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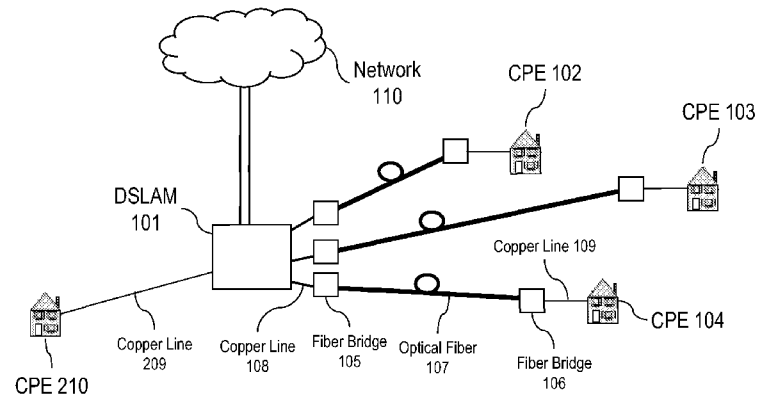
(54) Title: NETWORK COMPONENT AND METHOD FOR OPERATING SAID NETWORK COMPONENT

Fig.1



(57) Abstract: A network component is provided, comprising a DSL interface for processing DSL signals and comprising an optical interface, wherein said DSL signals are conveyed via the optical interface. Furthermore, a method for operating said network component, a system comprising at least one of said network components and an access point comprising said network component are suggested.

Description

Network component and method for operating said network component

The invention relates to a network component, a method for operating said network component and to a system comprising at least one such network component.

Based on an increasing demand for high speed broadband subscriber interfaces utilized by, e.g., so-called triple play services, i.e. high speed Internet access, voice telephony and video/TV services, telecommunication network operators are required to extend their network capacities.

Operators tend to concentrate on emerging technologies to enhance the bandwidth of the end user interfaces, in particular they try to overcome bandwidth limitations of long haul copper-based access technologies. Current solutions for such a "last mile" access connect end users via FTTB and/or FTTH products utilizing, e.g., micro DSLAMs and/or access switches that are connected via high speed digital fiber interfaces to the core network.

These devices can be deployed closely to the subscribers' premises, i.e. either in the basement of a building, near an apartment or in the apartment of a customer (FTTH).

Such FTTB and/or FTTH solutions can be supplied via optical P2P links to an aggregation node (switch device). As an alternative, a remote access node can be connected via a passive optical network (xPON) to the aggregation node. In both cases, high bandwidth digital transmission technology like Ethernet or ATM are used to provide high bandwidth links to the remote devices at the customers' premises.

Both approaches, P2P or xPON access topologies, require complex and thus costly termination devices (ONTs) either in the

basement of each building (deployed, e.g., as micro DSLAM or MDU) or in/at the apartment of the end user (deployed as SFU), because high speed digital uplink information need to be converted into a lower speed of a subscriber interface. The complexity of such termination devices stems from a CPU and appropriate software implemented in these devices, which require mechanisms to configure application specific parameters and/or provide mechanisms for remote software update and remote control via an in-band management channel. Especially such functionalities increase the complexity and thus costs of hardware components even in a scenario with only a single end user or two end users being connected to such a termination device (ONT).

The **problem** to be solved is to overcome the disadvantages stated above and in particular to provide an efficient approach to enable high data rates at the customer's premises, e.g., in uplink as well as in downlink direction.

This problem is solved according to the features of the independent claims. Further embodiments result from the depending claims.

In order to overcome this problem, a network component is suggested

- comprising a DSL interface for processing DSL signals and
- comprising an optical interface,
- wherein said DSL signals are conveyed via the optical interface.

This approach provides an efficient solution for FTTB or FTTH applications enabling high bandwidth at considerably low costs regarding xDSL subscriber interfaces.

Such a network component does not require any or any significant operation and maintenance effort, which is of advantage regarding, e.g., a remote deployment at the customer's prem-

ises. The network component does not have to comprise complex hardware and/or software components and costly administration or update services.

It is also an advantage that the network component enables the customer to be supplied with data rates in the order of 100Mbps (uplink direction as well as downlink direction according to, e.g., VDSL profile 30a) even if the customer is located at a distance kilometers off the DSLAM.

It is another advantage that legacy equipment could be used in combination with the network component suggested. Hence, no costly change of existing hardware is required.

In an embodiment, the DSL signals processed via the DSL interface are electrical DSL signals and the DSL signals conveyed via the optical interface are optically processed DSL signals.

In particular, the optical DSL signals may be electrical DSL signals conveyed via an optical interface towards an optical fiber.

In another embodiment, said DSL signals are xDSL signals, in particular ADSL signals or VDSL signals.

It is noted that DSL signal as mentioned herein may refer to all kinds of digital subscriber line signals in particular according to existing and upcoming standards, comprising, e.g., VDSL2, ADSL2+, etc.

In a further embodiment, layer-1 DSL signals are conveyed via the optical interface.

Such layer-1 signals, in particular physical layer signals, can be processed over the optical interface. For such purpose, the optical processing can be utilized to transmit digital or analog signals via the optical fiber.

The optical link referred to herein may also comprise any other long haul transmission solution, e.g., a radio link.

In a next embodiment, said DSL interface is connected to an access node, in particular to a DSLAM.

The network component may in particular be associated and/or integrated with an access node, e.g., a DSLAM.

Hence, the network component can be a part of the access node, e.g., arranged as or with a port of said access node.

It is also an embodiment that said DSL interface is connected to a CPE.

Pursuant to another embodiment, the optical interface is connected to an access point, in particular an optical line termination (OLT) or an optical port of a DSLAM.

According to an embodiment, the DSL interface is connected with a copper line, in particular with a twisted pair copper line.

Said copper line could be any electrical connection comprising other materials than copper.

According to another embodiment, the network component comprises a conversion unit converting electrical DSL signals to DSL signals to be conveyed via the optical interface and converting DSL signals received via the optical interface to electrical DSL signals.

According to an embodiment, the optical interface is connected to an optical link and/or to a radio link.

It is also an embodiment that the optical interface processes one or more DSL signals, in particular at least one DSL channel.

The problem stated above is also solved by a method for operating the network component as described herein.

The problem mentioned above is further solved by a system comprising at least one network component as described herein.

The problem described above is also solved by a system comprising a first network component and a second network component, wherein the optical interfaces of the first network component and the second network component are connected with each other via at least one optical fiber.

The problem stated above is also solved by an access point, e.g., a DSLAM, comprising a network component as described herein.

Embodiments of the invention are shown and illustrated in the following figures:

Fig.1 shows a DSLAM that is connected to a network (e.g., an operator's network), wherein the DSLAM provides xDSL signals towards various CPEs, wherein copper lines are used to connect the DSLAM and a Fiber Bridge is used to convey DSL signals to CPEs;

Fig.2 shows a DSLAM that is connected to a network (e.g., an operator's network), wherein the DSLAM comprises optical ports that allow for transmitting xDSL signals via an optical fiber 207 and for receiving xDSL signals via said optical fiber being converted to electrical xDSL signals;

Fig.3 shows a block diagram of a Fiber Bridge to which an optical fiber is attached and fed to a fiber port.

The approach provided suggests transmitting xDSL signals via an optical link to/from a building and/or apartment and in particular converting this optical signal into an electrical signal in a network component deployed for that purpose (which is referred to herein as "xDSL Fiber Bridge" or "Fiber Bridge").

Advantageously, this Fiber Bridge does not require any processing unit nor any software; it may just convert the xDSL signal that usually is to be transmitted via a short haul twisted pair copper line between via an optical fiber.

Hence, the Fiber Bridge may comprise the following functional components in a direction from the optical fiber towards the copper line:

(a) An optical receiver like a PIN diode or a photo transistor arranged for receiving the xDSL signal, which may be an (either directly or modulated) analog signal or a digital (e.g., sampled digits via an A/D converter) signal.

(b) An amplitude of the analog xDSL signal may be regained via analog circuitry (e.g., by a low path filter) and/or via an A/D converter in case of digital signal processing.

(c) A signal line driver may be provided for boosting the xDSL signal onto the copper line.

(d) A hybrid circuit ("Gabelschaltung") comprising a signal transformer can be used to separate and/or synthesize analog signals in transmit and/or receive direction(s).

The Fiber Bridge may comprise the following functional components in a direction from the copper line towards the optical fiber:

(a) The analog receive signal that is separated from the transmit signal in the hybrid circuit ("Gabelschaltung") can be either sampled by a A/D converter in case of digital transmission or it can be directly connected to the input of the optical transmitter.

(b) The optical transmitter may comprise a laser diode that sends the xDSL receive signal into the fiber.

By using the Fiber Bridge, a range of the VDSL2 subscriber line (typically limited to about 300m for 100/100 Mbps capacities in uplink/downlink direction) can be extended via the optical fiber to a range of several kilometers.

This approach allows maintaining administrative functionality in a centralized DSLAM, whereas the remotely deployed Fiber Bridges may only have to convert the xDSL signal. Hence, the Fiber Bridge does not require for any supervision, configuration or any software. The Fiber Bridge can be designed and maintained in a very cost effective and thus economic manner.

Variants of the Fiber Bridge may be as follows:

(1) The Fiber Bridge may convert the xDSL signal for a single user interface (on the copper side as well as on the fiber side).

(2) The Fiber Bridge may extract and/or aggregate the xDSL signal for a single user interface out of and/or into a bundle of xDSL channels available at an optical interface.

Furthermore, the Fiber Bridge may be applied or used according to the following scenarios:

(I) A DSLAM service interface can be provided serving "optical xDSL" interfaces:
This DSLAM service interface can be an integral part of a DSLAM and it may provide an optical interface that transmits and/or receives xDSL signal of either a single (default) or a group of xDSL user interfaces via a single optical link. In this case, the Fiber Bridge may terminate the fiber at the end user's building or apartment and it may provide a standard xDSL copper interface at the user side.

(II) The Fiber Bridge could be used according to a "mirror topology":
Two Fiber Bridges can be used in a combined manner by being connected via at least one optical fiber. Hence, the two Fiber Bridges terminate both ends of the optical fiber.
Instead of directly connecting the optical fiber to a DSLAM service interface (which may not be present in legacy DSLAM equipment), a standard DSLAM with xDSL copper service interfaces can be used. The electrical xDSL interface of the DSLAM is connected to the Fiber Bridge, which provides conversion into the optical signals and conveys said optical signals via the at least one fiber to the second Fiber Bridge. Hence, the combination of the two Fiber Bridges allows increasing the range of communication at a high bandwidth considerably by utilizing said at least one optical fiber.

Fig.1 shows a DSLAM 101 that is connected to a network 110 (e.g., an operator's network). The DSLAM 101 provides xDSL signals towards various CPEs 102 to 104 and 210, wherein copper lines 108, 209 are used to connect the DSLAM 101.

The CPEs 102 to 104 are attached to the DSLAM 101 in the same way. As an example, the connection of CPE 104 to the DSLAM 101 will be described hereinafter: The DSLAM 101 is connected

via an xDSL interface (sending and receiving xDSL signals via the copper line 108) to a Fiber Bridge 105. Said Fiber Bridge 105 converts xDSL signals to/from the copper line 108 to xDSL signals to be conveyed and/or received over an optical fiber 107. Such optically xDSL signals are conveyed via the optical fiber 107 from the Fiber Bridge 105 to another Fiber Bridge 106 (and vice versa). This Fiber Bridge 106 also has an optical interface and an xDSL interface, the latter being able to convey/receive xDSL signals via a copper line 109 to/from the CPE 104.

This approach bears the advantage that (providing a high data rate to/from the CPEs 102 to 104) a distance between each of the CPEs 102 to 104 and the DSLAM 101 can be significantly longer compared to conventional VDSL connection via copper line.

The Fiber Bridge 106 at or near the customer's premises could be a cost efficient device that is capable of processing xDSL signals that are conveyed via the optical fiber 107. The Fiber Bridge 106 (as well as the Fiber Bridge 105) is capable of converting optical xDSL signals to electrical xDSL signals and vice versa.

The optical fiber 109 allows supplying the CPE 104 with a data rate in uplink direction as well as in downlink direction in the order of, e.g., about 100 Mbps, wherein the CPE 104 (which may be a legacy CPE) can be located, e.g., several kilometers off the DSLAM 101.

In addition, the CPE 210 could be attached to the DSLAM 101 via a copper line 209. Hence, the DSALM could be a micro DSLAM that may be deployed at an office building supplying several DSL customers on site (one being indicated by the CPE 210). Other CPEs 102 to 104 can be attached to such (micro) DSLAM 101 via Fiber Bridges as described above.

Fig.2 shows a DSLAM 201 that is connected to a network 210 (e.g., an operator's network). The DSLAM 201 comprises optical ports 205 that allow for transmitting xDSL signals via an optical fiber 207 and for receiving xDSL signals via said optical fiber 207 being converted to electrical xDSL signals.

In addition, a copper line 209 can be used to directly supply a CPE 210 on site (as shown and described with regard to Fig.1 above).

The CPEs 202 to 204 are attached to the DSLAM 201 in the same way. As an example, the connection of CPE 204 will be described hereinafter: The DSLAM 201 comprises an optical port 205 that works similar to the Fiber Bridge described herein. The optical fiber 207 is attached to the optical port and conveys xDSL signals over said optical fiber to a Fiber Bridge 206 that is located at or near the CPE 204, which is connected to the Fiber Bridge 206 via a copper line 208.

According to this scenario shown in Fig.2, the DSLAM 201 may be a micro DSLAM comprising xDSL ports and optical ports. The xDSL ports can be directly connected to CPEs via copper lines, the optical ports are connected via optical fibers to Fiber Bridges deployed in the vicinity of the customer's premises. The optical fibers handling xDSL signals allows for a significant increase of reach, i.e. the CPEs 202 to 204 could be deployed kilometers off the DSLAM 201 and still be able to transmit and/or receive data at rates that are comparable to data rates provided to the CPE 210 that is attached to the DSLAM 201 with a comparably short (e.g., 100m) copper line 209.

Hence, the optical fiber transporting xDSL signals allows for a comparably long distance between the CPE 204 and the DSLAM 201 (e.g., in the range of kilometers) without significant deterioration regarding the data rate (or bandwidth).

The Fiber Bridges are cost efficient devices that could be deployed at each apartment or customer's home allowing the customer to be provided with high uplink as well as high downlink data rates.

Fig.3 shows a block diagram of a Fiber Bridge 301 to which an optical fiber 302 is attached and fed to a fiber port 304. Regarding incoming signals, the fiber port 304 comprises a PIN diode 305 detecting the optical signal and conveying an analog signal to a VDSL2 processing unit 307, which forwards the signal to a hybrid circuit 308 providing an output xDSL signal 303. In opposite direction, the xDSL signal 303 may be received at the Fiber Bridge 301, wherein the hybrid circuit 308 conveys it to the VDSL2 processing unit 307, which forwards an output signal to a laser 306 (e.g., a laser diode) of the fiber port 304 further conveying an optical signal that corresponds to the xDSL signal over the optical fiber 302.

The fiber port 304, the VDSL2 processing unit 307 and the hybrid circuit 308 are connected to a power supply 309.

Further Advantages:

Advantageously, the Fiber Bridge is very cost effective compared to more complex existing ONT solutions. It requires less components and can be provided at a smaller form factor than required for typical ONT designs.

Another significant advantage stems from the operational aspect of the Fiber Bridge: It can be connected via an optical fiber to a central DSLAM component, which may be maintained like a standard xDSL access DSLAM. End users can be connected via existing (legacy) CPEs.

DSLAMs can be equipped with an optical xDSL technology as suggested by the Fiber Bridge. Hence, the DSLAM comprising a Fiber Bridge may overcome the problem of the huge amount of

power dissipation caused by the xDSL line drivers boosting the xDSL signal into the copper wires and that are located in the same DSLAM. By using Fiber Bridges at the customer's remote location, the line drivers may become part of such remote Fiber Bridges and the DSLAM itself no longer needs to provide the power for them.

List of Abbreviations:

A/D	analog to digital
CO	Central Office
CPE	Customer Premises Equipment
D/A	digital to analog
DSL	Digital Subscriber Line
DSLAM	Digital Subscriber Line Access Multiplexer
FTTB	Fiber To The Building
FTTH	Fiber To The Home
Mbps	megabit per second
MDU	Multiple Dwelling Unit
ONT	Optical Network Termination
P2P	Point-to-Point
PON	Passive Optical Network
SFU	Single Family Unit
TV	Television Set
xDSL	various types of DSL, e.g., ADSL or VDSL
xPON	various types of PON, e.g., EPON or GPON

Claims:

1. A network component
   - comprising a DSL interface for processing DSL signals and
   - comprising an optical interface,
   - wherein said DSL signals are conveyed via the optical interface.

2. The network component according to claim 1, wherein the DSL signals processed via the DSL interface are electrical DSL signals and the DSL signals conveyed via the optical interface are optically processed DSL signals.

3. The network component according to any of the preceding claims, wherein said DSL signals are xDSL signals, in particular ADSL signals or VDSL signals.

4. The network component according to any of the preceding claims, wherein layer-1 DSL signals are conveyed via the optical interface.

5. The network component according to any of the preceding claims, wherein said DSL interface is connected to an access node, in particular to a DSLAM.

6. The network component according to any of the preceding claims, wherein the network component is or is associated and/or integrated with an access node, in particular a DSLAM.

7. The network component according to any of the preceding claims, wherein said DSL interface is connected to a CPE.

8. The network component according to any of the preceding claims, wherein the optical interface is connected to an

access point, in particular an optical line termination or an optical port of a DSLAM.

9. The network component according to any of the preceding claims, wherein the DSL interface is connected with a copper line, in particular with a twisted pair copper line.

10. The network component according to any of the preceding claims, comprising a conversion unit converting electrical DSL signals to DSL signals to be conveyed via the optical interface and converting DSL signals received via the optical interface to electrical DSL signals.

11. The network according to any of the preceding claims, wherein the optical interface is connected to an optical link and/or to a radio link.

12. The network according to any of the preceding claims, wherein the optical interface processes one or more DSL signals, in particular at least one DSL channel.

13. A method for operating the network component according to any of the claims 1 to 12.

14. A system comprising at least one network component according to any of claims 1 to 12.

15. A system comprising a first network component according to any of claims 1 to 12 and a second network component according to any of claims 1 to 12, wherein the optical interfaces of the first network component and the second network component are connected with each other via at least one optical fiber.

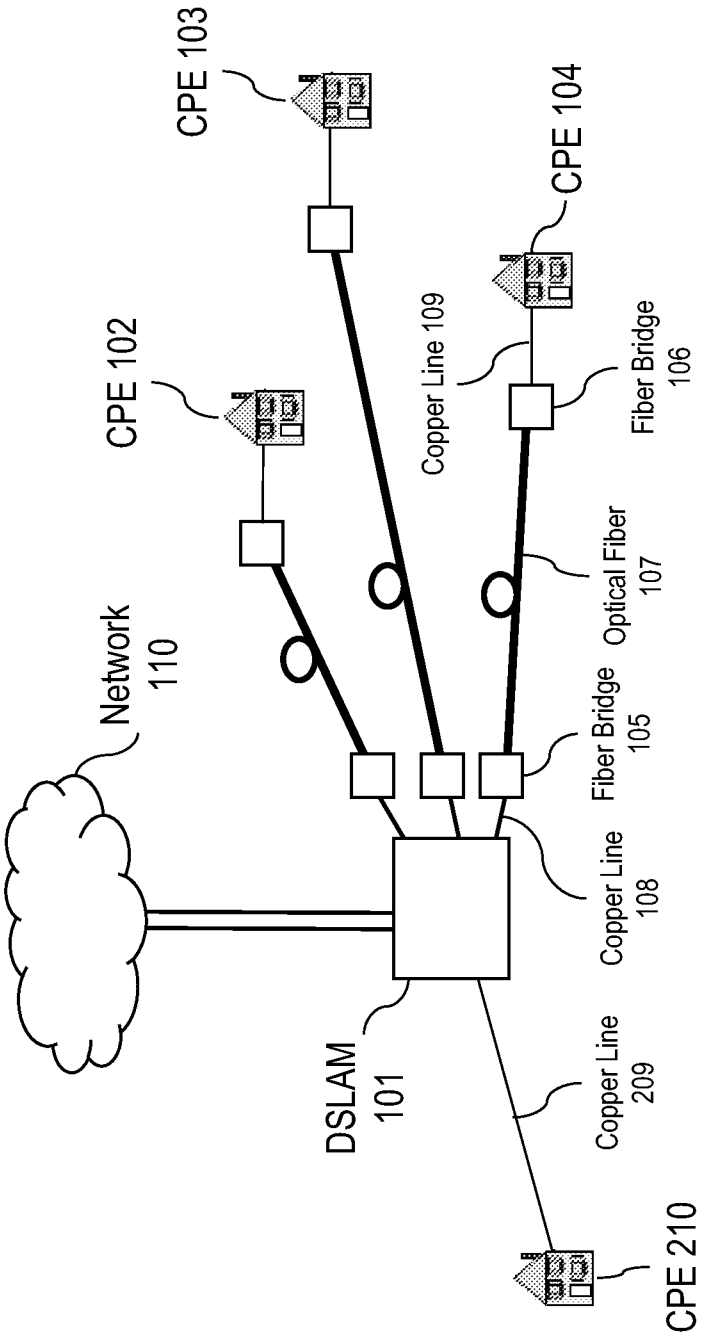

CPE 103
CPE 104
CPE 102
Copper Line 109
Fiber Bridge 106
Network 110
Optical Fiber 107
Fiber Bridge 105
Copper Line 108
DSLAM 101
Copper Line 209
CPE 210

Fig.1

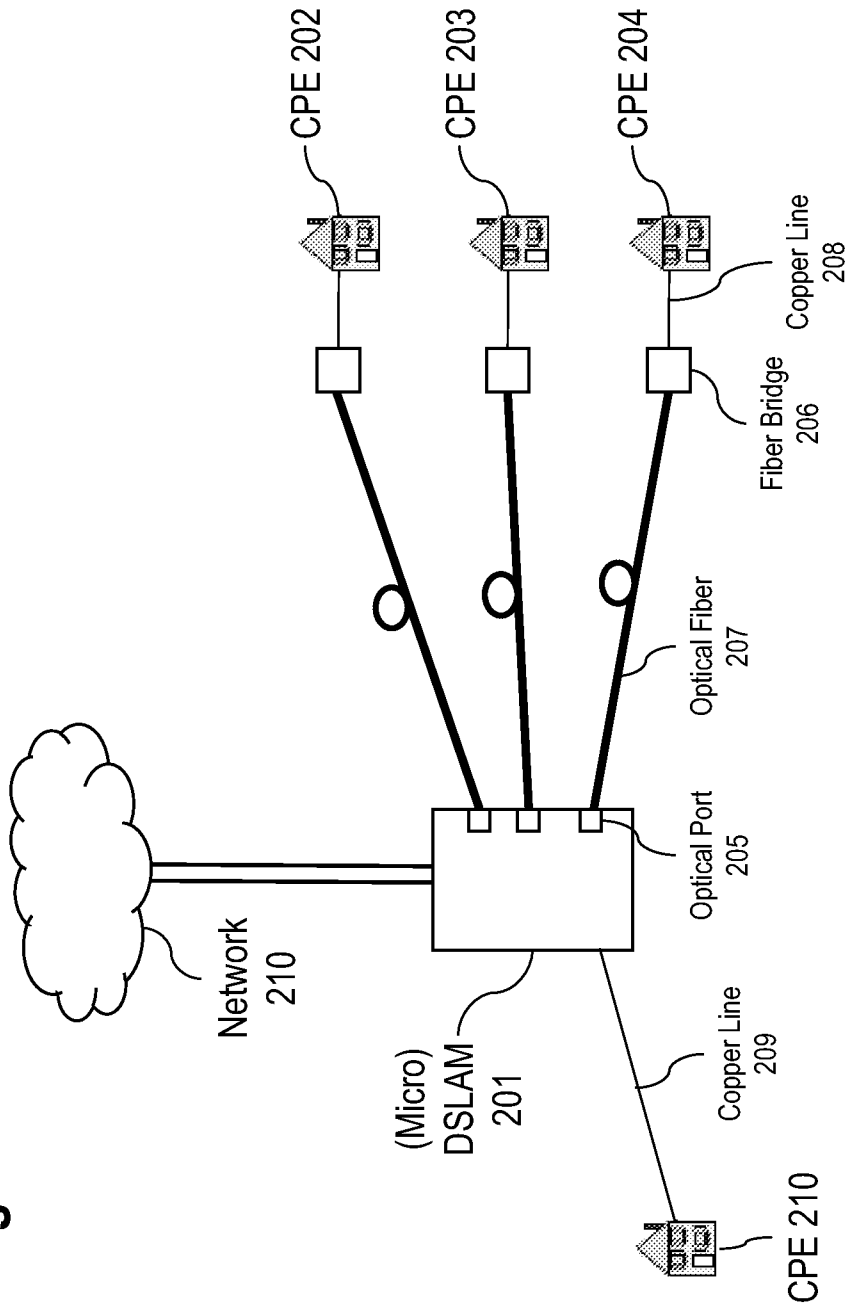

CPE 202
CPE 203
CPE 204
Copper Line
208
Fiber Bridge
206
Optical Fiber
207
Optical Port
205
Network
210
(Micro)
DSLAM
201
Copper Line
209
CPE 210

Fig.2

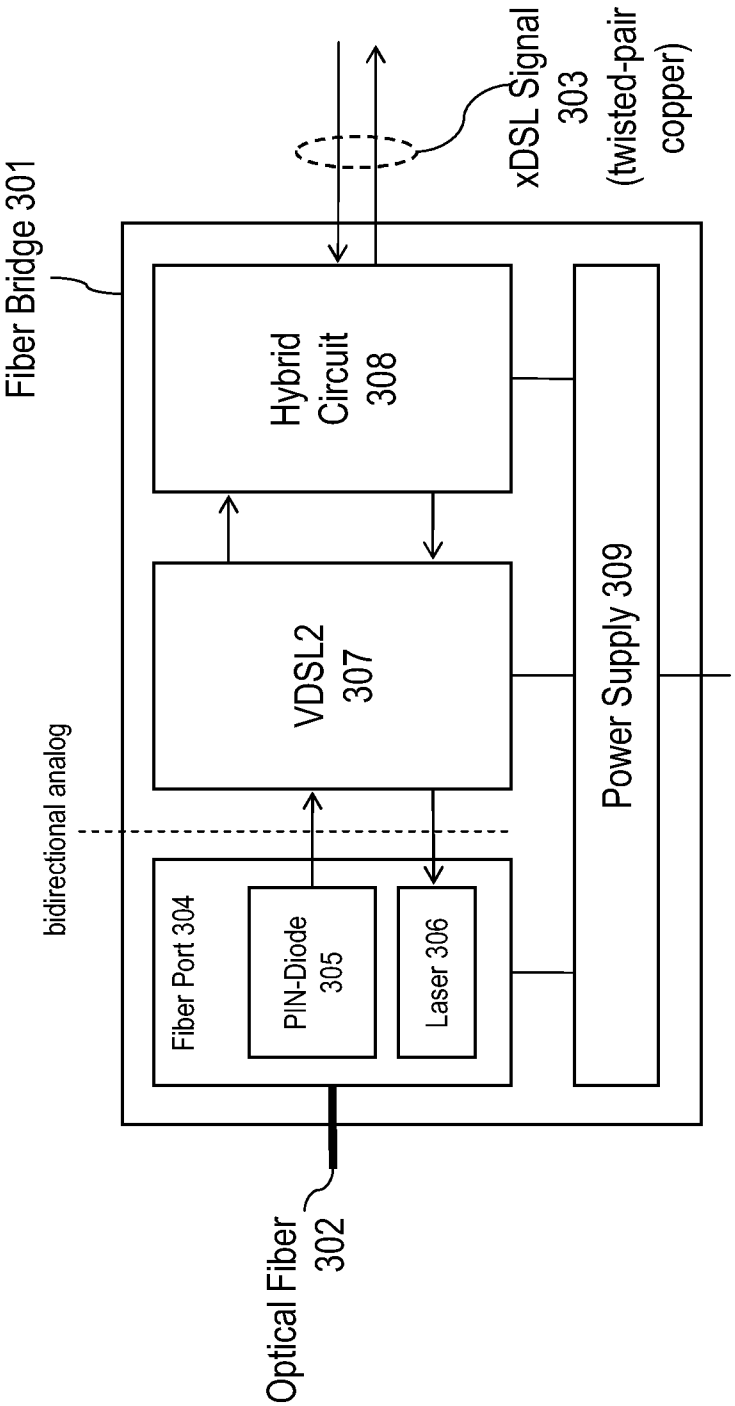

Fiber Bridge 301
xDSL Signal
303
(twisted-pair
copper)
Hybrid
Circuit
308
VDSL2
307
Power Supply 309
bidirectional analog
Fiber Port 304
PIN-Diode
305
Laser 306
Optical Fiber
302

Fig.3

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2009/051577

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04J14/02 H04M3/30

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H04M H04J H04B H04L

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

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2008/170605 A1 (UHLEMANN STEFAN [DE] ET AL) 17 July 2008 (2008-07-17) paragraphs [0002], [0013], [0016] - [0023] figures 1,3	1-15
X	GB 2 383 919 A (FUJITSU LTD [JP]) 9 July 2003 (2003-07-09) abstract page 1, line 10 - page 2, line 16 page 9, line 5 - page 12, line 8 figure 2	1-15

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
13 October 2009	21/10/2009

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Fax: (+31–70) 340–3016	Hamer, Jeremy

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2009/051577

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 03/017634 A (GOWDA UMESH [FI]; LAAMANEN HEIKKI [FI]) 27 February 2003 (2003-02-27) abstract page 1, lines 6-10 page 1, line 14 - page 2, line 21 page 7, line 24 - page 8, line 2 figures 1,2	1-15
X	JP 2003 209622 A (OKI ELECTRIC IND CO LTD) 25 July 2003 (2003-07-25) abstract	1-15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2009/051577

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