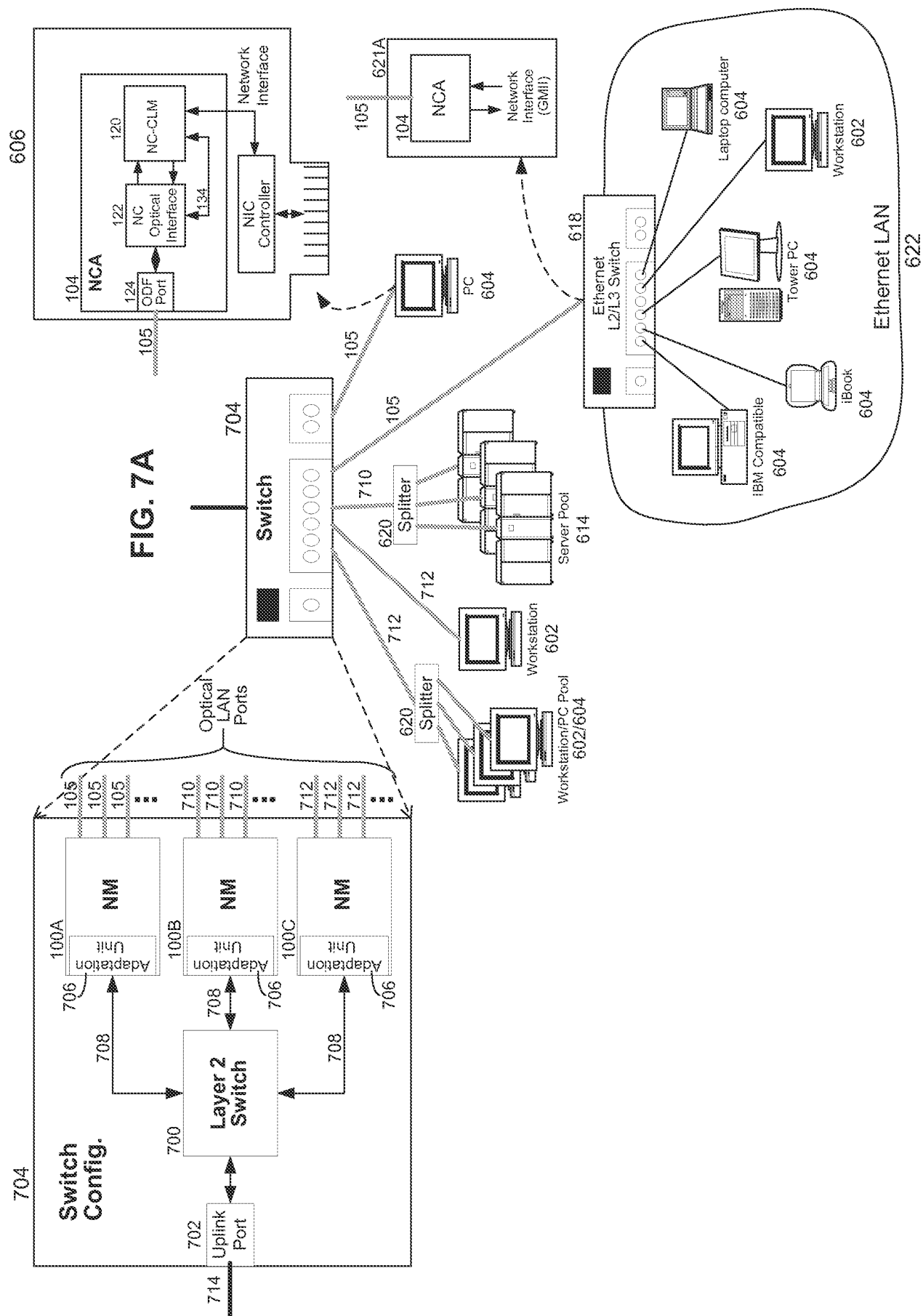
/Alexander Soto/

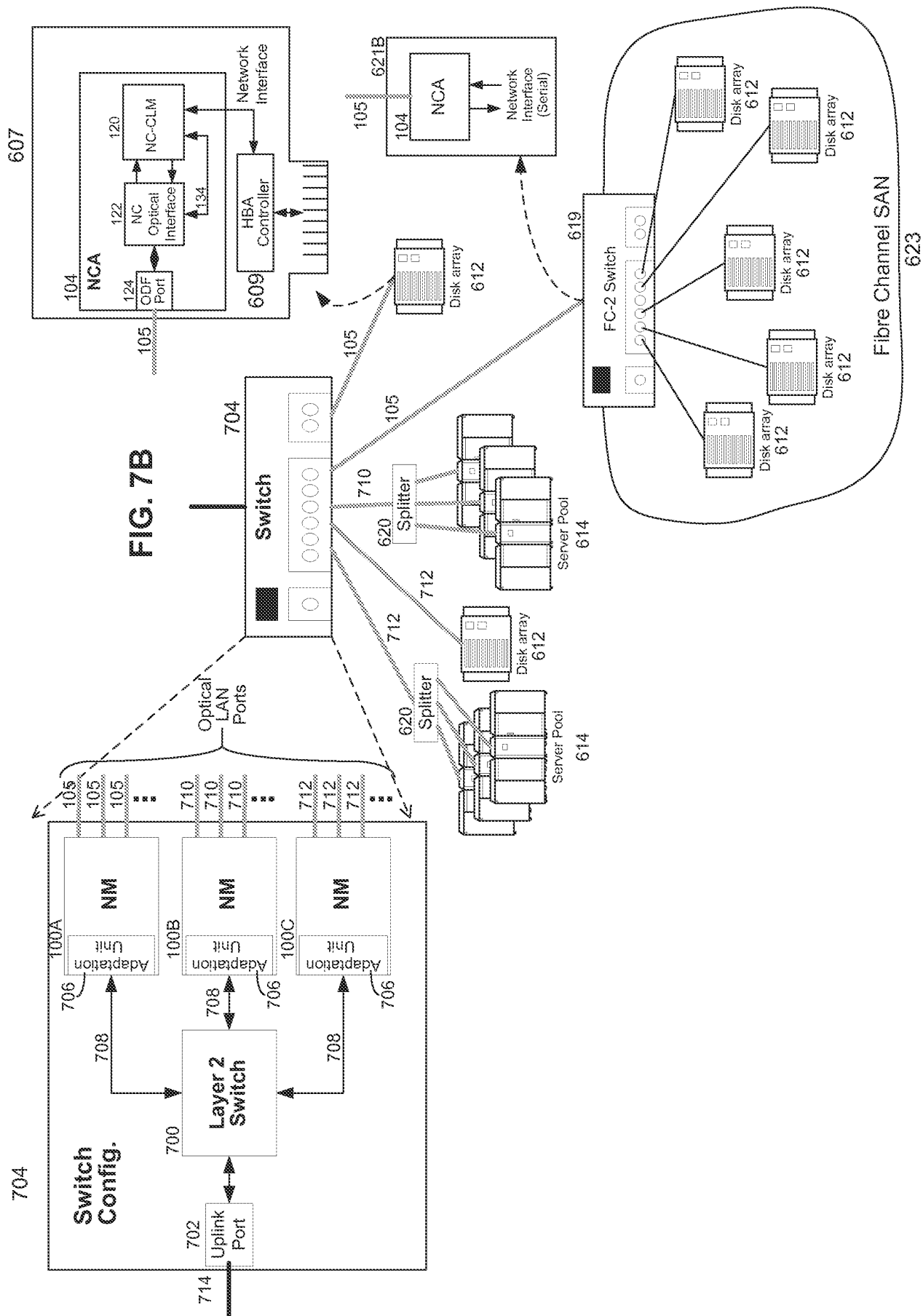
Alexander Soto
Customer No. 93,749
7673 Hazard Center Dr. San Diego, CA 92108
858-527-2397
alexander.i.soto@gmail.com

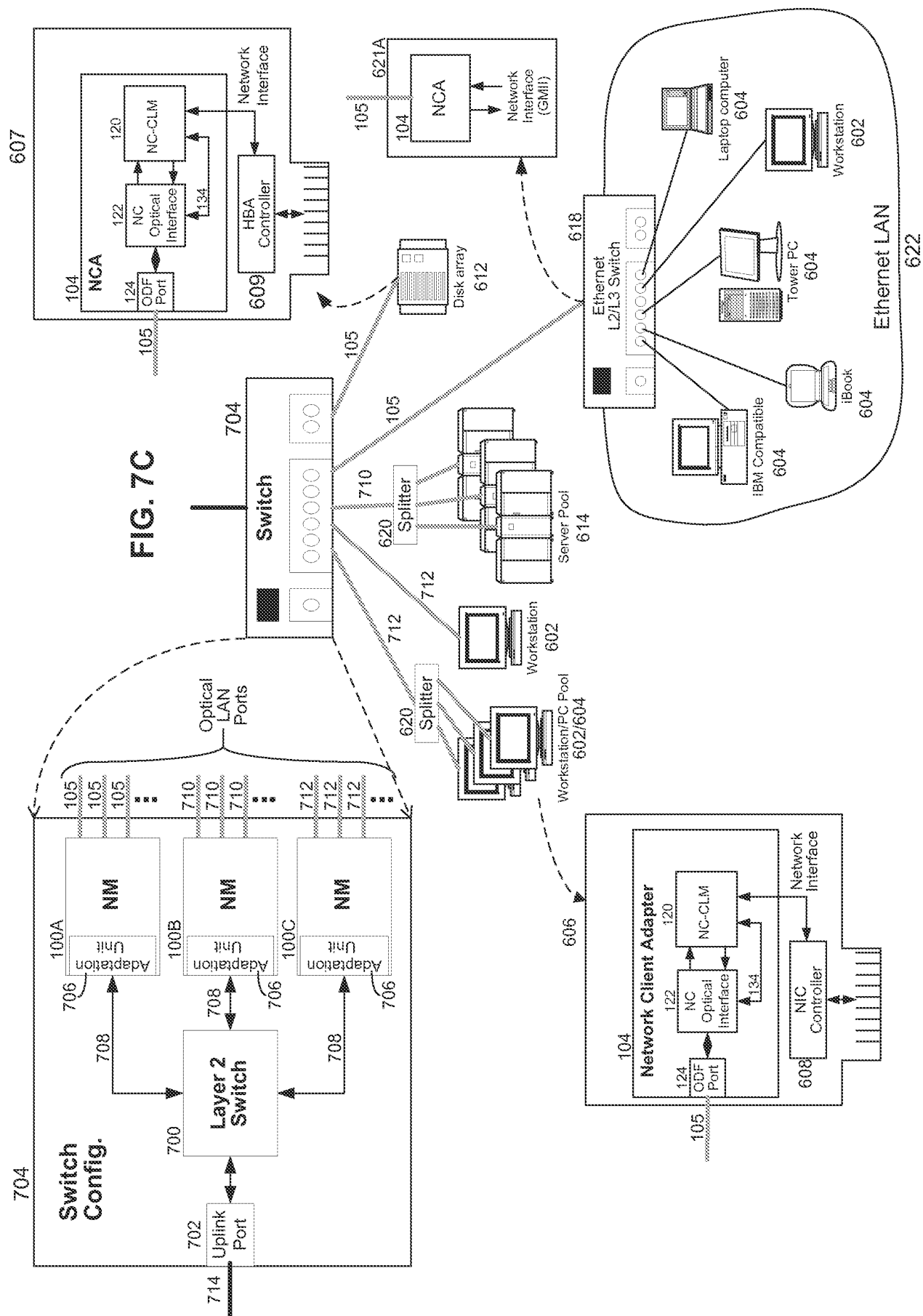


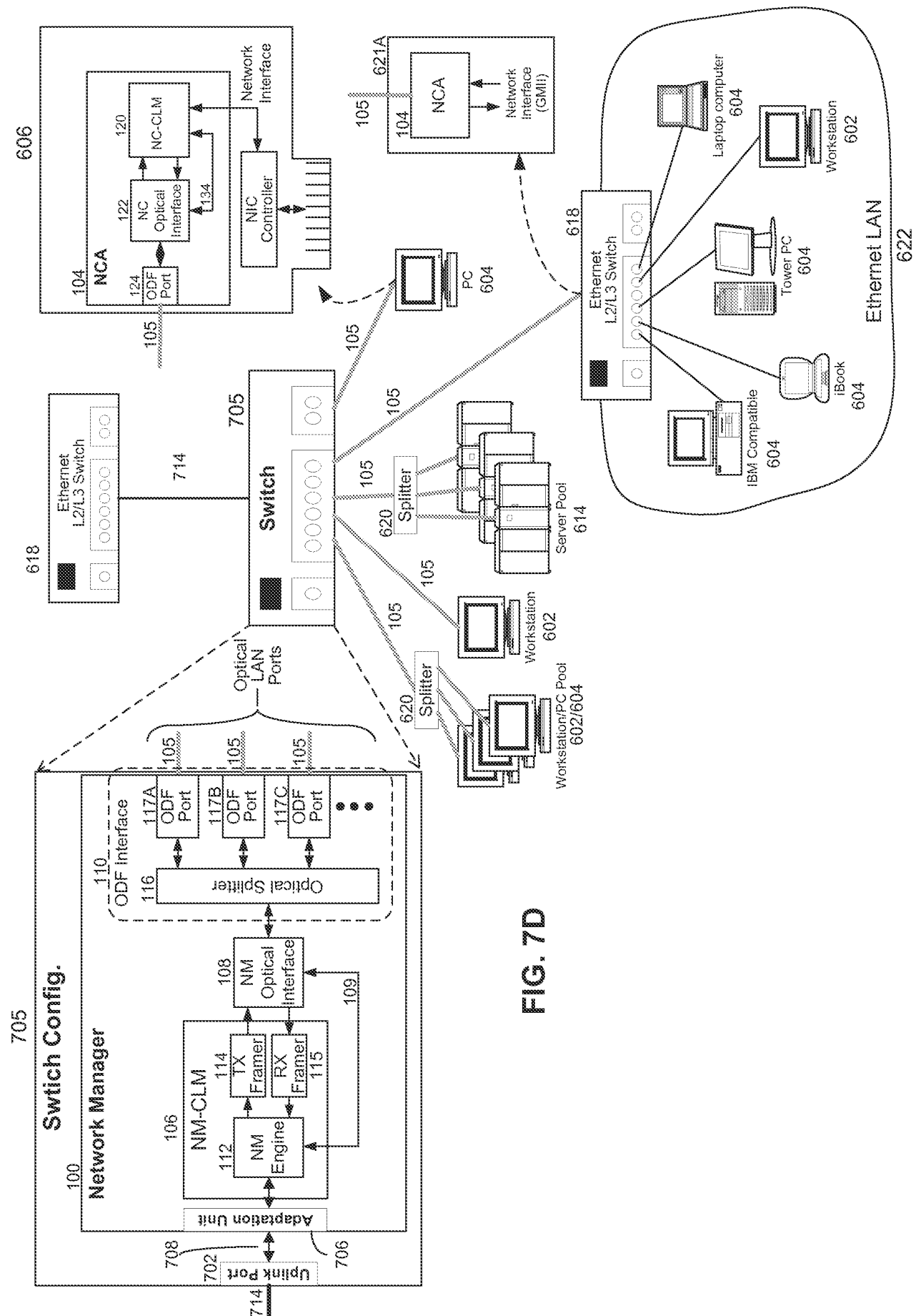


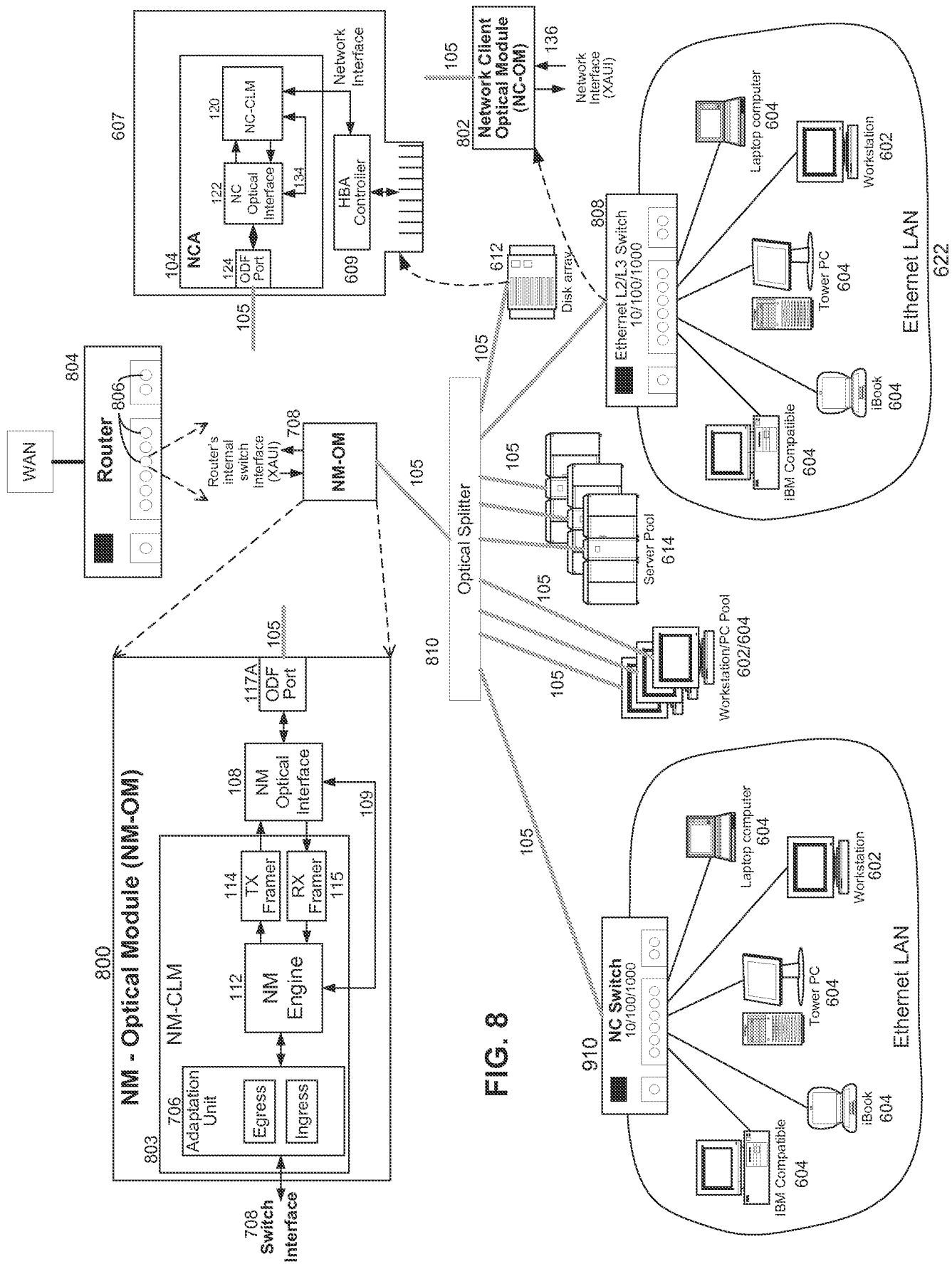












Electronic Patent Application Fee Transmittal				
Application Number:		12982872		
Filing Date:		30-Dec-2010		
Title of Invention:		System and Method for Pluggable Optical Modules for Passive Optical Networks		
First Named Inventor/Applicant Name:		Alexander I. Soto		
Filer:		Alexander Ivan Soto		
Attorney Docket Number:		UBI-005B		
Filed as Small Entity				
Utility under 35 USC 111(a) Filing Fees				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
Claims in excess of 20	2202	1	26	26
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Miscellaneous:				
Total in USD (\$)				26

Electronic Acknowledgement Receipt	
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Application Number:	12982872
International Application Number:	
Confirmation Number:	9206
Title of Invention:	System and Method for Pluggable Optical Modules for Passive Optical Networks
First Named Inventor/Applicant Name:	Alexander I. Soto
Customer Number:	93749
Filer:	Alexander Ivan Soto
Filer Authorized By:	
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1	Applicant Response to Pre-Exam Formalities Notice	Formal_Drawing_Transmittal_UBI-005B.pdf	242739 39c73cdf70d830410b049da194167ca2b2ab6e6c	no	9
Warnings:					
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2	Fee Worksheet (PTO-875)	fee-info.pdf	30362 c92067de5ac4de9cf099c255b2dddbc3ac9f00fa2	no	2
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SCORE Placeholder Sheet for IFW Content

Application Number: 12982872

Document Date: 3/7/2011

The presence of this form in the IFW record indicates that the following document type was received in electronic format on the date identified above. This content is stored in the SCORE database.

- Drawings – Other than Black and White Line Drawings

Since this was an electronic submission, there is no physical artifact folder, no artifact folder is recorded in PALM, and no paper documents or physical media exist. The TIFF images in the IFW record were created from the original documents that are stored in SCORE.

To access the documents in the SCORE database, refer to instructions developed by SIRA.

At the time of document entry (noted above):

- Examiners may access SCORE content via the eDAN interface.
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Form Revision Date: February 8, 2006



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
12/982,872	12/30/2010	Alexander I. Soto	UBi-005B

CONFIRMATION NO. 9206

FORMALITIES LETTER



OC000000045478829

Date Mailed: 01/18/2011

93749
Alexander Soto
7673 Hazard Center Dr.
San Diego, CA 92108

NOTICE TO FILE CORRECTED APPLICATION PAPERS

Filing Date Granted

An application number and filing date have been accorded to this application. The application is informal since it does not comply with the regulations for the reason(s) indicated below. Applicant is given TWO MONTHS from the date of this Notice within which to correct the informalities indicated below. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

The required item(s) identified below must be timely submitted to avoid abandonment:

- Replacement drawings in compliance with 37 CFR 1.84 and 37 CFR 1.121(d) are required. The drawings submitted are not acceptable because:
 - The drawings must be reasonably free from erasures and must be free from alterations, overwriting, interlineations, folds, and copy marks. See Figure(s) 6A-7D, 8.

Applicant is cautioned that correction of the above items may cause the specification and drawings page count to exceed 100 pages. If the specification and drawings exceed 100 pages, applicant will need to submit the required application size fee.

The applicant needs to satisfy supplemental fees problems indicated below.

The required item(s) identified below must be timely submitted to avoid abandonment:

- Additional claim fees of \$26 as a small entity, including any required multiple dependent claim fee, are required. Applicant must submit the additional claim fees or cancel the additional claims for which fees are due.

SUMMARY OF FEES DUE:

Total fee(s) required within **TWO MONTHS** from the date of this Notice is \$26 for a small entity

- Total additional claim fee(s) for this application is \$26
 - \$26 for 45 total claims over 20.

Replies should be mailed to:

Mail Stop Missing Parts
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P.O. Box 1450
Alexandria VA 22313-1450

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

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For more information about EFS-Web please call the USPTO Electronic Business Center at **1-866-217-9197** or visit our website at <http://www.uspto.gov/ebc>.

If you are not using EFS-Web to submit your reply, you must include a copy of this notice.

/rerry/

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

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875						Application or Docket Number 12/982,872			
APPLICATION AS FILED - PART I									
(Column 1)		(Column 2)		SMALL ENTITY		OTHER THAN SMALL ENTITY			
FOR	NUMBER FILED	NUMBER EXTRA	RATE(\$)	FEE(\$)		RATE(\$)	FEE(\$)		
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	82		N/A			
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A	270		N/A			
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	110		N/A			
TOTAL CLAIMS (37 CFR 1.16(j))	65	minus 20 = * 45	x 26	= 1170	OR				
INDEPENDENT CLAIMS (37 CFR 1.16(h))	4	minus 3 = * 1	x 110	= 110	OR				
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$270 (\$135 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					
			TOTAL	1742		TOTAL			
* If the difference in column 1 is less than zero, enter "0" in column 2.									
APPLICATION AS AMENDED - PART II									
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OTHER THAN SMALL ENTITY	
AMENDMENT A	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)	
	Total (37 CFR 1.16(i))	*	Minus **	=	x	=	OR	x	=
	Independent (37 CFR 1.16(h))	*	Minus ***	=	x	=	OR	x	=
	Application Size Fee (37 CFR 1.16(s))					OR			
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))					OR			
			TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE			
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OTHER THAN SMALL ENTITY	
AMENDMENT B	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)	
	Total (37 CFR 1.16(i))	*	Minus **	=	x	=	OR	x	=
	Independent (37 CFR 1.16(h))	*	Minus ***	=	x	=	OR	x	=
	Application Size Fee (37 CFR 1.16(s))					OR			
	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.									



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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
12/982,872	12/30/2010	2613	1716	UBi-005B	65	4

CONFIRMATION NO. 9206

93749

Alexander Soto
7673 Hazard Center Dr.
San Diego, CA 92108

FILING RECEIPT



OC000000045478828

Date Mailed: 01/18/2011

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)

Alexander I. Soto, San Diego, CA;
Walter G. Soto, San Clemente, CA;

Power of Attorney: The patent practitioners associated with Customer Number 93749

Domestic Priority data as claimed by applicant

This application is a CON of 10/886,514 07/06/2004
which claims benefit of 60/485,072 07/03/2003
and claims benefit of 60/515,836 10/30/2003

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.)

If Required, Foreign Filing License Granted: 01/13/2011

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 12/982,872**

Projected Publication Date: To Be Determined - pending completion of Corrected Papers

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

System and Method for Pluggable Optical Modules for Passive Optical Networks

Preliminary Class

398

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

page 2 of 3

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IPR2023-00960, Ex. 1002-1

AT&T Ex. 1002-1

Ex. 1002-1.097

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

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

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NOT GRANTED

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

PATENTS Docket No. UBI-006C	
IN THE UNITED STATES PATENT AND TRADEMARK OFFICE	
In re Application of: Alexander I. Soto et al.	Group Art Unit: Examiner:
Patent Application No.: 12/982872	
Filed on: December 30, 2010	
For: System and Method for Pluggable Optical Modules	

Commissioner for Patents
 Mail Stop Amendment
 PO Box 1450
 Alexandria, VA 22313-4150

PRELIMINARY AMENDMENT PER 37 CFR 1.115

Prior to examination of the above-referenced application, please enter the following amendment.

Amendments to the Specification

Kindly replace the title with the following:

~~COMMUNICATION SYSTEM AND METHOD FOR AN~~ PLUGGABLE OPTICAL MODULES LOCAL AREA FOR PASSIVE OPTICAL NETWORKS

Kindly replace paragraph [0001] of the Cross-reference to related applications section with the following paragraph:

“[0001] This application is filed under 37 C.F.R. §1.53(b)(1) as a continuation claiming the benefit under 35 U.S.C. §120 of the pending Patent Application No. 10/886,514, “COMMUNICATION SYSTEM AND METHOD FOR AN OPTICAL LOCAL AREA NETWORK”, which was filed by the same inventors on July 6, 2004, claim[[s]]ing the benefit under 35 U.S.C. 119(e) of U.S. Provisional Patent Application No. 60/485,072 filed on Jul 3, 2003 and now expired, incorporated herein by reference, and U.S. Provisional Patent Application No. 60/515,836 filed on Oct. 30, 2003 and now expired, incorporated herein by reference.

REMARKS

Kindly amend the title and paragraph [0001] of the Cross-reference to related applications section of the specification as described above.

Respectfully submitted,

/Alexander Soto/

Alexander Soto
Customer No. 93,749
7673 Hazard Center Dr. San Diego, CA 92108
858-527-2397
alexander.i.soto@gmail.com

Electronic Acknowledgement Receipt	
EFS ID:	9241523
Application Number:	12982872
International Application Number:	
Confirmation Number:	9206
Title of Invention:	System and Method for Pluggable Optical Modules for Passive Optical Networks
First Named Inventor/Applicant Name:	Alexander I. Soto
Customer Number:	93749
Filer:	Alexander Ivan Soto
Filer Authorized By:	
Attorney Docket Number:	UBI-005B
Receipt Date:	15-JAN-2011
Filing Date:	30-DEC-2010
Time Stamp:	20:13:28
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment		no			
File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Preliminary Amendment	Preliminary_Amendment_UBI-005B_10Dec10.pdf	80042	no	3
			71ea0b3677b77a2b1733ea4c7465a3e76f928cdf		
Warnings:					
Information:					

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.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		12982872
	Filing Date		2010-12-30
	First Named Inventor	Alexander I. Soto	
	Art Unit		
	Examiner Name		
	Attorney Docket Number		UBI-005B

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	6498667	B1	2002-12-24	Masucci et al.	
	2	6778399	B2	2004-08-17	Medina et al.	
	3	6788833	B1	2004-09-07	Brisson et al.	
	4	6970461	B2	2005-11-29	Unitt et al.	
	5	5572349	A	1996-11-05	Hale et al.	
	6	4776041	A	1998-10-04	Husbands, Charles R.	
	7	4701909	A	1987-10-20	Kavehrad, Mosen	
	8	5029333		1991-07-02	Graves et al	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		12982872	
	Filing Date		2010-12-30	
	First Named Inventor	Alexander I. Soto		
	Art Unit			
	Examiner Name			
	Attorney Docket Number	UBI-005B		

	9	6023467	A	2000-02-08	Abdelhamid et al.	
	10	7031343	B1	2006-04-18	Kuo et al.	
	11	6792207	B2	2004-09-14	Iannone et al.	

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Examiner Initial*	Cite No	Publication Number	Kind Code ¹	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	20030236916	A1	2003-12-25	Adcox et al.	
	2	20020006111		2002-01-17	Akita et al.	
	3	20020067529	A1	2002-06-06	Yokomoto et al.	
	4	20020163921	A1	2002-11-07	Ethridge et al.	
	5	20030091045	A1	2003-05-15	Choi et al.	
	6	20030227926		2003-12-11	Ramamurthy et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		12982872	
	Filing Date		2010-12-30	
	First Named Inventor	Alexander I. Soto		
	Art Unit			
	Examiner Name			
	Attorney Docket Number	UBI-005B		

	7	20040052274	A1	2004-03-18	Wang et al.	
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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵	
	1	E. MODIANO et al., "A Novel Medium Access Control Protocol for WDM-Based LAN's and Access Networks Using a...", Journal of Lightwave Tech., Vol 18, No 4, April 2000.	☐	
	2	M. SACHES et al., "Fibre Channel and Related Standards", IEEE Communications Magazine, August 1996.	☐	
	3	RODOVANOVIC, "Ethernet-Based Passive Optical Local-Area Networks for Fiber-to-the-Desk Application", Journal of Lightwave Tech., Nov 2003, pages 2534-2545 vol 21 no 11.	☐	
	4	CHAING et al, "Implementation of STARNET: A WDM Computer Communications Network", Journal on Selected Areas of Communications, June 1996, pages 824-839, vol 14, no 5.	☐	
	5	RAWSON, ERIC, "The Fibernet II Ethernet-Compatible Fiber-Optic LAN", IEEE Journal of Lightwave Technology, June 1985, pages 496-501, vol LT-3, No. 3.	☐	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		12982872
	Filing Date		2010-12-30
	First Named Inventor	Alexander I. Soto	
	Art Unit		
	Examiner Name		
	Attorney Docket Number		UBI-005B

	6	E. MODIANO, "WDM-Based Packet Networks", IEEE Communications Magazine, March 1999	☐
	7	E.MODIANO, "Design and Analysis of an Asynchronous WDM Local Area Network Using a Master/Slave Scheduler", IEEE, 1999	☐
	8	R. MAUGER, "The Integration of ATM, SDH and PON Technology in the Access Network, Fourth IEE Conference on Telecommunications 1993.	☐

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

EXAMINER SIGNATURE

Examiner Signature		Date Considered	
--------------------	--	-----------------	--

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

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

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		12982872
	Filing Date		2010-12-30
	First Named Inventor	Alexander I. Soto	
	Art Unit		
	Examiner Name		
	Attorney Docket Number	UBI-005B	

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		Date (YYYY-MM-DD)	
Name/Print		Registration Number	

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

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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.

Electronic Acknowledgement Receipt	
EFS ID:	9212098
Application Number:	12982872
International Application Number:	
Confirmation Number:	9206
Title of Invention:	System and Method for Pluggable Optical Modules for Passive Optical Networks
First Named Inventor/Applicant Name:	Alexander I Soto
Customer Number:	93749
Filer:	Alexander Ivan Soto
Filer Authorized By:	
Attorney Docket Number:	UBI-005B
Receipt Date:	11-JAN-2011
Filing Date:	
Time Stamp:	20:30:23
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment		no			
File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	NPL Documents	NPL_modiano-1-1999.pdf	630197	no	6
			40adb355f07e97b7a69fae6ae79c152981df583		
Warnings:					
Information:					

2	NPL Documents	NPL_mauger.pdf	194208	no	6
			538646eebe992cc858bfac8a36bffdac21a0af3		
Warnings:					
Information:					
3	NPL Documents	NPL_modiano-2-1999.pdf	643076	no	8
			92bd9c166bf1c37c46bdd70cd5e244906a8202cd		
Warnings:					
Information:					
4	NPL Documents	NPL_rawson.pdf	394101	no	6
			7d5854a9b7f791cdf6807f0e179ed259a4f9ff6f		
Warnings:					
Information:					
5	NPL Documents	NPL_radovanovic.pdf	1199413	no	12
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Warnings:					
Information:					
6	NPL Documents	NPL_chiang.pdf	2014373	no	16
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Warnings:					
Information:					
7	NPL Documents	NPL_modiano-2000.pdf	746405	no	9
			034e38099cf0faec6fa3233c8b87f87f87089c6ed		
Warnings:					
Information:					
8	NPL Documents	NPL_sachs.pdf	1301158	no	12
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Warnings:					
Information:					
9	Information Disclosure Statement (IDS) Filed (SB/08)	IDS_UBI-005B.pdf	613750	no	6
			0c27b61f0492a67d1bda3c6598c9cfceb88b75b		
Warnings:					
Information:					
Total Files Size (in bytes):			7736681		

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.

UTILITY PATENT APPLICATION TRANSMITTAL (Only for new nonprovisional applications under 37 CFR 1.53(b))		Attorney Docket No. UBI-005B
		First Inventor Soto, Alexander I.
		Title System and Method for Pluggable Opt
		Express Mail Label No.

APPLICATION ELEMENTS See MPEP chapter 600 concerning utility patent application contents. 1. ☐ Fee Transmittal Form (e.g., PTO/SB/17) 2. ☒ Applicant claims small entity status. See 37 CFR 1.27. 3. ☒ Specification [Total Pages <u>34</u>] Both the claims and abstract must start on a new page (For information on the preferred arrangement, see MPEP 608.01(a)) 4. ☒ Drawing(s) (35 U.S.C. 113) [Total Sheets <u>14</u>] 5. Oath or Declaration [Total Sheets _____] a. ☒ Newly executed (original or copy) b. ☐ A copy from a prior application (37 CFR 1.63(d)) (for continuation/divisional with Box 18 completed) i. ☐ DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) name in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b). 6. ☒ Application Data Sheet. See 37 CFR 1.76 7. ☐ CD-ROM or CD-R in duplicate, large table or Computer Program (Appendix) ☐ Landscape Table on CD 8. Nucleotide and/or Amino Acid Sequence Submission (if applicable, items a. – c. are required) a. ☐ Computer Readable Form (CRF) b. ☐ Specification Sequence Listing on: i. ☐ CD-ROM or CD-R (2 copies); or ii. ☐ Paper c. ☐ Statements verifying identity of above copies	ADDRESS TO: Commissioner for Patents P.O. Box 1450 Alexandria VA 22313-1450 ACCOMPANYING APPLICATION PARTS 9. ☐ Assignment Papers (cover sheet & document(s)) Name of Assignee _____ 10. ☐ 37 CFR 3.73(b) Statement ☐ Power of Attorney (when there is an assignee) 11. ☐ English Translation Document (if applicable) 12. ☒ Information Disclosure Statement (PTO/SB/08 or PTO-1449) ☒ Copies of citations attached 13. ☐ Preliminary Amendment 14. ☐ Return Receipt Postcard (MPEP 503) (Should be specifically itemized) 15. ☐ Certified Copy of Priority Document(s) (if foreign priority is claimed) 16. ☐ Nonpublication Request under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent. 17. ☐ Other: _____
---	--

18. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in the first sentence of the specification following the title, or in an Application Data Sheet under 37 CFR 1.76:			
☒ Continuation	☐ Divisional	☐ Continuation-in-part (CIP)	of prior application No.: <u>10/886,514</u>
Prior application information: Examiner <u>Li, Shi K.</u> Art Unit: <u>2613</u>			

19. CORRESPONDENCE ADDRESS			
☒ The address associated with Customer Number:		93749	OR ☐ Correspondence address below
Name			
Address			
City	State	Zip Code	
Country	Telephone	Email	
Signature	/Alexander Soto/		Date Dec. 30, 2010
Name (Print/Type)	Alexander Soto		Registration No. (Attorney/Agent)

This collection of information is required by 37 CFR 1.53(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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

Title of Invention	System and Method for Pluggable Optical Modules for Passive Optical Networks
As the below named inventor(s), I/we declare that: This declaration is directed to: ☒ The attached application, or ☐ United States application or PCT international application number _____ filed on _____ ☐ As amended on _____ (if applicable); I/we believe that I/we am/are the original and first inventor(s) of the subject matter which is claimed and for which a patent is sought; I/we have reviewed and understand the contents of the above-identified application, including the claims, as amended by any amendment specifically referred to above; I/we acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me/us to be material to patentability as defined in 37 CFR 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. WARNING: Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available. All statements made herein of my/our own knowledge are true, all statements made herein 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 are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001, and may jeopardize the validity of the application or any patent issuing thereon.	
FULL NAME OF INVENTOR(S)	
Inventor one: <u>Alexander I. Soto</u> Date: <u>December 30, 2010</u>	
Signature: <u>/Alexander Soto/</u> Citizen of: <u>USA</u>	
Inventor two: <u>Walter G. Soto</u> Date: <u>December 30, 2010</u>	
Signature: <u>/Walter Soto/</u> Citizen of: <u>USA</u>	
☐ Additional inventors or a legal representative are being named on _____ additional form(s) attached hereto.	

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	UBi-005B
		Application Number	
Title of Invention	System and Method for Pluggable Optical Modules for Passive Optical Networks		
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	
	Alexander	I	Soto		
Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service					
City	San Diego	State/Province	CA	Country of Residence i	US
Citizenship under 37 CFR 1.41(b) i					
Mailing Address of Applicant:					
Address 1	7673 Hazard Center Dr				
Address 2					
City	San Diego	State/Province	CA		
Postal Code	92108	Country i	US		
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	
	Walter	G	Soto		
Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service					
City	San Clemente	State/Province	CA	Country of Residence i	US
Citizenship under 37 CFR 1.41(b) i					
Mailing Address of Applicant:					
Address 1	2020 Costero Hermoso				
Address 2					
City	San Clemente	State/Province	CA		
Postal Code	92673	Country i	US		
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button.					Add

Correspondence Information:

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

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

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	UBi-005B
		Application Number	
Title of Invention	System and Method for Pluggable Optical Modules for Passive Optical Networks		
Customer Number	93749		
Email Address	alexander.i.soto@gmail.com	Add Email	Remove Email

Application Information:

Title of the Invention	System and Method for Pluggable Optical Modules for Passive Optical Networks		
Attorney Docket Number	UBi-005B	Small Entity Status Claimed	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Suggested Class (if any)		Sub Class (if any)	
Suggested Technology Center (if any)	2613		
Total Number of Drawing Sheets (if any)	14	Suggested Figure for Publication (if any)	8

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	93749		

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)
	Continuation of	10886514	2004-07-06
Prior Application Status	Expired	Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
10886514	non provisional of	60485072	2003-07-03

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	UBi-005B
		Application Number	
Title of Invention	System and Method for Pluggable Optical Modules for Passive Optical Networks		
Prior Application Status	Expired	Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
10886514	non provisional of	60515836	2003-10-30
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
			☒ 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
If the Assignee is an Organization check here. ☐				
Prefix	Given Name	Middle Name	Family Name	Suffix
Mailing Address Information:				
Address 1				
Address 2				
City		State/Province		
Country ⁱ		Postal Code		
Phone Number		Fax Number		
Email Address				
Additional Assignee Data may be generated within this form by selecting the Add button.				Add

Signature:

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	/Alexander I Soto/		Date (YYYY-MM-DD)	2010-12-10
First Name	Alexander	Last Name	Soto	Registration Number

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	UBi-005B
		Application Number	
Title of Invention	System and Method for Pluggable Optical Modules for Passive Optical Networks		

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.

Electronic Patent Application Fee Transmittal				
Application Number:				
Filing Date:				
Title of Invention:		System and Method for Pluggable Optical Modules for Passive Optical Networks		
First Named Inventor/Applicant Name:		Alexander Soto		
Filer:		Alexander Ivan Soto		
Attorney Docket Number:		UBI-005B		
Filed as Small Entity				
Utility under 35 USC 111(a) Filing Fees				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Utility filing Fee (Electronic filing)	4011	1	82	82
Utility Search Fee	2111	1	270	270
Utility Examination Fee	2311	1	110	110
Pages:				
Claims:				
Claims in excess of 20	2202	44	26	1144
Independent claims in excess of 3	2201	1	110	110
Miscellaneous-Filing:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				1716

Electronic Acknowledgement Receipt	
EFS ID:	9145644
Application Number:	12982872
International Application Number:	
Confirmation Number:	9206
Title of Invention:	System and Method for Pluggable Optical Modules for Passive Optical Networks
First Named Inventor/Applicant Name:	Alexander Soto
Customer Number:	93749
Filer:	Alexander Ivan Soto
Filer Authorized By:	
Attorney Docket Number:	UBI-005B
Receipt Date:	30-DEC-2010
Filing Date:	
Time Stamp:	23:56:56
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Credit Card
Payment was successfully received in RAM	\$ 1716
RAM confirmation Number	5439
Deposit Account	
Authorized User	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
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1	Specification	specification-UBI-005B.pdf	1086695	no	20
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Warnings:					
Information:					
2	Abstract	abstract-UBI-005B.pdf	14863	no	1
			3d1f86cd3b3e10ff6b64af4fb56ab4d93400902e2		
Warnings:					
Information:					
3	Drawings-only black and white line drawings	drawings-UBI-005B.pdf	473706	no	14
			a5434984abe216cd73d7f78d62d67a1d89cc94b		
Warnings:					
Information:					
4	Claims	claims_UBI-005B.pdf	82433	no	17
			0b44caa9cbfafcc1f47dd4435f26ffcd774d0723		
Warnings:					
Information:					
5	Transmittal of New Application	Transmittal-UBI-005B.pdf	162852	no	1
			d174c8516dd44766bdcef53312b449e4c343ef7		
Warnings:					
Information:					
6	Oath or Declaration filed	Declaration-UBI-005B.pdf	96541	no	1
			97537ea5fdbab37575a7515a2c82e9653ea2b397		
Warnings:					
Information:					
7	Application Data Sheet	ADS_UBI-005B.pdf	1031664	no	5
			39b5bb36aeb78221371e05192f8221be9916c3a6		
Warnings:					
Information:					
8	Fee Worksheet (PTO-875)	fee-info.pdf	37818	no	2
			15324f74af4426818b8bb6a3a44e5d57de5a5d7a		
Warnings:					
Information:					
Total Files Size (in bytes):			2986572		

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.

**COMMUNICATION SYSTEM AND METHOD FOR AN OPTICAL LOCAL
AREA NETWORK**

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No.
5 60/485,072 filed July 3, 2003, incorporated herein by reference, and U.S. Provisional
Application No. 60/515,836 filed October 30, 2003, incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The present invention relates to optical fiber networks.

BACKGROUND OF THE INVENTION

A local-area network (LAN) is a computer network that spans a relatively small area.
Most LANs are confined to a single building or group of buildings. However, one LAN
can be connected to other LANs over any distance often spanning an area greater than
15 either LAN via telephone lines, coaxial cable, optical fiber, free-space optics and radio
waves. A system of LANs connected in this way is commonly referred to as a wide-area
network (WAN).

SUMMARY OF THE INVENTION

20 [0003] In general, in one aspect, the invention includes a method for broadcasting
data including receiving an incoming optical signal at a first port of a plurality of ports;
converting the received incoming optical signal to an electrical signal; processing the
electrical signal; converting the processed electrical signal to a broadcast optical signal;
and coupling the broadcast optical signal to each of the plurality of ports.

25 [0004] Aspects of the invention may include one or more of the following
features. Processing the electrical signal includes coupling the electrical signal to a
device that processes the electrical signal according to an OSI layer-2 protocol.
Processing the electrical signal includes coupling the electrical signal to a device that
processes the electrical signal according to an OSI layer-3 protocol. The method further
30 includes converting an electrical client signal to the incoming optical signal. The method
further includes adapting the electrical client signal from a signal conforming to an OSI

layer-2 protocol. The OSI layer-2 protocol includes a media access control protocol. The media access control protocol is Ethernet or Fibre Channel. The method further includes transmitting the incoming optical signal from a network client adapter to one of the plurality of ports over an optical distribution fabric. The method further includes
5 transmitting the broadcast optical signal from one of the plurality of ports over an optical distribution fabric; and receiving the broadcast optical signal at network client adapters in a plurality of clients. The method further includes converting the received broadcast optical signal to a second electrical signal in at least one of the clients. The method further includes selecting a frame within the second electrical signal associated with the
10 network client adapter and adapting data in the selected frame for transmission over a network interface.

[0005] In general, in another aspect, the invention includes an apparatus including a plurality of ports; a passive optical coupler coupled to each of the plurality of ports; an optical-electrical converter in optical communication with the passive optical coupler;
15 and a control module in electrical communication with the optical-electrical converter for scheduling slots for incoming and outgoing signals over the plurality of ports.

[0006] Aspects of the invention may include one or more of the following features. The control module is operable to schedule a slot for receiving a signal over one of the plurality of ports and to schedule a slot for broadcasting a signal over each of
20 the plurality of ports. The apparatus includes only a single optical-electrical converter in optical communication with the passive optical coupler. The control module is coupled to a device that is operable to process an electrical signal provided by the optical-electrical converter according to an OSI layer-2 protocol. The control module is coupled to a device that is operable to process an electrical signal provided by the optical-electrical
25 converter according to an OSI layer-3 protocol.

[0007] In general, in another aspect, the invention includes an optical local area network including a plurality of optical waveguides; a network manager that includes an optical-electrical converter in optical communication with the plurality of optical waveguides; and a control module in electrical communication with the optical-electrical
30 converter for scheduling slots for incoming and outgoing signals transmitted over the plurality of optical waveguides; and a plurality of network client adapters coupled to the

plurality of optical waveguides, each network client adapter including an optical-electrical converter for processing transmitted and received optical signals at a client.

[0008] Aspects of the invention may include one or more of the following features. The optical local area network further includes a passive optical coupler coupled to each of the plurality of optical waveguides. The network manager further includes a passive optical coupler coupled to each of the plurality of optical waveguides. The control module is operable to schedule a slot for receiving a signal over one of the plurality of optical waveguides and to schedule a slot for broadcasting a signal over each of the plurality of optical waveguides. The control module is operable to dynamically schedule a slot for receiving a signal over one of the plurality of optical waveguides in response to a message from one of the network client adapters. The control module is operable to determine a response delay between the optical-electrical converter and one of the network client adapters. The control module is coupled to a device that is operable to process an electrical signal provided by the optical-electrical converter according to an OSI layer-2 protocol. The control module is coupled to a device that is operable to process an electrical signal provided by the optical-electrical converter according to an OSI layer-3 protocol. Each of the network client adapters is operable to convert an electrical client signal to an optical signal for transmission over one of the optical waveguides. Each of the network client adapters is operable to adapt the client signal from a signal conforming to an OSI layer-2 protocol. The OSI layer-2 protocol includes a media access control protocol. The media access control protocol used by a network client adapter is Ethernet or Fibre Channel. Each of the network client adapters is operable to convert a received optical signal to an electrical signal. Each network client adapter is operable to select a frame within the electrical signal associated with the network client adapter. The optical local area network further includes a client that includes a network interface card, the network interface card including one of the network client adapters. The client is selected from the group consisting of a workstation, a personal computer, a disk storage array, a server, a switch, and a router.

[0009] In general, in another aspect, the invention includes an optical local area network including a passive optical distribution fabric interconnecting a plurality of nodes including a first node and a plurality of remaining nodes; a hub that includes the

first node and a control module; and a client network adapter coupled to each of the remaining nodes for responding to the control module; wherein the control module controls timing for each of the client network adapters to transmit signals over the passive optical distribution fabric and distribution of signals to each of the nodes.

5 [0010] Aspects of the invention may include one or more of the following features. The control module is operable to schedule a slot for receiving a signal from one of the remaining nodes and to schedule a slot for broadcasting a signal to each of the remaining nodes. The control module is operable to dynamically schedule a slot for receiving a signal from one of the remaining nodes in response to a message from one of the network client adapters. The control module is operable to determine a response delay between the hub and one of the network client adapters. The control module is coupled to a device that is operable to process signals according to an OSI layer-2 protocol. The control module is coupled to a device that is operable to process signals according to an OSI layer-3 protocol. Each of the network client adapters is operable to convert an electrical signal to an optical signal for transmission over the passive optical transmission fabric. Each of the network client adapters is operable to adapt a signal conforming to an OSI layer-2 protocol. The OSI layer-2 protocol includes a media access control protocol. The media access control protocol used by a network client adapter is Ethernet or Fibre Channel. Each of the network client adapters is operable to convert a received optical signal to an electrical signal. Each network client adapter is operable to select a frame within the electrical signal associated with the network client adapter. The optical local area network further includes a client that includes a network interface card, the network interface card including one of the network client adapters. The client is selected from the group consisting of a workstation, a personal computer, a disk storage array, a server, a switch, and a router.

25 [0011] In general, in another aspect, the invention includes an optical local area network including a hub; a plurality of external nodes interconnected by a passive optical distribution fabric, wherein the external nodes are located external to the hub, and the hub is operable to control traffic across all nodes; adaptors at each external node responsive to hub instruction; and an interface coupled to the hub coupling signals received from any individual external node for distribution to all external nodes.

[0012] Aspects of the invention may include one or more of the following features. The hub includes an internal node coupled to the passive optical distribution fabric. The hub is operable to measure response delay between the hub and external nodes. The hub is operable to allocate slots for external nodes dynamically. Slot
5 allocations are made to guarantee external nodes have a minimum bandwidth. The optical local area network further includes splitters coupled between the hub and external nodes. Traffic arriving at one or more external nodes includes Ethernet traffic. Traffic arriving at one or more external nodes includes Fibre channel traffic. The hub includes an optical module. At least one of the external nodes is located within an optical module
10 external to the hub.

[0013] Implementations of the invention may include one or more of the following advantages. A network manager in an optical local area network can provide switching functions of a hub, a switch or a router. A switch configuration in which network managers are aggregated enables a high performance network in a compact
15 apparatus. Connectivity of network managers and network client adapters to existing conventional routers and switches using industry standard form factor optical modules enables a high performance network upgrade with minimal new equipment. A network client switch can support multiple physical layer ports without necessarily requiring a Layer-2 MAC or switching elements and the associated routing tables and packet
20 memory. The number of optical transceivers and switching elements used to sustain the same number of computing nodes in a LAN via a point-to-multipoint optically coupled network configuration is reduced, thus saving the majority of expense described above.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] FIG. 1 is a block diagram of an optical local area network.
[0015] FIGS. 2, 3A and 3B are schematic diagrams showing frame structures.
[0016] FIG. 4 is a flowchart for a network operating process.
[0017] FIG. 5 is a flowchart for a response delay process.
[0018] FIGS. 6A – 6C are diagrams of optical local area networks utilizing a hub
30 configuration.

[0019] FIGS. 7A-7D are diagrams of optical local area networks utilizing a switch configuration.

[0020] FIG. 8 is a diagram of an optical local area network.

[0021] FIGS. 9A and 9B are block diagrams of switches.

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DETAILED DESCRIPTION

[0022] Referring to **FIG. 1**, a high-level schematic of an optical local area network **50** includes a network manager (NM) **100** at the head end of a passive optical distribution fabric (ODF) **102**. The NM **100** acts as a central transmission point and an overall controlling device for the optical local area network **50**. On another end, the ODF **102** is terminated by a plurality of (in one implementation, generally similar) network client adapters (NCAs) **104A**, **104B**, **104C**. Herein the NCA **104A**, NCA **104B**, NCA **104C**, are also referred to collectively as NCAs **104**. Though three NCAs **104** are shown more or fewer NCAs may be included in the optical local area network **50**.

10 [0023] The NM **100** transmits/receives data to/from the NCAs **104** in the form of modulated optical light signals of known wavelength through the ODF **102**. The transmission mode of the data sent over the ODF **102** may be continuous, burst or both burst and continuous modes. Both NM **100** and NCAs **104** may transmit light signals having a same wavelength. In one implementation, the light signals are polarized and the polarization of light transmitted by the NM **100** is perpendicular to the polarization of the light transmitted by the NCAs **104**. Alternatively, the transmissions can be made in accordance with a time-division multiplexing scheme or similar protocol.

20 [0024] In another implementation, bi-directional wavelength-division multiplexing (WDM) may be used. Bi-directional WDM is herein defined as any technique by which two optical signals having different wavelengths may be simultaneously transmitted bi-directionally with one wavelength used in each direction over a single fiber. In yet another implementation, bi-directional dense wavelength-division multiplexing (DWDM) may be used. Bi-directional DWDM is herein defined as any technique by which more than two optical signals having different wavelengths may be simultaneously transmitted bi-directionally with more than one wavelength used in each direction over a single fiber with each wavelength unique to a direction. For

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example, if bi-directional WDM is used, the NM 100 may transmit data to an NCA 104A, 104B, 104C utilizing a first wavelength of modulated light conveyed via a fiber 105A, 105B, 105C, respectively, in the ODF 102 and, similarly, the NCAs 104A, 104B, 104C may transmit data via the same fiber 105A, 105B, 105C, respectively, in the ODF 102 to the NM 100 utilizing a second wavelength of modulated light. Because only a single fiber is used (e.g., between the NM 100 and each respective NCA 104), this type of transmission system is commonly referred to as a bi-directional transmission system. Although the optical local area network 50 illustrated in FIG. 1 includes an NM 100 in communication with a plurality of NCAs 104 using a plurality of fibers, other implementations of optical local area networks 50 may be used. In some implementations, the NCAs 104 are generally similar. In other implementations, the NCAs 104 may differ in one or more aspects.

[0025] The NM 100 includes network management communication logic and memory (NM-CLM) 106 block, a network management optical interface (NM Optical Interface) 108 block and an optical distribution fabric interface (ODF Interface) 110 block. The NM-CLM 106 includes a network manager engine (NM Engine) 112 block, a transmit framer (Tx Framer) 114 block and a receive framer (Rx Framer) 115 block.

[0026] The NM Engine 112 is a control module that performs various processing and scheduling functions of an NM 100. The Tx Framer 114 frames outgoing data from the NM Engine 112 in accordance with a framing protocol that is in-use. The Rx Framer 115 receives incoming frames and recovers appropriate data and messages to pass on to the NM Engine 112. The NM Optical Interface 108 is controlled by the NM-CLM 106 using, for example, bus 109. The NM Optical Interface 108 converts electrical signals carrying data from the Tx Framer 114 to optical signals, for example, by modulating a laser (not shown) included in the NM Optical Interface 108 and transmitting the laser output to the ODF interface 110. The NM Optical Interface 108 also receives optical signals from the ODF interface 110 and converts the optical signals to electrical signals carrying data that is then transferred to the Rx Framer 115. Thus, the NM Optical Interface 108 functions as an “optical-electrical converter” that can convert a signal from an optical signal to electrical signal or from an electrical signal to an optical signal.

[0027] The ODF Interface **110** includes an optical splitter **116** and a plurality of ODF Ports **117A**, **117B**, **117C**, etc. For example, the optical splitter **116** can be a $1:n$ splitter (where n is at least 2) that splits light coming from the NM Optical Interface **108** into n portions of light coupled into n optical ports, respectively. The optical ports (e.g., ODF Ports **117**) can be coupled to one or more optical waveguides. In one implementation, each ODF Port **117** is coupled to an optical waveguide. The optical waveguides can be, for example, single mode or multimode fibers that guide received/transmitted light to/from respective ODF Ports **117A**, **117B**, **117C**, etc. The $1:n$ splitter (or equivalently, $n:1$ combiner) also directs light from any of the ODF Ports **117A**, **117B**, **117C**, etc. received over one of the optical waveguides to the NM Optical Interface **108**. ODF Ports **117A**, **117B**, **117C**, etc. include optical fiber connector sockets (e.g., SC, LC, FC, ST, or MU connector sockets) for coupling to the optical waveguides.

[0028] The ODF **102** can include any of a variety of passive optical components including optical fibers (e.g., single mode fibers, multimode fibers), optical connectors, fiber splices, passive branching components (e.g., passive splitters) and passive optical attenuators.

[0029] In this implementation, the NCAs **104** each include a network client communication logic and memory (NC-CLM) **120** block, a network client optical interface (NC Optical Interface) **122** block and an ODF port **124**. The NC-CLM **120** block includes an Adaptation Unit **126** block, a network client engine (NC Engine) **128** block, a transmit framer (Framer) **130** block and a receiver framer (Deframer) **131** block. The NC Engine **128** is a control module that performs various functions associated with an NCA **104**, such as responding to messages from the NM **100**. The Framer **130** frames outgoing data from the NC Engine **128** in accordance with a framing protocol that is in-use. The Deframer **131** receives incoming frames and recovers appropriate data and messages to pass on to the NC Engine **128**. The adaptation unit **126** receives and transmits data and messages in the form of frames, packets or cells according to one or more external protocol(s). External controls, data and messages can be received using the network interface **136**. The responsibilities of the adaptation unit **126** may include providing buffering, data and/or message filtering and translation between the external protocol(s) and the protocol of the optical local area network **50**. The adaptation Unit

126 includes egress queue 132 block and ingress queue 133 block. Egress and ingress queues 132, 133 can be of the form of memory and are used for buffering receive and transmit data and messages, respectively. The adaptation unit 126 can filter out or drop data and/or messages that are not intended to egress through its network interface 136.

5 Filtering can be based on the destination address of the data and/or messages according to the external protocol in-use. Additionally, the adaptation unit 126 can filter out or drop data and/or messages that are not intended to ingress through its network interface 136. Filtering can be based on equal values for the source and destination addresses of the data and/or messages according to the external protocol in-use. The NC Optical Interface 122 is controlled by the NC-CLM 128 using bus 134. The NC Optical Interface 122 converts
10 electrical signals carrying data from the Framer 130 block to optical signals, for example, by modulating a laser (not shown) included in the NC Optical Interface 122 and transmitting the laser output to the ODF port 124. The NC Optical Interface 122 also receives optical signals from the ODF port 124 and converts the optical signals to
15 electrical signals carrying data that is then transferred to the Deframer 131 block. The ODF port 124 includes an optical fiber connector socket (e.g., an SC, LC, FC ST, or MU connector socket).

[0030] The NCAs 104 can be coupled to data link layer devices (not shown) or physical layer devices (not shown) using network interface 136. The data link layer
20 devices and physical layer devices are network devices that operate at a Layer-2 or Layer-1 respectively, according to the Open Systems Interconnect (OSI) 7-layer reference model. Furthermore, these network devices may comply with industry standard specifications such as IEEE 802.3 and Fibre Channel (incorporated herein by reference). Consequently, the network interface 136 may be an MII, GMII, XGMII, XAUI or SPI
25 type interface. Other Layer-2 and Layer-1 type interface specifications may also be used.

[0031] The optical local area network 50 transfers data between an NM 100 and the NCAs 104 in the form of downstream frames (NM 100 to NCAs 104) and upstream “virtual frames” (NCAs 100 to NM 104). Downstream frames from the NM 100 are transmitted into the ODF 102 in an essentially continuous sequence of constant period
30 frames. In one implementation, downstream frames have a period of 125 μ s, and transfer data downstream at a rate of approximately 10 Gb/s, although other periods and rates

may be used. The ODF Interface **110** and potentially the ODF **102** split the downstream transmissions passively so that all NCAs **104** receive the frames in a generally broadcast manner. In the upstream direction, separate transmissions from the plurality of NCAs **104** are transmitted as burst transmissions or in slots which are combined in a virtual frame so that the separate burst transmissions do not collide when they arrive at the NM **100**. In one implementation, the virtual upstream frames have essentially the same period as the downstream frames, and upstream data transmissions are transmitted at a rate approximately equal to the downstream rate. Alternatively, different upstream and downstream rates may be used.

[0032] **FIG. 2** is a schematic timing and framing diagram, showing overall structure of a downstream frame **200**, and a virtual upstream frame **202** in an implementation of a framing protocol. Referring now to **FIG.s 1** and **2**, each downstream frame **200** includes a header **204** and a payload section **206**. The downstream header **204** includes a downstream synchronization (DS Sync) **208** section, a station management **210** section, two sections containing the number of NCAs **104** in communication with the NM **100** (# of NCAs) **212**, **214** and an upstream slot allocation (US slot allocation) **216** section. The DS Sync **208** section includes a consecutive sequence of bits that enables receiving NCAs **104** to identify a beginning of the downstream frame **200** and thus acts as starting marker for frame timing throughout the optical local area network **50**. The number of NCAs **104** in communication with the NM is sent twice **212**, **214** to ensure correct interpretation of the US slot allocation section **216**. The order of downstream header sections **210**, **212**, **214**, **216** after a DS Sync **208** may differ in other implementations.

[0033] During each network period **218** defined by respective adjacent downstream headers, each NCA **104** is able to send upstream data. The virtual upstream frame **202** is partitioned into slots, where a "slot" corresponds to a fixed number of bits or a fixed length of time within a virtual frame. For each network period **218**, the NM **100** allocates each NCA **104** respective slots within which an NCA is able to transmit data upstream. Each slot allocation includes a start slot number and end slot number (also referred to as start time and end time), relative to the starting marker defined by a DS Sync **208** from the next network period after an NCA **104** receives a slot allocation. In

alternative implementations, a start slot number and a length of time during which a specific NCA 104 is permitted to transmit may be sent instead of a start slot number and an end slot number. Slot allocation start and end numbers are allocated within the virtual upstream frame so that slot allocations do not overlap, ensuring that there are no collisions of data from different NCAs 104 at the NM 100. The allocations can be determined by the NM Engine 112 based on total upstream bandwidth requests and can be communicated to NCAs 104 in the downstream frame US slot allocation 216 section. The US slot allocation 216 section includes start and end slot numbers pertaining to and identified to specific NCAs 104 (as shown in 220 and 222). Slot allocations assigned to NCAs 104 can be dynamic and may be changed from network period to network period.

[0034] The upstream frame 224 includes header 226 and payload 228 sections. The header 226 includes a preamble 230 section, a frame delimiter (Delimiter) 232 section and a station management 234 section. The preamble 230 section includes a consecutive sequence of bits designed to aid an NM 100 in synchronizing to the bit clock of a respective transmitting NCA 104. The Delimiter 232 includes a consecutive sequence of bits designed to aid an NM 100 in synchronizing to and recognizing the beginning of an upstream frame 224.

[0035] Each downstream frame 200 and upstream frame 224 includes a payload section 206, 228 respectively, in which data to and from NCAs 104 (from the network interface 136) are transferred. FIG. 3A is a schematic showing the payload in downstream and upstream framing, showing that the payload of both upstream and downstream may contain a single adaptation data unit (ADU) 300. ADUs 300 are output units of data from an adaptation unit 126, where the adaptation unit 126 has processed data received from the network interface 136 for transfer across the optical local network 50. For example, in one implementation the adaptation unit 126 receives Ethernet media access control frames (MAC frames) via a GMII interface (as an implementation for the network interface 136) and removes the MAC frame's preamble and start of frame delimiter (SFD) fields with the remaining fields of the MAC frame encapsulated in an ADU 300. Additionally, in one implementation the adaptation unit 126 receives Fibre Channel (FC) FC-2 frames through a serial interface (as an implementation of the

network interface 136) and removes the FC-2 frame's start of frame and end of frame fields with the remaining fields of the FC-2 frame encapsulated in an ADU 300.

[0036] In another example, the adaptation unit 126 can receive IEEE 802.3 MAC frames via a GMII interface and form an ADU 300 with the entire MAC frame included (i.e., encapsulate the entire MAC frame). In yet another example, the adaptation unit 126 can receive FC-2 frames through a serial interface (as an implementation for the network interface 136) and form an ADU 300 with the entire FC-2 frame included (i.e., encapsulate the entire FC-2 frame).

[0037] In one implementation, the payload 204, 232 of downstream frames 200 and upstream frames 224 may include multiple consecutive sub-frames. Referring to FIG.s 1 and 3B, a sub-frame includes a sub-frame header 302 section and a sub-frame payload 304 section. A sub-frame header 302 section includes a payload length indicator (PLI) 308 and cyclic redundancy check (CRC) 310 section that covers the PLI 308. CRC sections, although not shown, may be used in the downstream 200 and upstream 224 frames as well. The sub-frame payload 304 section includes a type 312 section, a CRC 314 that relates to the type 312 section, a payload data unit (PDU) 316 and optionally a CRC 318 that relates to the PDU 316. The PLI 308 gives an indication of the length, e.g., in bits, of the sub-frame payload 304 section immediately following the sub-frame header 302. The type 312 section gives an indication of the type of data in the PDU 316. An adaptation unit 126 may receive data from a mixture of protocols essentially simultaneously (as described below) and the use of sub-frames allows the data to be transferred across the network ensuring quality of service or class of service. An adaptation unit 126 uses sub-frames by placing received data in the PDU 316, indicating the type of data received in the type 312 section and entering the length of the sub-frame payload 304 in the PLI 308 section.

[0038] The optical local area network 50 operates according to an exemplary process illustrated in FIG. 4. Referring now to FIG.s 1 and 4, after an NM 100 is powered on 400, the NM 100 sends out 402 one or more message(s) requesting new NCAs 104 (NCAs 104 that the NM 100 is unaware of) to identity themselves by reporting to the NM 100 with their respective serial number. The NM 100 also sends out 402 network parameters including initial NCA transmit power levels using, for example,

a station management message(s). The NCAs 104 respond using slot allocation(s) given by the NM 100 for new NCAs 104 to respond. After successfully receiving new NCA serial numbers, the NM 100 assigns each new NCA 104 a network identification number (NC-ID) and requests 404 the new NCA 104 to adjust its transmitting power level. In one implementation, the NM 100 sends these requests in a station management message. The respective new NCAs 104 use the assigned NC-ID to interpret specific messages of concern (i.e., addressed) to a given NCA 104. The NM 100 initiates 406 a response delay process to determine the delay in responses between the new NCA and the NM 100. After performing 419 the response delay process, the NM 100 enters normal operation in which network data is transmitted and received 408 across the optical local area network 50.

[0039] When an NCA 104 is powered on 410, the NCA 104 attempts to synchronize 412 to downstream frames by searching for the DS Sync 208. After successful downstream synchronization, the NCA 104 interprets 414 network parameters received via downstream station management messages 404, adjusts its initial transmit power level and awaits instructions (e.g., a message) for new NCAs 104. The instructions include a slot allocation for new NCAs 104 to respond 416 to the NM 100 with the NCA's 104 serial number. Once the NCA 104 has sent its serial number the NCA 104 is then assigned an NC-ID by the NM 100. The NCA 104 then enters a waiting loop (e.g., for a station management message from the NM 100 to adjust its transmit power level). In response to a request to set transmit power level, the NCA 104 adjusts the transmit power level 418. The NCA 104 then enters a waiting loop again (e.g., until receipt of a message from the NM 100 to initiate a response delay process). Upon receipt of an instruction to begin a response delay process, the NCA 104 can, in cooperation with the NM 100, determine the delay between the respective network elements (not shown as part of the process flow). The details of the response delay process are described in greater detail below. After the NCA 104 and NM 100 complete the response delay process, the NCA 104 may adjust 420 its alignment with the network period to account for downstream and upstream transmission delay. The NCA 104 then enters its normal operation state in which network data is received and transmitted 422.

[0040] **FIG. 5** shows one implementation for executing a response delay process **500**. The response delay process **500**, is a process to determine the delay in NM downstream transmission to NM upstream reception of a message or network data transmission. Referring now to **FIG.s 1, 2 and 5**, the NM **100** starts **501** the delay process with a new NCA **104** or with an NCA **104** that may cause upstream transmission collisions. The NM **100** assigns one or more slot(s) to the target NCA **104** (i.e., the new NCA or one NCA that may cause a collision in upstream communication) to respond with a response delay message. The NM **100** generates **502** a silence period in the upstream virtual frame **202** (e.g., by not assigning or granting any slots for that period) around the slot(s) assigned to the target NCA **104**. The silence period ensures no upstream collisions will occur. The NM **100** sends **504** a message to the NCA **104** to respond with a response delay message and informs the NCA **104** of its slot(s) assignment to respond. Thereafter, the NCA **104** responds **506** to the NM **100** at the appropriate slot time. The NM **100** receives the NCA **104** response delay message and calculates **508** the transmission delay. In one implementation, the NM **100** transmits **510** the result of the response delay calculation to the NCA **104** and the NCA **104** aligns **512** itself to the proper network period.

[0041] The NM **100** may assign, schedule or grant slot allocations in a number of ways (e.g. according to fixed time-division multiplex or statistical time-division multiplex schemes). In one implementation the slot allocations are scheduled to give the NCs **104** a guaranteed minimum upstream transfer rate. The rate may be determined by dividing the maximum upstream data rate by the number of NCAs **104**. In another implementation, the NM **100** receives status information about the NCAs **104** egress **132** and ingress **133** queue status. The NM **100** can schedule slot allocations that best minimize the depth of the egress **132** and ingress **133** queues to minimize transmission delays ensuring quality of service (QOS) or class of service (COS).

[0042] **FIG.s 6A – 6C, 7A – 7C and 8** are illustrations of implementations of the optical local area network **50**. In one implementation shown in **FIG. 6A**, an NM **100** may function in a hub configuration **600** networking clients including workstations **602**, personal computers (PC) **604** and Ethernet switches **618** together using the Ethernet protocol. The workstations **602** and PCs **604** are connected to the hub configuration **600**

with a network interface card (NIC) 606 containing an NCA 104 and a NIC controller 608. In one implementation of the NIC 606, the NIC controller 608 includes a GMII interface, an Ethernet MAC and a peripheral component interconnect (PCI) bus interface. The NCA 104 communicates to the NIC controller 608 through the GMII interface.

5 Ethernet switches 618 are connected to the hub configuration 600 with a network adaptor 621A containing an NCA 104. Ethernet switches 618 can be conventional Ethernet switches. In one implementation of the network adaptor 621A, the network interface 136 is a GMII interface.

[0043] In another implementation shown in FIG. 6B, the hub configuration 600
10 can network disk storage array devices 612, servers 614 and FC switches 619 together using the Fibre Channel (FC) protocol. This implementation may be described as a Storage Area Network (SAN). The disk storage array devices 612 and servers 614 are connected to the hub configuration 600 with a host bus adaptor (HBA) 607. In one implementation of HBA 607, the HBA controller 609 includes a serial interface, FC
15 controller and a PCI bus interface. FC switches 619 are connected to the hub configuration 600 with a network adaptor 621B containing an NCA 104. FC switches 619 can be conventional FC switches. In one implementation of the network adaptor 621B, the network interface 136 is a serial interface.

[0044] In yet another implementation of the optical local area network 50 shown
20 in FIG. 6C, the hub configuration 600 may network clients such as workstations 602, PCs 604, disk storage array devices 612, servers 614 and switches 618, 619 (FIG. 6B) using both Ethernet and FC protocols concurrently. NICs 606 can connect a particular client to the hub configuration 600 using the Ethernet protocol. HBAs 607 can connect a particular client to the hub configuration 600 using the FC protocol. For example,
25 workstations 602, PCs 604 and switches 618 can communicate with the hub configuration 600 using Ethernet protocol while disk storage array devices 612 and servers 614 can communicate with the hub configuration 600 using FC protocol. The ODF 102 (not shown) of the optical local area network 50 can include splitters 620. Hub configuration 600 can also connect to a switch 618 using an adaptor card 621A. Adaptor
30 card 621A includes an NCA 104 with a respective network interface 136 (e.g., GMII,

XAUI, Serial). Switch **618** may be, for example, a switch in a conventional Ethernet LAN **622**.

[0045] One or more NMs **100** can interface to a switching device (e.g., a Layer-2 switch or a Layer-3 switch) to process frames from the various NCAs **104** according to a communication protocol of the switching device. Referring to **FIG. 7A**, a switch configuration **704** includes multiple NMs **100A**, **100B**, **100C** in communication with a Layer-2 switch device **700** which is in further communication with an uplink port **702**. In alternative implementations, the Layer-2 switch device **700** may be in communication with a plurality of uplink ports (not shown). Though three NMs **100A**, **100B**, **100C** are shown more or fewer NMs **100** may be in communication with a Layer-2 switch device **700** included in the switch configuration **704**. Each NM **100A**, **100B**, **100C** includes an adaptation unit **706** in communication with a NM Engine (not shown). The adaptation unit **706** receives and transmits data and messages in the form of frames, packets or cells according to the Layer-2 switch device **700** via a switch interface **708**. Adaptation unit **706** can provide buffering, data and/or message filtering and translation between the protocol of the Layer-2 switch device **700** and the protocol of the optical local area network **50**. The adaptation unit **706** includes an egress queue block (not shown) and an ingress queue block (not shown). Egress and ingress queues can be of the form of memory and are used for buffering receive and transmit data and messages, respectively. In one implementation of the NMs **100A**, **100B**, **100C**, all upstream traffic received by an NM **100** is passed through the switch interface **708** to the Layer-2 switch device **700**. All downstream traffic transmitted by an NM **100** is received by the NM **100** through the switch interface **708**. In another implementation upstream traffic received by an NM **100** can be filtered based on destination address to either pass data and/or messages back to one or more NCAs **104** multiplexed in downstream traffic (e.g. hairpinning) or to the Layer-2 switch device **700** through the switch interface **708**. The fiber connections **105** form a first ODF for connecting NM **100A** with one or more NCAs. The fiber connections **710** form a second ODF for connecting NM **100B** with one or more NCAs. The fiber connections **712** form a third ODF for connecting NM **100C** with one or more NCAs.

[0046] In one implementation of an optical local area network **50** shown in **FIG. 7A**, the switch configuration **704** is used to network workstations **602**, PCs **604** and a Ethernet switch **618** together using the Ethernet protocol with appropriate NICs **606** as described above. The switch configuration **704** includes a Layer-2 switch (e.g., Layer-2 switch device **700**) that implements an Ethernet MAC and switching functions. The optical fibers **105**, **710**, **712** connecting the workstations **602**, PCs **604** and Ethernet switches **618** to the switch configuration **704** can be associated with different NMs **100A**, **100B**, **100C** depending on which fiber connections are used. The uplink port **702** of switch configuration **704** can connect to an Ethernet switch and/or router (not shown).

[0047] In another implementation of an optical local area network **50** shown in **FIG. 7B**, the switch configuration **704** is used to network one or more disk storage array devices **612**, servers **614** and FC-2 switches **619** using, for example, the FC protocol with appropriate HBAs **607** as described above. This implementation may also be described as a Storage Area Network (SAN). The switch configuration **704** includes a Layer-2 switch (e.g., Layer-2 switch device **700**) that implements an FC-2 controller and switching functions. The optical fibers **105**, **710**, **712** connecting the disk storage array devices **612**, servers **614** and FC-2 switch **619** to the switch configuration **704** can be associated with different NMs **100A**, **100B**, **100C** depending on which fiber connections are used. The uplink port **702** of switch configuration **704** may connect to an FC-2 switch and/or router (not shown). FC-2 switches **619** can be a conventional FC-2 switch.

[0048] In yet another implementation of an optical local area network **50** shown in **FIG. 7C**, a switch configuration **704** is used to network workstations **602**, PCs **604**, disk storage array devices **612**, servers **614** and other switches (e.g. an Ethernet switch **618**) together using, for example, both Ethernet and FC protocols concurrently in a manner described previously. The switch configuration **704** includes a Layer-2 switch (e.g. Layer-2 switch device **700**) that implements both an Ethernet MAC and FC-2 controller with switching functions. Layer-2 switch device **700** can be implemented by a packet processor or network processor. The optical fibers **105**, **710**, **712** connecting the workstations **602**, PCs **604**, disk storage array devices **612**, servers **614** and t switches to the switch configuration **704** can be associated with different NMs **100A**, **100B**, **100C**

depending on which fiber connections are used. The uplink port **702** of switch configuration **704** may connect to an Ethernet or FC-2 switch and/or router (not shown).

[0049] In yet another implementation of an optical local area network **50**, an implementation of switch configuration **705** containing an NM **100**, an adaptation unit **706** and an uplink port **702** is shown in **FIG. 7D**. Switch configuration **705** can be used to network workstations **602**, PCs **604** and other switches **618** in a manner described previously. The NM **100** is in communication with a Layer-2 switch device (not shown) through the uplink port **702** that is connected to a switch. The connection between uplink port **702** and switch **618** can be a physical layer connection **714** (e.g., 1000 BASE-SX, 1000 BASE-LX). Ethernet switch **618** can be a conventional Ethernet switch.

[0050] In some implementations of switch configurations **704**, **705** the uplink port **702** can be an NCA adaptor (not shown) similar to **621A**, **621B** wherein the network interface **136** and switch interface **708** are coupled using the same interface standard (e.g., XAUI, Serial, Parallel), thus enabling the uplink port **702** to connect to other hub configurations **600** and switch configurations **704** (**FIG.s 7A-7C**), **705** (**FIG. 7D**).

[0051] In another implementation of an optical local area network **50** shown in **FIG. 8**, NM **100** and NCA **104** may be implemented in optical modules. A network manager in an optical module (NM-OM) **800** is provided that, in one implementation, conforms to an industry standard form factor and includes an NM-CLM **803** that includes an adaptation unit **706** to transfer data into and out of a network interface (e.g., switch interface **708**). The NM-OM **800** also includes a NM Optical interface **108** and an ODF port **117A**. In one implementation, the optical module NM-OM **800** conforms to an industry standard Multi-source agreement (MSA) form factor (e.g., 300pin, XENPAK, X2, XPAK, XFP or SFP). A network client adaptor in an optical module (NC-OM) **802** can be provided that, in one implementation, also conforms to an industry standard form factor and includes an NCA **104**. For example, the optical module NC-OM may conform to an MSA form factor (e.g., 300pin, XENPAK, X2, XPAK, XFP or SFP).

[0052] The NM-OM **800** can connect to a conventional router **804** that has optical module ports **806** using the router's switch interface (e.g., XAUI or Serial). The NM-OM **800** is in optical communication with an optical splitter **810** that splits light among and collects light from workstations **602**, PCs **604**, disk storage array devices **612**, servers **614**

and switches using appropriate NICs 606 and/or NC-OM 802 as previously described. The Ethernet Layer-2/3 switch 808 may be of conventional design and include an uplink port, that in one implementation, conforms to an industry standard optical module form factor. The Ethernet Layer-2/3 switch 808 can communicate with the NM-OM 800 in router 804 by using an NC-OM 802 via network interface 136 (e.g., XAUI or Serial).

[0053] The Ethernet Layer-2/3 switch 808 is further detailed in FIG. 9A. In the Ethernet Layer-2/3 switch 808, an NC-OM 802 is in communication with a Layer-2 switch 900 by means of a MAC (not shown) using a network interface 136 (e.g., XAUI or Serial). Ethernet Layer-2/3 switch 808 also includes physical layer ports (PHY ports) 902 that, in one implementation, form a conventional Ethernet LAN (e.g., Ethernet LAN 622 of FIG. 8) connecting network clients such as workstations 602 and PCs 604.

[0054] An implementation of an alternative configuration for a switch is shown in FIG. 9B. FIG. 9B is an illustration of an NC-Switch 910, in which no conventional Layer-2 switch and MAC is used. NC-Switch 910 includes an NCA 912 and multiple PHY ports 902. Each PHY port may perform wireline (e.g., 10/100/1000 BASE-T, DSL) or wireless (e.g., IEEE 802.11, IEEE 802.16) physical layer communications with conventional LAN clients. In this implementation, the adaptation unit 126 supports multiple network interfaces 136. The switching function previously performed by the Layer-2 switch (e.g., Layer-2 switch 900 of FIG. 9A) is consolidated to the switch or router in communication with an NM 100 in a switch configuration 704 (as described above) or an NM-OM 800 (e.g. as illustrated in FIG. 8 an NC-Switch 910 in communication with an NM-OM 800). Alternatively, the switching function previously performed by the Layer-2 switch is consolidated to Layer-2 switches (not shown) in communication with other NCAs 104 networked in a hub configuration 600.

[0055] In hub configuration 600 (e.g. FIG.s 6A-6C) of the optical local area network 50, flow control, denial of service and other network administration functions are dependent on external Layer-2 devices in communication with NCAs 104 (for example, the Ethernet MAC or FC-2 controller in the NIC controller 608 dependent on the implementation as previously discussed). In switch configurations 704 (e.g. FIG.s 7A-7C) of the optical local area network 50, flow control, denial of service and other network administration functions are further dependent on the external Layer-2 device

700 in communication with NMs **100**, in addition to the Layer-2 devices external and in communication with NCAs **104** as previously mentioned.

[0056] Although the invention has been described in terms of particular implementations, one of ordinary skill in the art, in light of this teaching, can generate additional implementations and modifications without departing from the spirit of or exceeding the scope of the claimed invention. Accordingly, it is to be understood that the drawings and descriptions herein are proffered by way of example to facilitate comprehension of the invention and should not be construed to limit the scope thereof.

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ABSTRACT

An optical local area network includes a passive optical distribution fabric interconnecting a plurality of nodes including a first node and a plurality of remaining nodes, a hub that includes the first node and a control module, and a client network adapter coupled to each of the remaining nodes for responding to the control module. The control module controls timing for each of the client network adapters to transmit signals over the passive optical distribution fabric and distribution of signals to each of the nodes.

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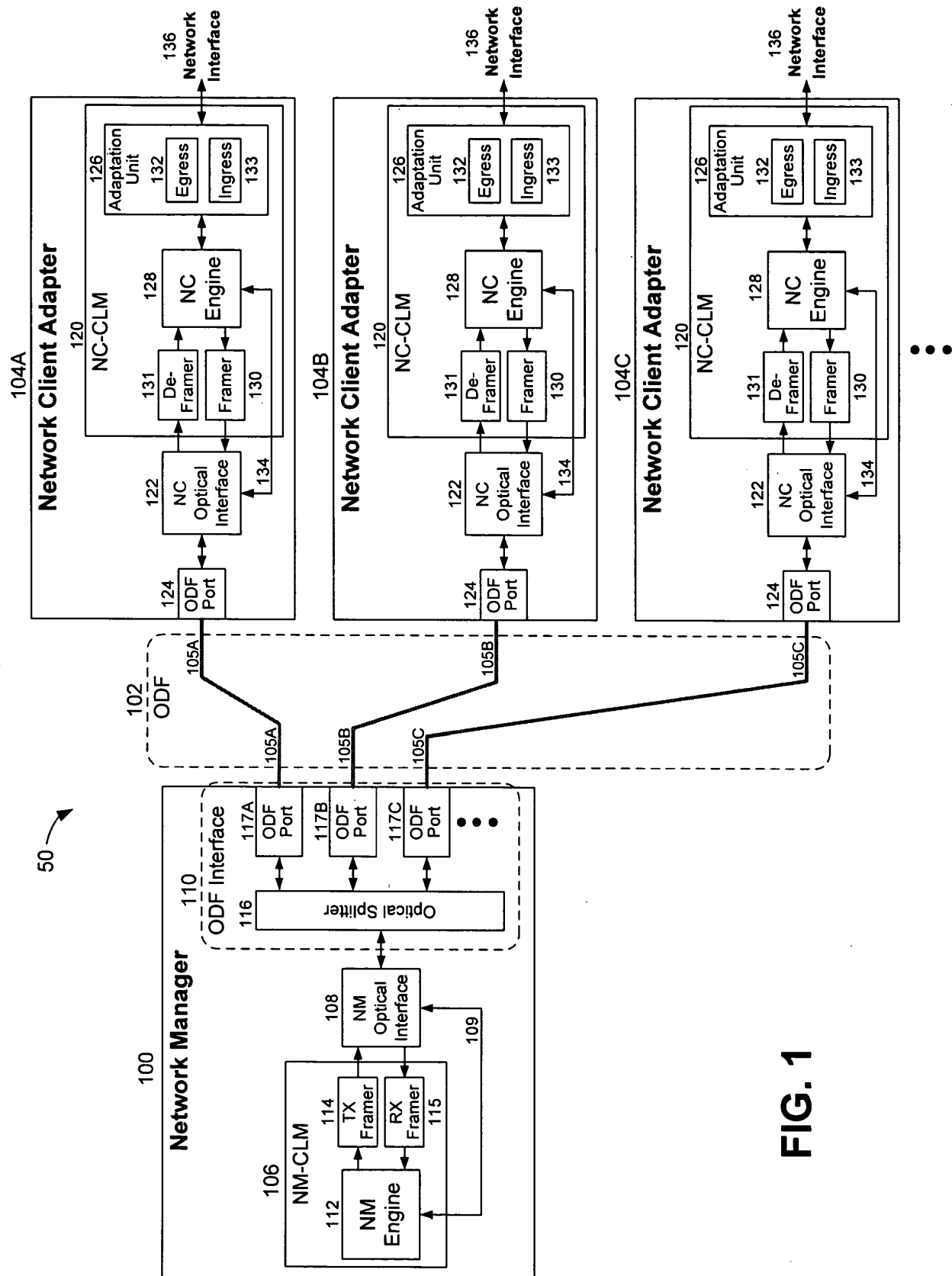
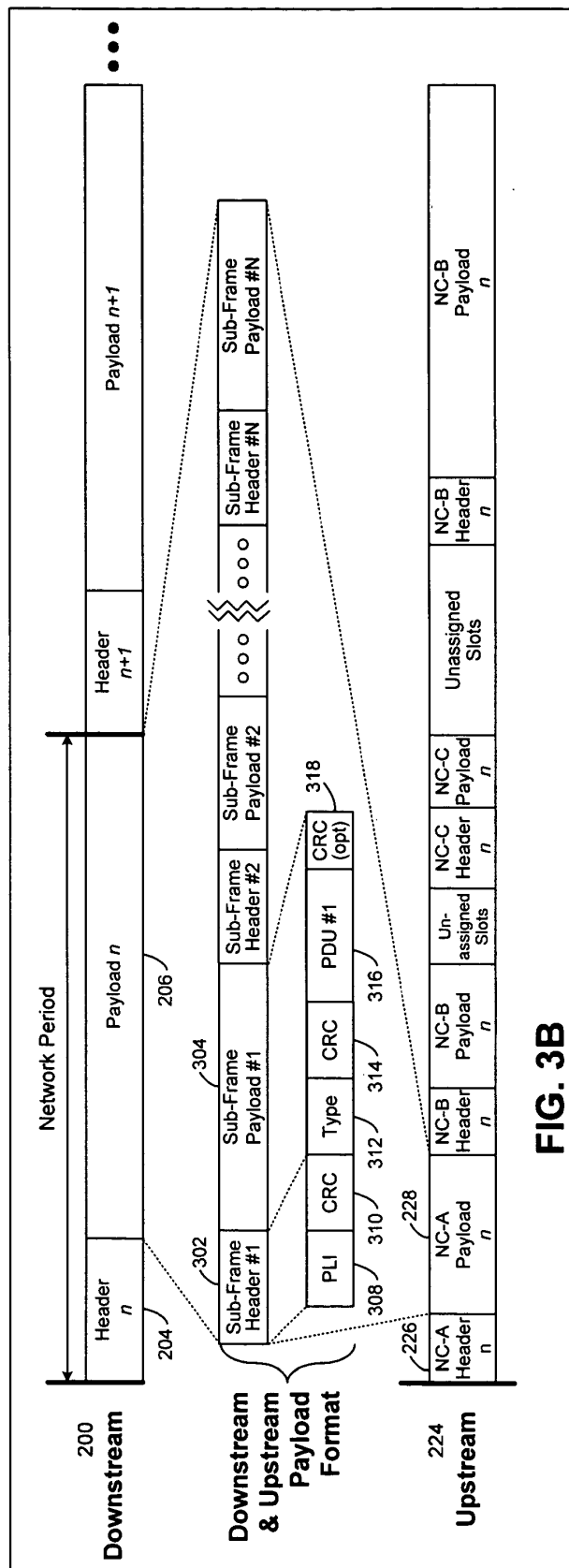
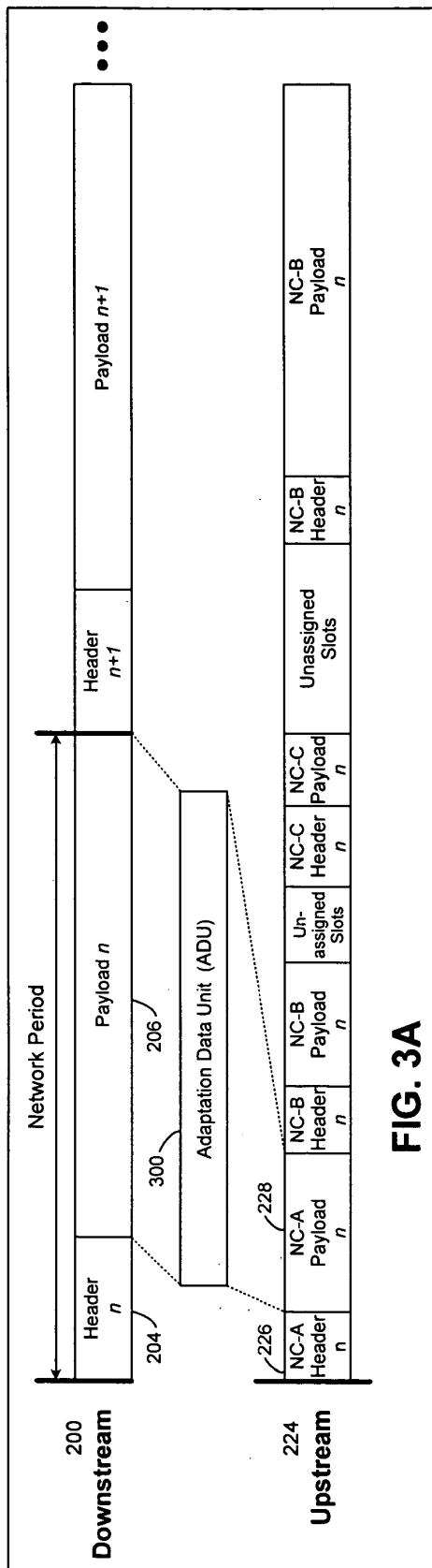


FIG. 1



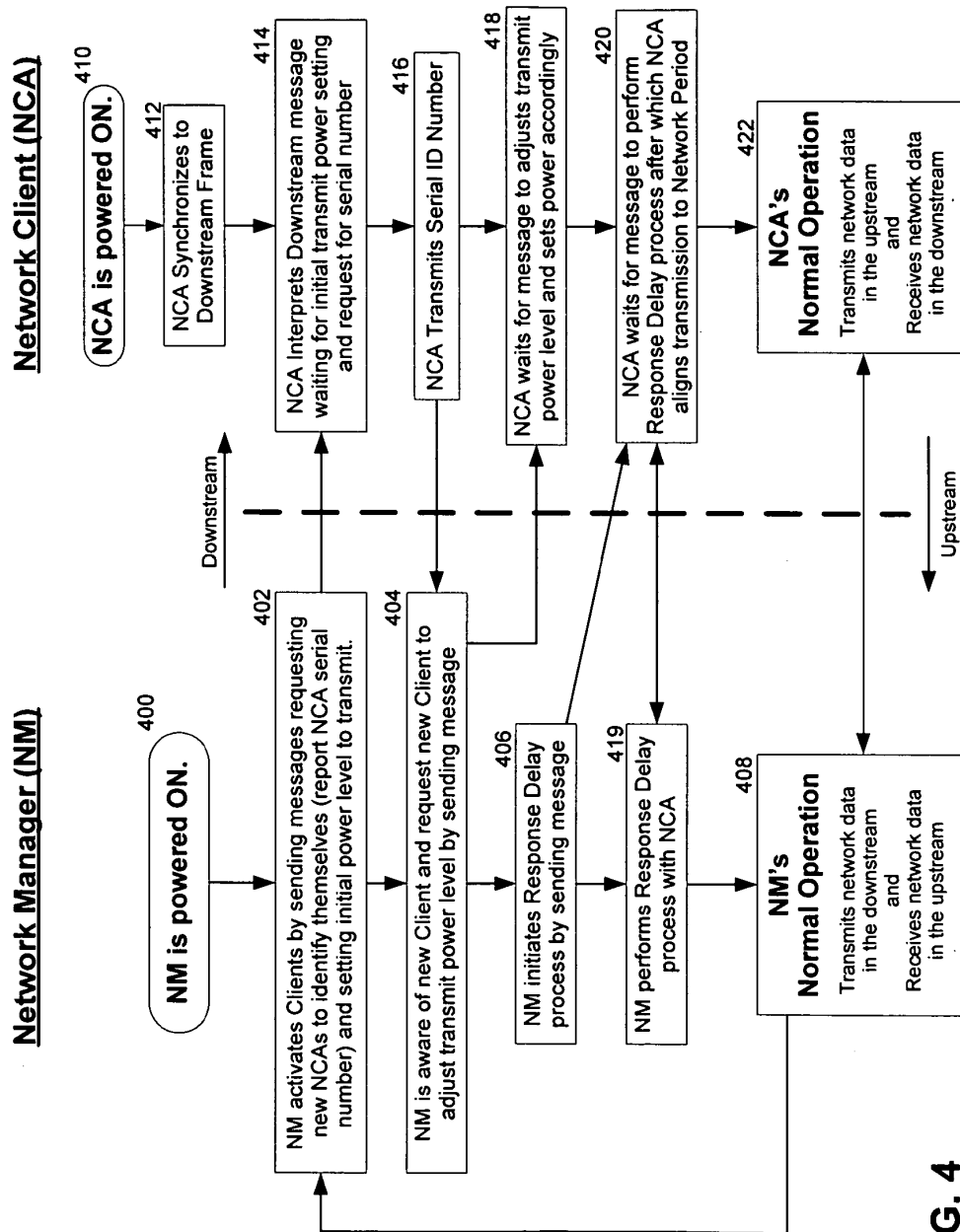


FIG. 4

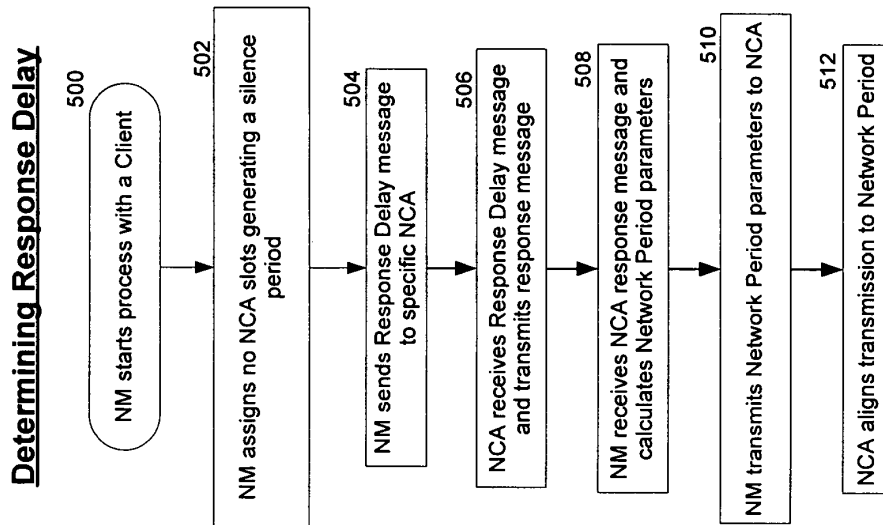
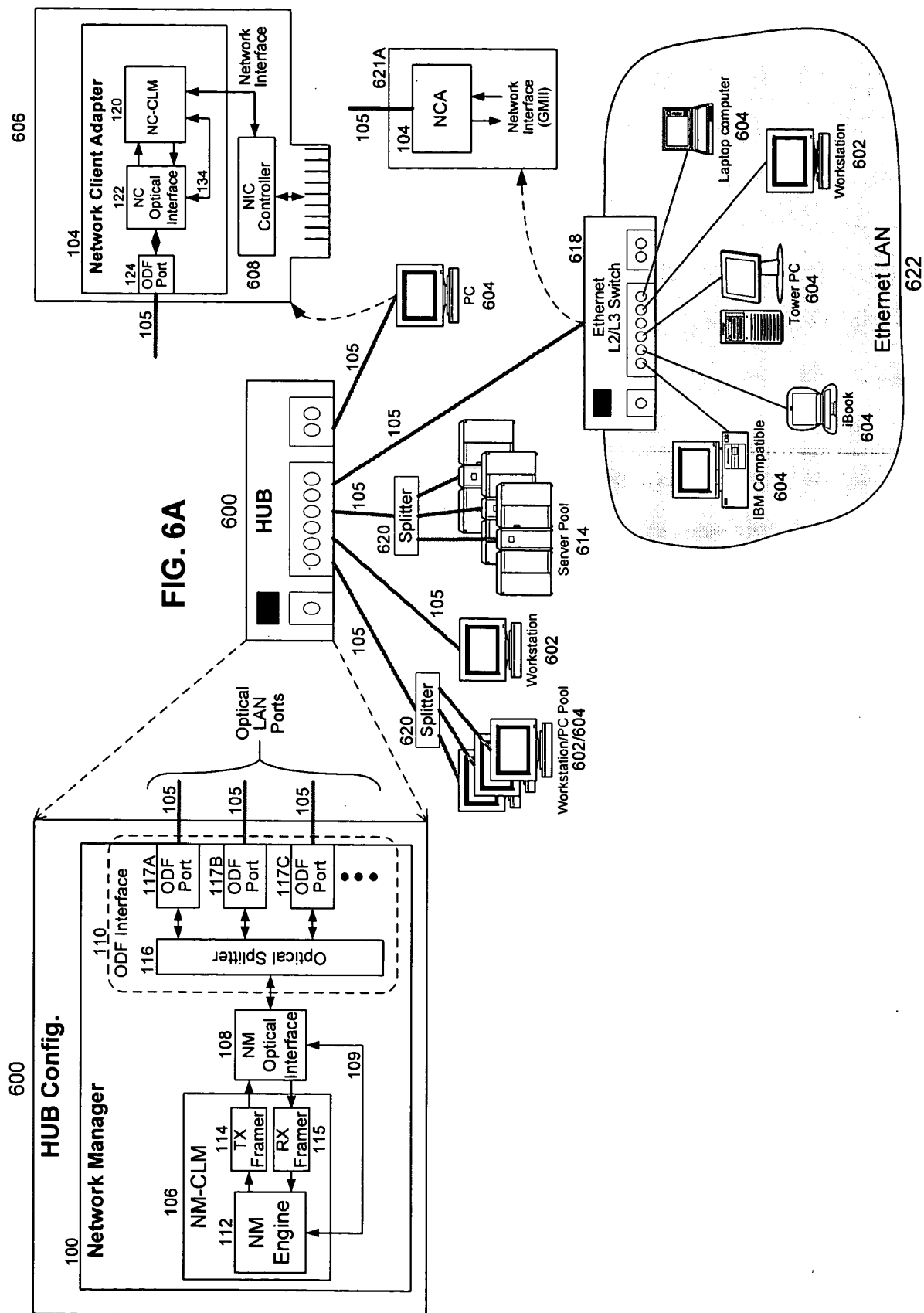
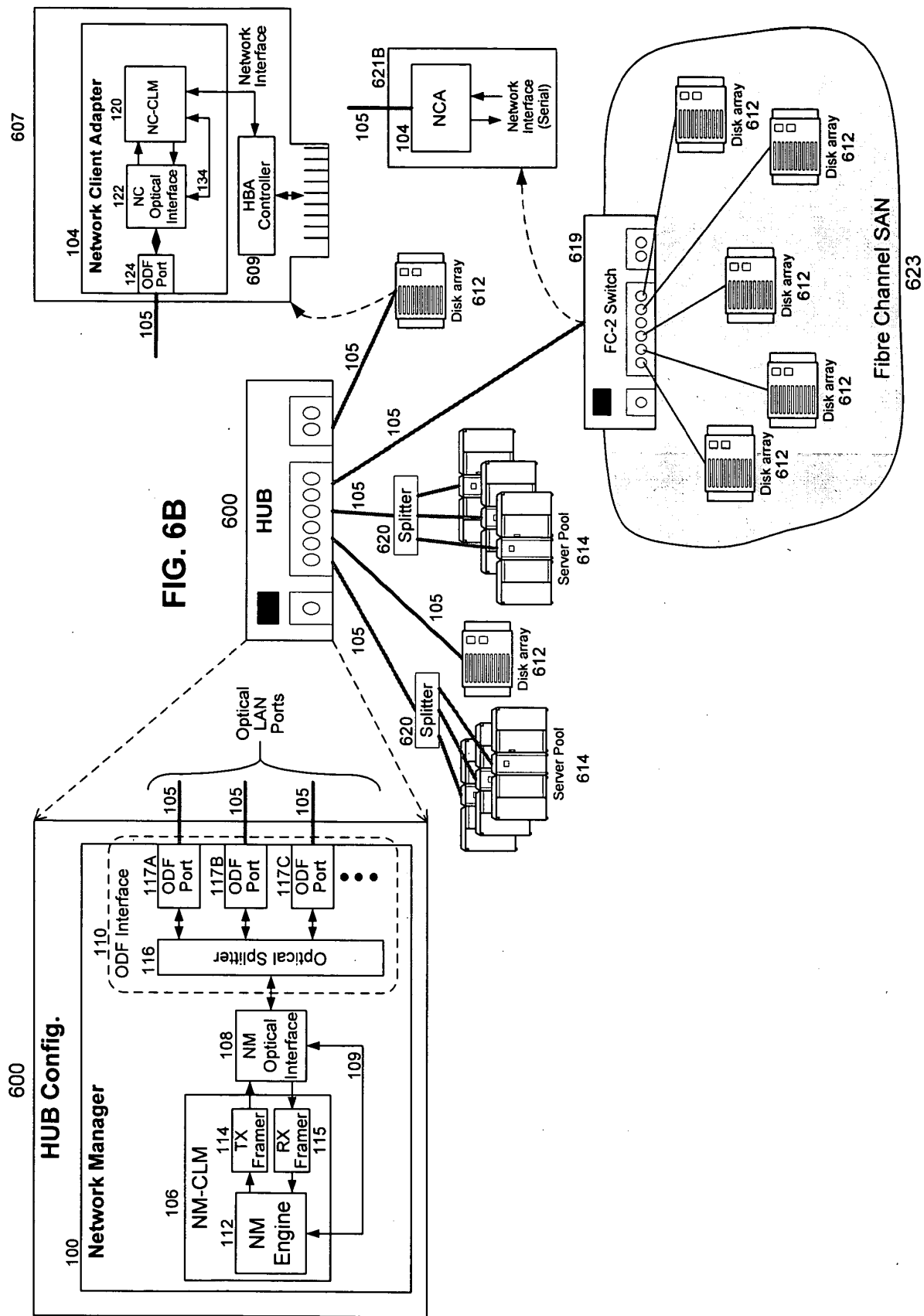
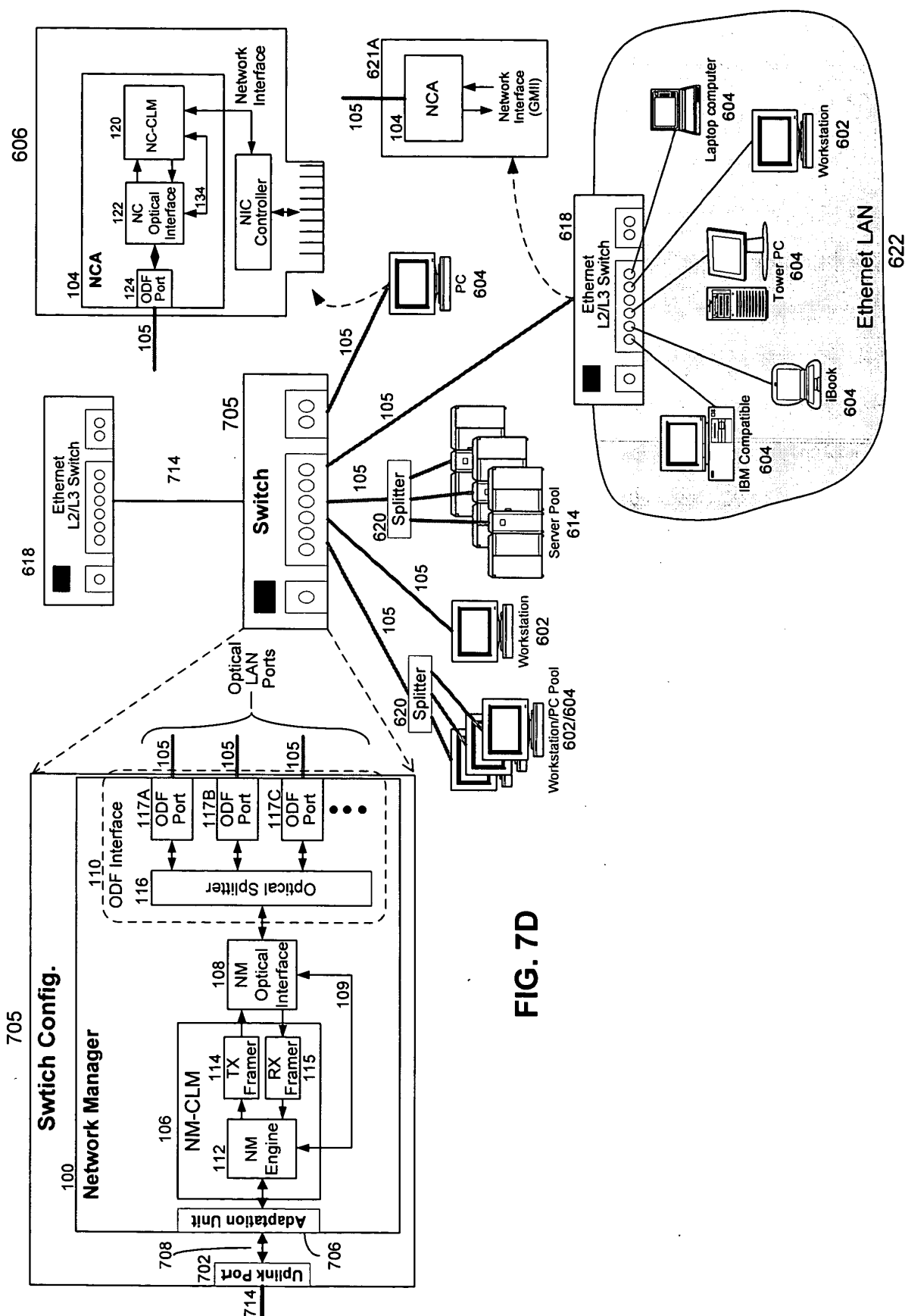


FIG. 5







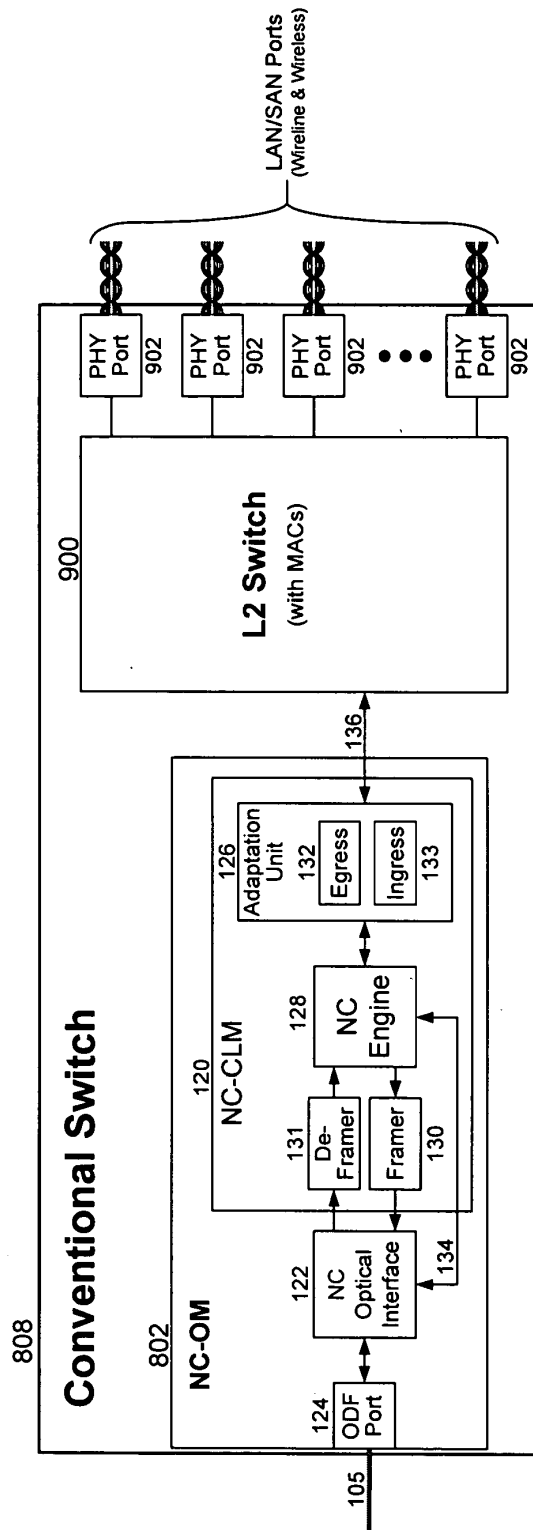


FIG. 9A

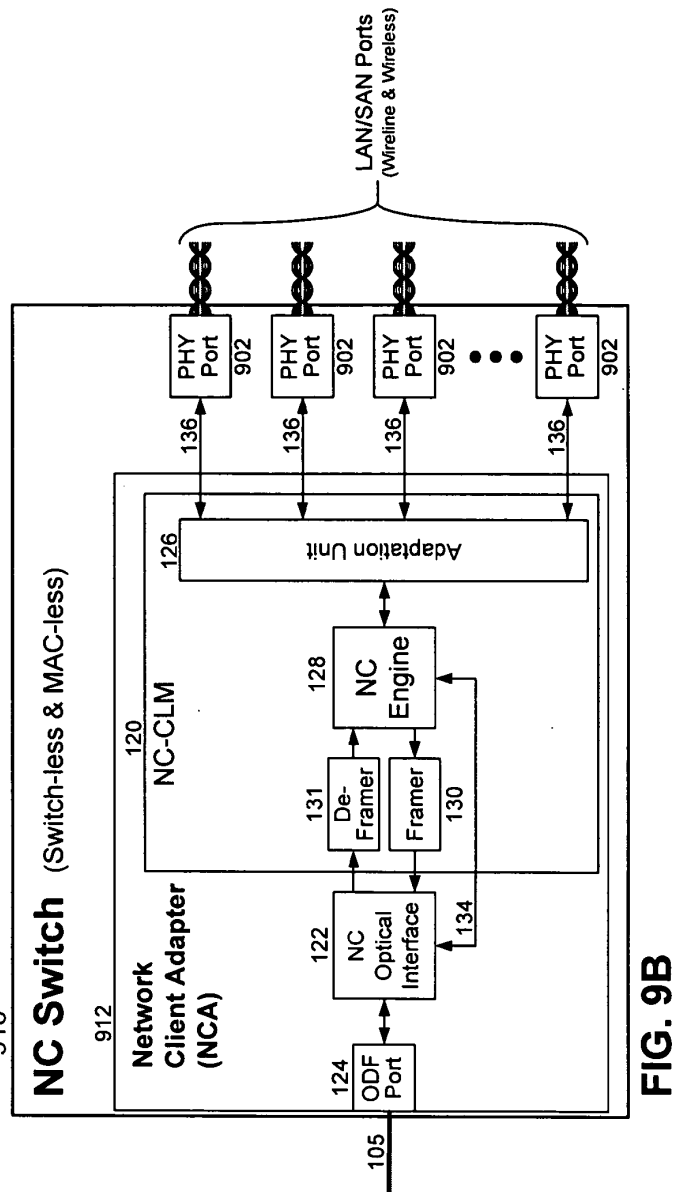


FIG. 9B

What is claimed is:

- 1.) A network client optical transceiver module for a passive optical network, the passive optical network having one or more passive optical splitters for coupling the network client optical transceiver module over one or more optical fibers to the head end of the passive optical network and the network client optical transceiver module having a pluggable form factor and configured to removably couple to an optical module port of a switch or router, the network client optical transceiver module comprising:

an optical port configured to optically couple to one or more optical fibers of the passive optical network having one or more passive optical splitters;

a bi-directional optical interface block optically coupled to the optical port and configured to perform optical-to-electrical and electrical-to-optical signal conversion;

a control module electrically coupled to the bi-directional optical interface block and configured to receive from the head end of the passive optical network data communications representing one or more start times for transmitting data communications to the head end of the passive optical network and configured to transmit the data communications to the head end of the passive optical network responsive to the start times; and

an electrical network interface port electrically coupled to the control module and for electrically coupling into the optical module port of the switch or router and for communicating with the switch or router; whereby

the network client optical transceiver module is configured to optically communicate with the head end of the passive optical network responsive to start times for transmitting data communications to the head end of the passive optical network and the network client optical transceiver module is configured to removably couple to the optical module port of the switch or router and electrically communicate with the switch or router.

- 2.) The network client optical transceiver module of claim 1, wherein the pluggable form factor of the network client optical transceiver module is selected from the group consisting essentially of:

Small Form-factor Pluggable (SFP);
10 Gigabit Small Form-factor Pluggable (XFP);
XENPAK;
X2; and
XPAK.

- 3.) The network client optical transceiver module of claim 1, wherein the control module is configured to receive from the head end of the passive optical network data communications representing one or more end times for transmitting data communications to the head end of the passive optical network and the control module is configured to end transmissions to the head end of the passive optical network response to the end times.
- 4.) The network client optical transceiver module of claim 1, wherein the control module is configured to receive from the head end of the passive optical network data communications representing one or more lengths of times respectively to the start times for transmitting data communications to the head end of the passive optical network and the control module is configured to transmit to the head end of the passive optical network response to the lengths of times.
- 5.) The network client optical transceiver module of claim 1, wherein the optical port is adapted to optically couple to one or more optical fibers selected from the group consisting of:
- multimode optical fibers; and
 - single mode optical fibers.
- 6.) The network client optical transceiver module of claim 1, wherein the optical port includes one or more optical fiber connectors and the optical fiber connectors are selected from the group consisting essentially of :
- Subscriber Connector (SC);
 - Lucent Connector (LC);
 - Fiber Channel (FC);
 - Straight TP (ST); and
 - Miniature Unit (MU).

- 7.) The network client optical transceiver module of claim 1, wherein the electrical network interface port includes an interface selected from the group consisting essentially of:
- a serial interface;
 - a parallel interface; and
 - a XAUI interface.
- 8.) The network client optical transceiver module of claim 1, wherein the network client optical transceiver module includes a framing block electrically coupled to the bi-directional optical interface block and the control module is electrically coupled to the framing block and wherein the framing block is configured for framing data communications for transmission in accordance with a framing protocol for the passive optical network.
- 9.) The network client optical transceiver module of claim 1, wherein the control module is configured to receive from the head end of the passive optical network an assigned network identification address and wherein the assigned network identification address can be used for receiving data addressed to the network client optical transceiver module.
- 10.) The network client optical transceiver module of claim 1, wherein the control module is configured to respond to the head end of the passive optical network responsive to a network operating protocol for new network clients.
- 11.) The network client optical transceiver module of claim 1, wherein the control module is configured to respond to a response delay message from the head end of the passive optical network, wherein the response delay message is used to determine the delay in responses from the network client optical transceiver module.
- 12.) The network client optical transceiver module of claim 1, wherein the control module is configured to align data communication transmissions with the network period of the optical network to account for transmission delays responsive to a response delay process.
- 13.) The network client optical transceiver module of claim 1, wherein the control module is configured to adjust the transmitting optical power level responsive to a message received from the head end of the passive optical network.

- 14.) The network client optical transceiver module of claim 1, wherein the control module is configured to encapsulate at least a portion of the data received through the electrical network interface port into a payload section of a framing protocol for the passive optical network.
- 15.) The network client optical transceiver module of claim 1, wherein the network client optical transceiver module includes one or more of the following:
- a laser;
 - a laser driver;
 - a photodiode;
 - a transimpedance amplifier; and
 - a limiting amplifier.
- 16.) The network client optical transceiver module of claim 1, wherein the network client optical transceiver module is an optical network terminal (ONT) and includes a discrete chip selected from the group consisting essentially of:
- a media access controller (MAC) discrete chip; and
 - a transmission convergence layer (TC-Layer) discrete chip.
- 17.) The network client optical transceiver module of claim 1, wherein the network client optical transceiver module includes 8/10 bit encoding for communications sent and 8/10 bit decoding for communications received through the electrical network interface port.
- 18.) A network client optical transceiver module for a passive optical network, the passive optical network having one or more passive optical splitters for coupling the network client optical transceiver module over one or more optical fibers to the head end of the passive optical network and the network client optical transceiver module having a pluggable form factor and adapted to removably couple to an optical module port of a switch or router, and the network client optical transceiver module having an optical port for coupling to one or more optical fibers of the passive optical network, and the network client optical transceiver module having an optical interface block optically coupled to the optical port and for converting electrical signals to optical signals and for converting optical signals to electrical

signals, and the network client optical transceiver module having a control module electrically coupled to the optical interface block and for communicating with the head end of the passive optical network, and the network client optical transceiver module having an electrical network interface port electrically coupled to the control module and for electrically communicating to the switch or router, a method of communicating with the head end of a passive optical network from the network client optical transceiver module comprising the steps of:

- (a) receiving data from the switch or router through the electrical network interface port of the network client optical transceiver module;
- (b) storing the received data inside the network client optical transceiver module;
- (c) receiving a first optical signal from the head end of the passive optical network through the optical port at the optical interface block of the network client optical transceiver module;
- (d) converting the first optical signal to an electrical signal at the optical interface block and conveying the electrical signal to the control module of the network client optical transceiver module;
- (e) processing the electrical signal at the control module to determine one or more start times for data transmissions from the network client optical transceiver module to the head end of the passive optical network;
- (f) converting a portion of the stored received data to a second optical signal; and
- (g) transmitting the second optical signal from the optical interface block through the optical port responsive to the one or more start times for data transmissions to the head end of the passive optical network; whereby

the network client optical transceiver module optically communicates with the head end of the passive optical network responsive to start times for data transmissions and the network client optical transceiver module electrically communicates with the switch or router.

- 19.) The method of claim 18, wherein the pluggable form factor of the optical transceiver module is selected from the group consisting essentially of:

SFP;

XFP;
XENPAK;
X2; and
XPAK.

- 20.) The method of claim 18, further comprising the steps of:
- (e1) processing the electrical signal at the control module to determine one or more end times for data transmissions from the network client optical transceiver module to the head end of the passive optical network; and
- (g1) terminating the transmission of the second optical signal responsive to an end time for data transmissions to the head end of the passive optical network.
- 21.) The method of claim 18, further comprising the steps of:
- (e1) processing the electrical signal at the control module to determine one or more lengths of times respective to the start times for data transmissions from the network client optical transceiver module to the head end of the passive optical network; and
- (g1) transmitting the second optical signal responsive to a length of time for data transmissions to the head end of the passive optical network.
- 22.) The method of claim 18, wherein the optical port is adapted to optically couple to one or more optical fibers selected from the group consisting of:
- multimode optical fibers; and
single mode optical fibers.
- 23.) The method of claim 18, wherein the optical port includes one or more optical fiber connectors and the optical fiber connectors are selected from the group consisting essentially of:
- SC;
LC;
FC;
ST; and

MU.

- 24.) The method of claim 18, wherein the electrical network interface port includes an interface selected from the group consisting essentially of:

a serial interface;
a parallel interface; and
a XAUI interface.

- 25.) The method of claim 18, further comprising the step of:

(e1) processing the electrical signal at the control module to determine an assigned network identification address from the head end of the passive optical network for addressing data to the network client optical transceiver module at the control module.

- 26.) The method of claim 18, further comprising the step of:

(g1) adjusting the transmission of the second optical signal from the optical interface block through the optical port to account for the response delay of the optical transceiver module.

- 27.) The method of claim 18, further comprising the step of:

(e1) processing the electrical signal at the control module to determine an optical power level and adjusting the transmit optical power level of the network client optical transceiver module to the determined optical power level.

- 28.) The method of claim 18, further comprising the step of:

(f1) encapsulating a portion of data received through the electrical network interface port into the payload section of a framing protocol for the passive optical network at the control module for conveyance to the optical interface block.

- 29.) The method of claim 18, wherein the network client optical transceiver module includes one or more of the following:

a laser;

- a laser driver;
- a photodiode;
- a transimpedance amplifier; and
- a limiting amplifier.

30.) The method of claim 18, wherein the network client optical transceiver module is ONT and includes a discrete chip selected from the group consisting essentially of:

- a MAC discrete chip; and
- a TC-Layer discrete chip.

31.) The method of claim 18, further comprising the steps of:

- (b1) performing 8/10 bit decoding on the received data; and
- (h) performing 8/10 bit encoding on data sent through the electrical network interface port.

32.) A head end optical transceiver module for a passive optical network, the passive optical network having one or more passive optical splitters for coupling one or more optical network clients over one or more optical fibers to the head end optical transceiver module and the head end optical transceiver module having a pluggable form factor and configured to removably couple to an optical module port of a switch or router, the head end optical transceiver module comprising:

- an optical port configured to optically couple to one or more optical fibers of the passive optical network having one or more passive optical splitters;

- a bi-directional optical interface block optically coupled to the optical port and configured to perform optical-to-electrical and electrical-to-optical signal conversion;

- a control module electrically coupled to the optical interface block and configured to communicate with one or more optical network clients as the head end of the passive optical network and configured to allocate and transmit data representing one or more start times for

communication transmissions from one or more optical network clients to the optical network clients; and

an electrical network interface port electrically coupled to the control module and for electrically coupling into the optical module port of the switch or router and for communicating with the switch or router; whereby

the head end optical transceiver module is configured to optically communicate across the passive optical network with the optical network clients and manage the communications of one or more optical network clients by allocating and transmitting data representing start times for optical network client transmissions and the head end optical transceiver module is configured to removably couple to the optical module port of the switch or router and configured to electrically communicate with the switch or router.

33.) The head end optical transceiver module of claim 32, wherein the pluggable form factor of the head end optical transceiver module is selected from the group consisting essentially of:

SFP;
XFP;
XENPAK;
X2; and
XPAK.

34.) The head end optical transceiver module of claim 32, wherein the control module is configured to allocate and send data communications representing one or more end times respectively to the start times for transmitting data communications from a network client to the head end of the passive optical network.

35.) The network client optical transceiver module of claim 32, wherein the control module is configured to allocate and send data communications representing one or more lengths of times respectively to the start times for transmitting data communications from a network client to the head end of the passive optical.

- 36.) The head end optical transceiver module of claim 32, wherein the optical port is adapted to optically couple to one or more optical fibers selected from the group consisting of:
- multimode optical fibers; and
 - single mode optical fibers.
- 37.) The head end optical transceiver module of claim 32, wherein the optical port includes one or more optical fiber connectors and the optical fiber connectors are selected from the group consisting essentially of :
- SC;
 - LC;
 - FC;
 - ST; and
 - MU.
- 38.) The head end optical transceiver module of claim 32, wherein the electrical network interface port includes an interface selected from the group consisting essentially of:
- a serial interface;
 - a parallel interface; and
 - a XAUI interface.
- 39.) The head end optical transceiver module of claim 32, wherein the head end optical transceiver module includes a framing block electrically coupled to the bi-directional optical interface block and the control module is electrically coupled to the framing block and wherein the framing is configured for framing data for transmission in accordance with a framing protocol for the passive optical network.
- 40.) The head end optical transceiver module of claim 32, wherein the control module is configured to assign and transmit a network identification address for an optical network client of the passive optical network for addressing data to the optical network client.
- 41.) The head end optical transceiver module of claim 32, wherein the control module is configured to transmit a message to new optical network clients on the passive optical

network wherein the message requests the new optical network clients to identify themselves to the head end optical transceiver module.

- 42.) The head end optical transceiver module of claim 32, wherein the control module is configured to transmit a response delay message to a optical network client of the passive optical network, wherein the response delay message is used to determine the delay in responses from the optical network client.
- 43.) The head end optical transceiver module of claim 32, wherein the control module is configured to allocate start times for optical network client transmissions to guarantee a minimum transfer rate from the optical network clients and wherein the minimum transfer rate can be determined by dividing the maximum receive rate of the head end optical transceiver module by the number of optical network clients.
- 44.) The head end optical transceiver module of claim 32, wherein the control module is configured to allocate start times for optical network client transmissions to minimize the depth of the memory buffer queues of optical network clients wherein the control module receives status information representing the optical network client memory buffer queues.
- 45.) The head end optical transceiver module of claim 32, wherein the control module is configured to send a request to adjust transmit optical power levels in a message to an optical network client.
- 46.) The head end optical transceiver module of claim 32, where the control module is configured to encapsulate at least a portion of the data received through the electrical network interface port into a payload section of a framing protocol for on the passive optical network.
- 47.) The head end optical transceiver module of claim 32, wherein the head end optical transceiver module includes one or more of the following:
 - a laser;
 - a laser driver;
 - a photodiode;
 - a transimpedance amplifier; and

a limiting amplifier.

48.) The head end optical transceiver module of claim 32, wherein the head end optical transceiver module is an optical line terminal (OLT) and includes a discrete chip selected from the group consisting essentially of:

a MAC discrete chip; and

a TC-Layer discrete chip.

49.) A head end optical transceiver module for the head end of a passive optical network, the passive optical network having one or more passive optical splitters for coupling one or more optical network clients over one or more optical fibers to the head end optical transceiver module and the head end optical transceiver module having a pluggable form factor and adapted to removably couple to an optical module port of a switch or router, the head end optical transceiver module having an optical port for coupling to one or more optical fibers of the passive optical network, and the head end optical transceiver module having an optical interface block optically coupled to the optical port and for converting electrical signals to optical signals and for converting optical signals to electrical signals, and the head end optical transceiver module having a control module electrically coupled to the optical interface block and for communicating with optical network clients on the passive optical network, and the head end optical transceiver module having an electrical network interface port electrically coupled to the control module and for electrically communicating to the switch or router, a method of allocating start times to optical network clients by the head end optical transceiver module for communication transmissions from the optical network clients comprising the steps of:

(a) allocating one or more start times for communication transmissions from an optical network client at the control module of the head end optical transceiver module;

(b) generating a first message containing information representing the allocated start times for communication transmissions from an optical network client at the control module;

(c) addressing the first message to the optical network client at the control module;

- (d) conveying the first message to the optical interface block of the head end optical transceiver module;
- (e) converting the first message to a first optical signal at the optical interface block; and
- (f) transmitting the first optical signal from the optical interface block through the optical port of the head end optical transceiver module;
- (g) receiving a second optical signal from the optical network client responsive to the first message containing information representing the allocated start times through the optical port and at the optical interface block;
- (h) converting the second optical signal to an electrical signal at the optical interface block; and
- (i) conveying a portion of the electrical signal to the switch or router through the electrical network interface by the control module of the head end optical transceiver module; whereby

the head end optical transceiver module manages optical communications across the passive optical network by allocating start times for optical network clients to transmit optical communications and the head end optical transceiver module electrically communicates with the switch or router.

- 50.) The method of claim 49, wherein the pluggable form factor of the head end optical transceiver module is substantially the same form factor selected from the group consisting essentially of:

SFP;
XFP;
XENPAK;
X2; and
XPAK.

- 51.) The method of claim 49, further comprising the steps of:

- (b) generating a first message containing information representing the allocated start times and end times for communication transmissions from an optical network client at the control module; and

- (g) receiving a second optical signal from the optical network client responsive to the first message containing information representing the allocated start times and end times through the optical port and at the optical interface block;
- 52.) The method of claim 49, further comprising the steps of:
- (b) generating a first message containing information representing the allocated start times and length of times for communication transmissions from an optical network client at the control module; and
- (g) receiving a second optical signal from the optical network client responsive to the first message containing information representing the allocated start times and length of times through the optical port and at the optical interface block;
- 53.) The method of claim 49, wherein the optical port is adapted to optically couple to one or more optical fibers selected from the group consisting of:
- multimode optical fibers; and
- single mode optical fibers.
- 54.) The method of claim 49, wherein the optical port includes one or more optical fiber connector sockets and the optical fiber connector sockets are selected from the group consisting essentially of :
- SC;
- LC;
- FC;
- ST; and
- MU.
- 55.) The method of claim 49, wherein the electrical network interface port includes an interface selected from the group consisting essentially of:
- a serial interface;
- a parallel interface; and
- a XAUI interface.

- 56.) The method of claim 49, wherein the conveying a portion of the electrical signal to the switch or router includes adapting the portion of the electrical signal in accordance to an OSI Layer 2 protocol by the control module.
- 57.) The method of claim 49, further comprising the steps of:
- (a) assigning a network identification address to an optical network client for addressing data to the optical network client at the control module; and
 - (b) transmitting the network identification address to the optical network client from the optical interface block and through the optical port.
- 58.) The method of claim 49, further comprising the step of:
- (j) generating a second message for new optical network clients on the passive optical network at the control module wherein the second message requests the new optical network clients to identify themselves to the head end optical transceiver module; and
 - (k) transmitting the second message from the optical interface block through the optical port to the new optical network clients on the passive optical network.
- 59.) The method of claim 49, further comprising the step of:
- (j) generating a response delay message for an optical network client of the passive optical network at the control module, wherein the response delay message is used to determine the delay in responses from the optical network client; and
 - (k) transmitting the response delay message to an optical network client of the passive optical network from the optical interface block and through the optical port.
- 60.) The method of claim 49, wherein the allocating start times for communication transmissions from an optical network client includes allocating start times to an optical network client to guaranteed a minimum transfer rate from the optical network client and wherein the minimum guaranteed transfer rate can be determined by dividing the maximum receive rate of the head end optical transceiver module by the number of optical network clients.

- 61.) The method of claim 49, wherein allocating start times for communication transmissions from an optical network client includes allocating start times to an optical network client to minimize the depth of the memory buffer queue of the optical network client wherein the head end optical transceiver module receives status information representing the optical network client memory buffer queue.
- 62.) The method of claim 49, further comprising the steps of:
- (j) generating a second message for an optical network client on the passive optical network at the control module wherein the second message requests the optical network client to adjust transmit optical power levels; and
 - (k) transmitting the second message from the optical interface block through the optical port to the optical network clients on the passive optical network.
- 63.) The method of claim 49, further comprising the steps of:
- (j) receiving data through the electrical network interface port;
 - (k) converting a portion of the data received into the payload section of a framing protocol for the passive optical network; and
 - (l) transmitting optically by the optical interface block the converted portion of data received through the electrical network interface port to an optical network client.
- 64.) The method of claim 49, wherein the head end optical transceiver module includes one or more of the following:
- a laser;
 - a laser driver;
 - a photodiode;
 - a transimpedance amplifier; and
 - a limiting amplifier.
- 65.) The method of claim 49, wherein the head end optical transceiver module is an OLT and includes a discrete chip selected from the group consisting essentially of:

a MAC discrete chip; and
a TC-Layer discrete chip.