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(71) Applicant *(for all designated States except US)*: **KT CORPORATION** [KR/KR]; 206 Jeongja-dong, Bundang-gu, Sungnam-si, Gyeonggi-do 463-010 (KR).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **PARK, Soo Jin** [KR/KR]; #203-106 Moogunghwa Apt., Wolpyung, 2-dong, Seo-gu, Daejeon 302-747 (KR). **SONG, Kil Ho** [KR/KR]; 463-1 Jeonmin-dong, Yuseong-gu, Daejeon 305-811 (KR).

(74) Agent: **BAE, KIM & LEE IP GROUP**; Hankook Tire Bldg., 647-15 Yoksam-dong,, Gangnam-gu,, Seoul 135-723 (KR).

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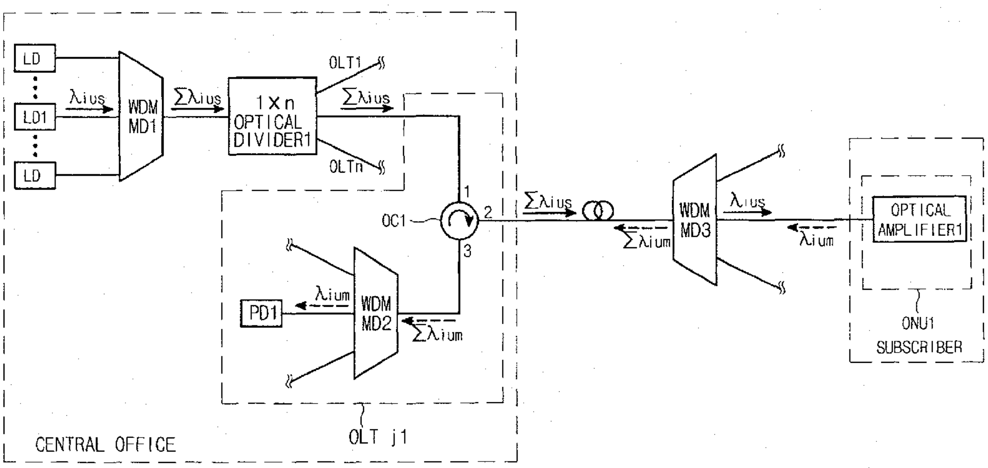
(54) Title: WAVELENGTH DIVISION MULTIPLEXING-PASSIVE OPTICAL NETWORK SYSTEM



(57) Abstract: A wavelength division multiplexing-passive optical network (WDM-PON) system comprises a light source provider configured to wavelength-division-multiplex a laser light source of a wavelength allotted to each subscriber and optical-power-divide the multiplexed light source, a plurality of optical line terminals each configured to transmit a light source for upward signal with the power-divided light source and convert an upward optical signal into an electric signal, a plurality of optical network units each configured to convert the light source for upward signal into the upward optical signal, and a multiplexer/demultiplexer configured to separate the signal source for upward signal transmitted from the optical line termination in each subscriber or to multiplex the upward optical signal for each subscriber transmitted from the optical network unit so as to transmit the multiplexed signal into the optical line terminal.

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WAVELENGTH DIVISION MULTIPLEXING-PASSIVE OPTICAL NETWORK SYSTEM

Technical Field

The present invention generally relates to a wavelength division multiplexing-passive optical network (hereinafter, referred to as "WDM-PON") system, and more specifically, to a WDM-PON system configured to multiplex and divide laser lights having various wavelengths each having the same intensity in a central office to supply the laser lights to subscribers so that several subscribers share a light source having the same wavelength.

Background of the Invention

As the information society is moved into, people are keenly concerned to a WDM-PON configured to connect an optical line directly to a subscriber terminal so as to supply various wideband multimedia services to a plurality of subscribers. The WDM-PON refers to a network configured to connect an interval between an optical line terminal (hereinafter, referred to as "OLT") and an optical network unit (hereinafter, referred to as "ONU") with a passive optical device and to transmit optical signals having multiplexed letters/audio/video data into each ONU. The WDM-PON can provide information of large capacity to subscribers with excellent security and performance.

Fig. 1 is a diagram illustrating a conventional WDM-PON system.

In the conventional WDM-PON system of Fig. 1, when a central office provides a light source ($\sum\lambda_{is}$) of a predetermined intensity in different wavelengths for each subscriber, a WDM multiplexer/demultiplexer (hereinafter, referred to as "WDM MD") located in a remote node of a subscriber demultiplexes wavelengths of light sources in each subscriber and transmits the demultiplexed light source into the ONU. The light source λ_{is} having the demultiplexed wavelength is modulated by projecting the light into a reflective optical amplifier of the ONU and amplifying or absorbing the light depending on input current of the optical amplifier. A modulated subscriber optical signal λ_{im} is multiplexed in the WDM MD ($\sum\lambda_{im}$) and transmitted into the central office.

However, in the conventional WDM-PON system, light sources having the same wavelength cannot be used by several subscribers since not a light of a predetermined intensity but a signal light is used. As a result, a light source between the central office and the ONU and a wavelength of optical signals are different in each subscriber, and a large amount of resources is required to embody the above-described system in an optical subscriber network to admit a large number of subscribers, thereby requiring great cost.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Technical Subject

Various embodiments of the present invention is directed at providing a WDM-PON system configured to multiplex and divide a laser light of various wavelengths each having the same intensity so that several subscribers share a light source.

Technical Solution

According to an embodiment of the present invention, a wavelength division multiplexing-passive optical network system comprises: a light source provider configured to wavelength-division-multiplex a laser light source of a wavelength allotted to each subscriber and optical-power-divide the multiplexed light source; a plurality of optical line terminals each configured to transmit a light source for upward signal with the power-divided light source and convert an upward optical signal into an electric signal; a plurality of optical network units each configured to convert the light source for upward signal into the upward optical signal; and a multiplexer/demultiplexer configured to demultiplex the light source for upward signal transmitted from the optical line terminal in each subscriber so as to transmit the demultiplexed light source into the optical network unit or to multiplex the upward optical signal for each subscriber transmitted from the optical network unit so as to transmit the multiplexed signal into the optical line terminal.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a diagram illustrating a conventional WDM-PON system.

Fig. 2 is a diagram illustrating a first example according to an embodiment of the present invention.

Fig. 3 is a diagram illustrating an optical amplifier according to an embodiment of the present invention.

Fig. 4 is a diagram illustrating a second example according to an embodiment of the present invention.

Fig. 5 is a diagram illustrating a third example according to an embodiment of the present invention.

Fig. 6 is a diagram illustrating a fourth example according to an embodiment of the present invention.

Preferred Embodiments

The present invention will be described in detail with reference to the accompanying drawings.

In an embodiment, a WDM-PON system includes a laser diode (hereinafter, referred to as "LD"), a WDM MD, an optical divider, a photo diode (hereinafter, referred to as "PD"), an optical circulator and an optical amplifier. The WDM-PON system is explained based on the flow of signals. Fig. 2 is a diagram illustrating a first example according to an embodiment of the present invention.

According to the first example of the present invention, a WDM MD1 wavelength-division-multiplexes a light source λ_{ius} corresponding to a wavelength of an i-subscriber supplied from a LD1 and light sources for the other subscribers. The light source is supplied form the single mode LD such as a DFB LD (Distributed FeedBack Laser Diode). The light source λ_{ius} is used for an upward signal to be transmitted from an ONU1 into a central office.

A light source $\sum\lambda_{ius}$ for upward signal which is multiplexed in the WDM MD1 is light-power-divided in a 1×n optical divider 1, and then supplied into each of OLT1~OLTn. Herein, OLTj1 of the OLTs is exemplified.

The light source λ_{ius} for upward signal of each subscriber supplied to the OLTj1 is transmitted into a WDM MD3 through an optical circulator OC1. The light source $\sum\lambda_{ius}$ for upward signal is demultiplexed in each subscriber in the WDM MD3, and the demultiplexed light source λ_{ius} is transmitted into the ONU1 of the subscriber.

The light source λ_{ius} for upward signal transmitted into the ONU1 is transmitted into an optical amplifier 1, and then modulated into an upward optical signal λ_{ium} having the same wavelength as that of the light source λ_{ius} for upward signal. The optical amplifier 1 is a reflection-type semiconductor optical amplifier.

Fig. 3 is a diagram illustrating the optical amplifier 1 according to an embodiment of the present invention.

The light source λ_{ius} projected into an active wave guide path 4 of the optical amplifier 1 through an optical wave guide path 2 is reflected in a high-reflection coating film 6, and outputted into the optical wave guide path 2 through the active wave guide path 4. The light source λ_{ius} is amplified depending on signal current (not shown) inputted into a substrate 8 while moving along the active wave guide path 4. That is, since the upward optical signal λ_{ium} copies the signal current, the optical amplifier 1 converts an electric signal into the upward optical signal λ_{ium} having the same wavelength as that of the light source λ_{ius} for upward signal.

The upward optical signal λ_{ium} generated from the optical amplifier 1 is transmitted into the WDM MD3 through an optical path where the light source λ_{ius} for upward signal is transmitted, multiplexed with the upward optical signals of other subscribers by the WDM MD3, and then transmitted into the OLTj1 of the central office.

The multiplexed upward light signal $\sum\lambda_{ium}$ is inputted in a 2nd port of the OC1, and outputted into a 3rd port. The outputted upward light signal $\sum\lambda_{ium}$ is demultiplexed in the WDM MD2 in each subscriber, projected in the PD1, and then converted into an electric signal.

The above-described first example according to an embodiment of the present invention is characterized in that a single mode laser light source whose wavelength is allotted to each subscriber is multiplexed and divided so that the light source can be shared in several systems, and in that the wavelength of the optical signal transmitted from the ONU is determined by a light source supplied from the central office.

Fig. 4 is a diagram illustrating a second example of the WDM-PON system according to an embodiment of the present invention. The system of Fig. 4 simultaneously transmits a downward optical signal from the central office into the ONU and an upward optical signal from the ONU into the central office.

In this embodiment, a WDM MD4 multiplexes the light source λ_{ius}

corresponding to a wavelength of an i-subscriber supplied from the LD2 and other light sources of other subscribers. The light source is supplied from the single mode LD such as the DFB LD, and the light source λ_{ius} is a light source for upward signal transmitted from the ONU2 into the central office.

The light source $\sum\lambda_{ius}$ for upward signal, which is multiplexed in the WDM MD4 is light-power-divided in a 1×n optical divider 2, and supplied into each of OLT1~OLTn. Herein, OLTj2 of the OLTs is exemplified.

The light source $\sum\lambda_{ius}$ for upward signal of each subscriber supplied to the OLTj2 is projected into a WDM MD8 through an optical circulator OC2, and multiplexed with a downward optical signal $\sum\lambda_{idm}$. The WDM MD8 multiplexes the light source for upward signal and the downward optical signal.

The downward optical signal $\sum\lambda_{idm}$ and the multiplexed light source $\sum\lambda_{ius}$ for upward signal are transmitted into a WDM MD9 of a subscriber through an optical path. The light source $\sum\lambda_{ius}$ is demultiplexed in the WDM MD9 in each subscriber, and the demultiplexed light sources λ_{ius} are transmitted into the ONU2 of the subscriber. Preferably, the light source λ_{ius} for upward signal and a downward optical signal λ_{idm} of the i-subscriber are outputted into the same output port.

The light source λ_{ius} for upward signal transmitted into the ONU2 is separated form the downward optical signal λ_{idm} by a WDM MD10, and transmitted into an optical amplifier 3. The optical amplifier 3 generates the upward optical signal λ_{ium} as shown in Fig. 3.

The upward optical signal λ_{ium} generated from the optical amplifier 3 is transmitted into the WDM MD9 through the WDM MD10, multiplexed with upward optical signals of other subscribers by the WDM MD9, and transmitted into the OLTj2 of the central office.

The multiplexed upward optical signal $\sum\lambda_{ium}$ is inputted into the 2^{nd} port of the optical circulator OC2 through the WDM MD8, and outputted into the 3^{rd} port. The upward optical signal $\sum\lambda_{ium}$ is demultiplexed in a WDM MD5 in each subscriber, and the demultiplexed upward optical signal λ_{ium} is projected into the PD2, and converted into an electric signal.

In the second example according to an embodiment of the present invention, a light source λ_{ids} for downward signal of an i-subscriber is multiplexed in a WDM MD6 with light sources for downward signal of other subscribers. The multiplexed light source $\sum\lambda_{ids}$ for downward signal is light-power-divided in a 1×n optical divider 3, and transmitted into a WDM MD7 through an optical circulator OC3. The wavelength of the light source λ_{ids} for downward signal is determined so that the light source λ_{ius} for upward signal of the i-subscriber and the downward optical signal λ_{idm} are demultiplexed into an output port.

The multiplexed light source $\sum\lambda_{ids}$ for downward signal is demultiplexed into the light source λ_{ids} of the i-subscriber in the WDM MD7, and the demultiplexed light source λ_{ids} is transmitted into the optical amplifier 2. As shown in Fig. 3, the optical amplifier 2 generates the downward optical signal λ_{idm}, and transmits it into the WDM MD7 which multiplexes the downward optical signal λ_{idm} with downward optical signals of other subscribers.

The multiplexed downward light signal $\sum\lambda_{idm}$ is projected into a WDM MD8 through the optical circulator OC3, multiplexed with the light source $\sum\lambda_{ius}$ for upward signal, and transmitted into the WDM MD9 of the subscriber.

The WDM MD9 demultiplexes the downward optical signal $\sum\lambda_{idm}$ in each subscriber, and transmits the demultiplexed signal λ_{idm} into the ONU2 of the subscriber.

The downward optical signal λ_{idm} transmitted into the ONU2 is separated from the light source λ_{ius} for upward signal by a WDM MD10 in the ONU2, transmitted into a PD3, and converted into an electric signal.

As mentioned above, the second example is characterized in that the configuration for transmitting a light source for downward signal and a downward optical signal is further comprised in the first example having the configuration for the light source for upward signal and the upward optical signal.

While two WDM MDs (WMD MD5, WDM MD7) are used for multiplexing and demultiplexing of optical signals and light sources in each subscriber in the OLT in the second example, Fig. 5 is a diagram illustrating a third example according to an embodiment of the present invention where one WDM MD (WDM MD14) for multiplexing or demultiplexing of optical signals and light sources in each subscriber. In the third example, wavelengths of the light source for downward signal, the downward optical signal, the light source for upward signal and the upward optical signal are determined so that they may be separated into the same port to the same subscriber when they are separated in the WDM MD14 and the WDM MD17.

In the third example, a WDM MD11 multiplexes the light source λ_{ius} corresponding to the wavelength of the i-subscriber supplied from a LD4 and other light sources of other subscribers. The light sources are supplied from the single mode LD such as a DFB LD. The light source λ_{ius} is a light source for upward signal transmitted from an ONU3 into the central office.

The multiplexed light source $\sum\lambda_{ius}$ for upward signal in the WDM MD11 is light-power-divided in a 1×n optical divider 4, and supplied into each of OLT1~OLTn. Herein, OLTj3 of the OLTs is exemplified.

The light source $\sum\lambda_{ius}$ for upward signal of each subscriber supplied to the OLTj3 is projected into a WDM MD16 through an optical circulator OC3, and multiplexed with a downward optical signal $\sum\lambda_{idm}$. The WDM MD16 multiplexes the light source for upward signal and the downward optical signal.

The downward optical signal $\sum\lambda_{idm}$ and the multiplexed light source $\sum\lambda_{ius}$ for upward signal are transmitted into a WDM MD17 of a subscriber through an optical path. The light source $\sum\lambda_{ius}$ for upward signal is demultiplexed in the WDM MD17 in each subscriber, and the demultiplexed light source λ_{ius} is transmitted into the ONU3 of the subscriber. Preferably, the light source λ_{ius} for upward signal and a downward optical signal λ_{idm} of the i-subscriber are outputted into the same output port.

The light source λ_{ius} for upward signal transmitted into the ONU3 is separated form the downward optical signal λ_{idm} by a WDM MD18, and transmitted into an optical amplifier 5. The optical amplifier 5 generates the upward optical signal λ_{ium} as shown in Fig. 3.

The upward optical signal λ_{ium} generated from the optical amplifier 5 is transmitted into the WDM MD17 through the WDM MD18, multiplexed with upward optical signals of other subscribers by the WDM MD17, and transmitted into the OLTj3 of the central office.

The multiplexed upward optical signal $\sum\lambda_{ium}$ is inputted into the 2nd port of the optical circulator OC4 through the WDM MD16 and outputted into the 3rd port. The upward optical signal $\sum\lambda_{ium}$ is multiplexed with the light source $\sum\lambda_{ids}$ for downward signal in the WDM MD15, and transmitted into the 2nd port of the WDM MD14.

The upward optical signal $\sum\lambda_{ium}$ and the light source $\sum\lambda_{ids}$ for downward signal are demultiplexed in each subscriber in the WDM MD14, and the upward optical signal λ_{ium} and the light source λ_{ids} for downward signal of the same subscriber are outputted into the same port (1st port). The outputted upward optical signal λ_{ium} like the light source λ_{ids} for downward signal in the WDM MD14 is separated from the light source λ_{ids} in the WDM MD13, transmitted into a PD4, and converted into an electric signal.

In the third example according to an embodiment of the present invention, the light source λ_{ids} for downward signal supplied from a LD5 is multiplexed in the WDM MD12 with other light sources for downward signal of other subscribers, light-power-divided in a 1×n optical divider 5, and transmitted into the WDM MD15 through an optical circulator OC5.

The light source $\sum\lambda_{ids}$ for downward signal is multiplexed with the upward optical signal $\sum\lambda_{ium}$ by the WDM MD15, and then transmitted into the WDM MD14.

The WDM MD14 outputs the upward optical signal λ_{ium} and the light source λ_{ids} for downward signal in each subscriber into the same port (1st port). The light source λ_{ids} for downward signal outputted with the upward optical signal λ_{ium} in the WDM MD14 is separated from the upward optical signal λ_{ium} in the WDM MD13, and transmitted into an optical amplifier 4. The optical amplifier 4 generates the downward optical signal λ_{idm} as shown in Fig. 3.

The downward optical signal λ_{idm} generated from the optical amplifier 4 is multiplexed with other downward optical signals of other subscribers in the WDM MD14, and transmitted into the WDM MD16 through the WDM MD15 and the optical circulator OC5.

The downward optical signal $\sum\lambda_{idm}$ transmitted into the WDM MD16 is multiplexed with the light source $\sum\lambda_{ius}$ for upward signal, and transmitted into the WDM MD17 of the subscriber through an optical path.

The WDM MD17 separates the downward optical signal $\sum\lambda_{idm}$ and the light source $\sum\lambda_{ius}$ for upward signal into the same port in each subscriber. The downward optical signal λ_{idm} separated in each subscriber is transmitted into the ONU3 with the light source λ_{ius} for upward signal, separated from the light source λ_{ius} for upward signal in the WDM MD18, transmitted into a PD5, and converted into an electric signal.

In the third example, the WDM MD13, the WDM MD15, the WDM MD16 and the WDM MD17 multiplex or demultiplex the light source for downward signal or the downward optical signal with the light source for upward signal or the upward optical signal, and the WDM MD14 and the WDM MD17 multiplex or demultiplex light sources or optical signals in each subscriber.

Fig. 6 is a diagram illustrating a fourth example of the WDM-PON system according to an embodiment of the present invention.

In the fourth example, the light source λ_{ius} for upward signal supplied from the central office into the ONU is light-power-divided in a 1×n optical divider 6 so that it may be shared in several systems. The DFB LD is used for the light source for upward signal as the single mode LD having a predetermined size.

The light source λ_{ius} for upward signal for the i-subscriber which is light-power-divided into 1/n in the 1×n optical divider 6 is multiplexed with the downward optical signal λ_{idm} in a WDM MD19, and transmitted into the i-th port (4^{th} port) of bidirectional arrayed waveguide grating (hereinafter, referred to as "BD AWG"). The BD AWG, which is a kind of the WDM MD, multiplexes various wavelengths inputted into different port to output them into one port, or demultiplexes the multiplexed wavelengths inputted into one port to output them into each port.

The light source λ_{ius} for upward signal transmitted into the BD AWG is multiplexed with light sources for upward signal of other subscribers.

The multiplexed light source $\sum\lambda_{ius}$ for upward signal is transmitted into a WDM MD20, separated from the downward optical signal $\sum\lambda_{idm}$ in the WDM MD20, and transmitted into a WDM MD 22 through an optical circulator OC7.

The light source $\sum\lambda_{ius}$ for upward signal transmitted into the WDM MD22 is transmitted into the AWG of the subscriber, and demultiplexed in each subscriber, and the demultiplexed light source λ_{ius} is outputted into the 2nd port and transmitted into the ONU.

The light source λ_{ius} for upward signal transmitted into the ONU is inputted into the 1st port of a WDM MD24 in the ONU so that it is separated from the downward optical signal λ_{idm} and outputted into the 2nd port. The light source λ_{ius} for upward signal outputted into the 2nd port of the WDM MD24 is transmitted into an optical amplifier 7, and converted into the upward optical signal λ_{ium}.

The upward optical signal λ_{ium} is inputted into the 2nd port of the BD AWG through the WDM MD24, multiplexed with other upward signals of other subscribers inputted into other ports, and outputted into the 1st port.

The multiplexed upward optical signal $\sum\lambda_{ium}$ of subscribers is transmitted into the OLT located at the central office, inputted into the 3rd port of the BD AWG through the WDM MD22, the optical circulator OC7 and a WDM MD21 in the OLT, and demultiplexed into each wavelength of each subscriber, and the demultiplexed upward optical signal λ_{ium} is outputted into the 1st port as.

The upward optical signal λ_{ium} outputted into the 1st port of the BD AWG is transmitted into a PD6 through a WDM MD23, and converted into an electric signal in a PD6. The WDM MD23 multiplexes or demultiplexes the upward optical signal λ_{ium} and the light source λ_{ids} for downward signal.

The light source λ_{ids} for downward signal supplied from the DFB LD2 is light-power-divided in a 1×n optical divider 7, and transmitted into the WDM MD23. The WDM MD23 multiplexes or demultiplexes the upward optical signal λ_{ium} and the light source λ_{ids} for downward signal.

The light source λ_{ids} for downward signal outputted from the WDM MD23 is inputted into the 1st port of the BD AWG, multiplexed with other light sources for downward signal of other subscribers inputted into other ports, and outputted into the 3rd port.

The multiplexed light source $\sum\lambda_{ids}$ for downward signal is inputted into the 2nd port of the BD AWG through the WDM MD21, an optical circulator OC6 and the WDM MD20, and demultiplexed into light sources for each subscriber, and the demultiplexed light source λ_{ids} for downward signal is outputted into the 4th port.

The light source λ_{ids} for downward signal of each subscriber outputted into the 4th port of the BD AWG is transmitted into the WDM MD19.

The light source λ_{ids} for downward signal outputted from the WDM MD19 is converted into the downward optical signal λ_{idm} in the power amplifier 6 as shown in Fig. 3.

The downward optical signal λ_{idm} is projected into the WDM MD19, multiplexed with the light source λ_{ius} for upward signal, inputted into the 4th port of the BD AWG, multiplexed with other downward optical signals of other subscribers inputted into other ports, and outputted into the 2nd port as $\sum\lambda_{idm}$.

The multiplexed downward optical signal $\sum\lambda_{idm}$ is demultiplexed from the light source $\sum\lambda_{ius}$ for upward signal by the WDM MD20, multiplexed with the light source $\sum\lambda_{ius}$ for upward signal in the WDM MD22 through the optical circulator OC6, transmitted into the BD AWG of the subscriber and demultiplexed in each subscriber, and the demultiplexed downward optical signal λ_{idm} is outputted into the 2nd port, and transmitted into the ONU.

The downward optical signal λ_{idm} transmitted into the ONU is inputted into the 1st port of the WDM MD24 in the ONU, separated from the light source λ_{ius}, and outputted into the 3rd port. The downward optical signal λ_{idm} outputted into the 3rd port of the WDM MD24 is transmitted into a PD7, and converted into an electric signal.

In the above-described fourth example, the optical divider is comprised in the rear end of the DFB LD unlike the first through third examples where the WDM MD and the optical divider are sequentially comprised in the rear end of the DFB LD. AS a result, a light source whose wavelength is allotted for a specific subscriber is light-power-divided so that several subscribers may share a single laser.

As shown in the first through fourth examples, a single mode laser light source having a wavelength allotted to each subscriber is multiplexed by power-dividing the multiplexed light so that several systems may share it.

Industrial Applicability

As described above, according to an embodiment of the present invention, a single mode laser light source having a wavelength allotted to each subscriber, and light-power-divided so that several systems may share the light source, thereby reducing resources and cost required for constitution of the system.

Moreover, a wavelength of an optical signal transmitted from an ONU is determined by a light source supplied from a central office so that it is not necessary to administrate the wavelength in the ONU.

What is Claimed is:

1. A wavelength division multiplexing-passive optical network system comprising:

a light source provider configured to wavelength-division-multiplex a laser light source of a wavelength allotted to each subscriber and optical-power-divide the multiplexed light source;

a plurality of optical line terminals each configured to transmit a light source for upward signal using the power-divided light source and convert an upward optical signal into an electric signal;

a plurality of optical network units each configured to convert the light source for upward signal into the upward optical signal; and

a multiplexer/demultiplexer configured to demultiplex the light source for upward signal transmitted from the optical line terminal in each subscriber so as to transmit the demultiplexed light source into the optical network unit or to multiplex the upward optical signal for each subscriber transmitted from the optical network unit so as to transmit the multiplexed signal into the optical line terminal.

2. The system according to claim 1, wherein the light source provider comprises:

a plurality of laser diodes each configured to supply the laser light source;

a 1st multiplexer/demultiplexer configured to wavelength-division-multiplex the laser light source supplied from the plurality of laser diodes; and

a 1st light dividing unit configured to divide the multiplexed laser light source so as to transmit the divided light source into the plurality of optical line terminals respectively.

3. The system according to claim 1 or 2, wherein the optical line terminal comprises:

a 2nd multiplexer/demultiplexer configured to demultiplex the multiplexed upward optical signal in each subscriber;

a plurality of photo diodes each configured to convert the upward optical signal demultiplexed in the 2nd multiplexer/demultiplexer into the electric signal; and

a 1st optical circulator configured to transmit the light source for upward signal transmitted from the 1st light divider into the multiplexer/demultiplexer and to transmit the multiplexed upward optical signal transmitted from the multiplexer/demultiplexer into the 2nd multiplexer/demultiplexer.

4. The system according to claim 3, wherein the optical network unit comprises a 1st optical amplifier configured to convert the light source for upward signal demultiplexed in each subscriber which is transmitted from the multiplexer/demultiplexer into the upward optical signal depending on input signal current so as to transmit the converted signal into the multiplexer/demultiplexer.

5. The system according to claim 1 or 2, wherein the light source provider comprises:

a light source provider for upward signal configured to provide the light source for upward signal; and

a light source provider for downward signal configured to provide a light source for downward signal.

6. The system according to claim 5, wherein the optical line terminal multiplexes a downward optical signal generated from the light sources for downward signal and the light source for upward signal so as to transmit the multiplexed signal into the multiplexer/demultiplexer.

7. The system according to claim 6, wherein the multiplexer/demultiplexer demultiplexes the downward optical signal transmitted from the optical line terminal in each subscriber so as to transmit the demultiplexed signal into the optical network unit.

8. The system according to claim 7, wherein the optical network unit comprises:

a 3rd multiplexer/demultiplexer configured to separate the light source for upward signal and the downward optical signal demultiplexed in each subscriber which are transmitted from the multiplexer/demultiplexer so as to transmit the separated signal;

a 2nd optical amplifier configured to convert the light source for upward signal transmitted from the 3rd multiplexer/demultiplexer into the upward optical signal depending on input signal current so as to transmit the converted signal into the 3rd multiplexer/demultiplexer; and

a 2nd photo diode configured to convert the downward optical signal transmitted from the 3rd multiplexer/demultiplexer into an electric signal.

9. The system according to claim 8, wherein the optical line terminal comprises:

a 4th multiplexer/demultiplexer configured to multiplex the light source for upward signal and the downward optical signal so as to provide the multiplexed signals into the multiplexer/demultiplexer and transmit the multiplexed upward optical signal transmitted from the multiplexer/demultiplexer;

a 5th multiplexer/demultiplexer configured to demultiplex the multiplexed upward optical signal in each subscriber;

a plurality of 3rd photo diodes each configured to convert the upward optical signal demultiplexed in each subscriber in the 5th multiplexer/demultiplexer into the electric signal;

a 2nd optical circulator configured to transmit the light source for upward signal into the 4th multiplexer/demultiplexer and to transmit the multiplexed upward optical signal received from the 4th multiplexer/demultiplexer into the 5th multiplexer/demultiplexer;

a 6th multiplexer/demultiplexer configured to demultiplex the light source for downward signal in each subscriber or to multiplex the downward optical signal in each subscriber;

a 3rd optical amplifier configured to convert the light source for downward signal transmitted from the 6th multiplexer/demultiplexer into the downward optical signal depending on input signal current so as to transmit the converted signal into the 6th multiplexer/demultiplexer; and

a 3rd optical circulator configured to transmit the light source for downward signal transmitted from the 1st optical divider of the light source provider for downward signal into the 6^{th} multiplexer/demultiplexer and to transmit the multiplexed downward optical signal transmitted from the 6^{th} multiplexer/demultiplexer into the 4^{th} multiplexer/demultiplexer.

10. The system according to claim 8, wherein the optical line terminal comprises:

a 7^{th} multiplexer/demultiplexer configured to multiplex the light source for upward signal and the downward optical signal so as to provide the multiplexed signals into the multiplexer/demultiplexer and to transmit the multiplexed upward optical signal transmitted from the multiplexer/demultiplexer;

a 4^{th} optical circulator configured to transmit the light source for upward signal into the 7^{th} multiplexer/demultiplexer and to transmit the multiplexed upward optical signal received from the 7^{th} multiplexer/demultiplexer;

a 5^{th} optical circulator configured to transmit light source for downward signal transmitted from the 1^{st} optical divider of the light source provider for downward signal and to transmit the multiplexed downward optical signal into the 7^{th} multiplexer/demultiplexer;

a 8^{th} multiplexer/demultiplexer configured to multiplex the multiplexed upward optical signal transmitted from the 4^{th} optical circulator and the light source for downward signal transmitted from the 5^{th} optical circulator and to transmit the multiplexed downward optical signal into the 5^{th} optical circulator;

a 9^{th} multiplexer/demultiplexer configured to demultiplex the multiplexed upward optical signal and the light source for downward signal in each subscriber and to multiplex the downward optical signal for each subscriber so as to transmit the multiplexed downward optical signal into the 8^{th} multiplexer/demultiplexer;

a 10^{th} multiplexer/demultiplexer configured to separate the light source for downward signal and the upward optical signal which are demultiplexed in each subscriber in the 9^{th} multiplexer/demultiplexer from the upward optical signal;

a 4^{th} optical amplifier configured to convert the light source for downward signal transmitted from the 10^{th} multiplexer/demultiplexer into the downward optical signal depending on input signal current so as to transmit the converted signal into the 10^{th} multiplexer/demultiplexer; and a 4th photo diode configured to convert the upward optical signal transmitted from the 10th multiplexer/demultiplexer into an electric signal.

11. A wavelength division multiplexing-passive optical network system comprising:

a light source provider for upward signal configured to light-power-divide a laser light source of a wavelength allotted to each subscriber so as to provide a light source for upward signal;

a light source provider for downward signal configured to light-power-divide a laser light source of a wavelength allotted to each subscriber so as to provide a light source for downward signal;

a plurality of optical line terminals each configured to multiplex the light source for upward signal which is light-power-divided and a downward optical signal generated from the light source for downward signal and to convert the upward optical signal inputted into an electric signal;

a plurality of optical network units each configured to convert the light source for upward signal into the upward optical signal; and

a multiplexer/demultiplexer configured to separate the light sources for upward signal and the downward optical signal transmitted from the optical line terminal in each subscriber so as to transmit the separated signals into the optical network unit and to multiplex the upward optical signal for each subscriber transmitted from the optical network unit so as to transmit the multiplexed signal into the optical line terminal.

12. The system according to claim 11, wherein each of the light source provider for upward signal and the light source provider for downward signal comprises:

a DFB laser diode configured to supply the laser light source; and

a 1st light divider configured to light-power-divide the laser light source so as to transmit the divided the light source into the plurality of optical line terminals respectively.

13. The system according to claim 11 or 12, wherein the optical network unit comprises:

a 1st multiplexer/demultiplexer configured to separate the light sources for upward signal and the downward optical signal demultiplexed in each subscriber which are transmitted from the multiplexer/demultiplexer;

a 1st optical amplifier configured to convert the light source for upward signal transmitted from the 1st multiplexer/demultiplexer into the upward optical signal depending on input signal current so as to transmit the converted signal into the 1st multiplexer/demultiplexer; and

a 1st photo diode configured to convert the downward optical signal transmitted from the 1st multiplexer/demultiplexer into an electric signal.

14. The system according to claim 13, wherein the optical line terminal comprises:

a 2nd optical amplifier configured to convert the light source for downward signal into the downward optical signal depending on input signal current;

a 2nd multiplexer/demultiplexer configured to multiplex the light source for upward signal transmitted from the 1st light divider of the light source provider for upward signal and the downward optical signal transmitted from the 2nd optical amplifier;

a 3rd multiplexer/demultiplexer configured to transmit the light source for downward signal and the upward optical signal transmitted from the 1st light divider of the light source provider for downward signal;

a 2nd photo diode configured to convert the upward optical signal transmitted from the 3rd multiplexer/demultiplexer into an electric signal;

a 4th multiplexer/demultiplexer configured to multiplex the light source for upward signal and the downward optical signal which are transmitted from the 2nd multiplexer/demultiplexer and the light source for downward transmitted from the 3rd multiplexer/demultiplexer and to demultiplex the multiplexed upward optical signal and the light source for downward signal in each subscriber;

a 5th multiplexer/demultiplexer configured to transmit the multiplexed light source for downward signal transmitted from the 4th multiplexer/demultiplexer and to transmit the multiplexed upward optical signal into the 4th multiplexer/demultiplexer;

a 6th multiplexer/demultiplexer configured to transmit the multiplexed light source for upward signal and the downward optical signal which are transmitted from the 4th multiplexer/demultiplexer and to transmit the multiplexed light source for downward signal into the 4th multiplexer/demultiplexer;

a 7th multiplexer/demultiplexer configured to multiplex the light source for upward signal and the downward optical signal so as to provide the multiplexed signal into the multiplexer/demultiplexer and to transmit the multiplexed upward optical signal transmitted from the multiplexer/demultiplexer;

a 1st optical circulator configured to transmit the light source for upward signal transmitted from the 6th multiplexer/demultiplexer into the 7th multiplexer/demultiplexer and and to transmit the multiplexed upward optical signal transmitted from the 7th multiplexer/demultiplexer into the 5th multiplexer/demultiplexer; and

a 2nd optical circulator configured to transmit the downward optical signal transmitted from the 6th multiplexer/demultiplexer into the 7th multiplexer/demultiplexer and to transmit the multiplexed light source for downward signal transmitted from the 5th multiplexer/demultiplexer into the 6th multiplexer/demultiplexer.

15. The system according to claim 14, wherein the multiplexer/demultiplexer is a waveguide-type grating.

16. The system according to claim 15, wherein the 4th multiplexer/demultiplexer is a bilateral wavelength-type grating.

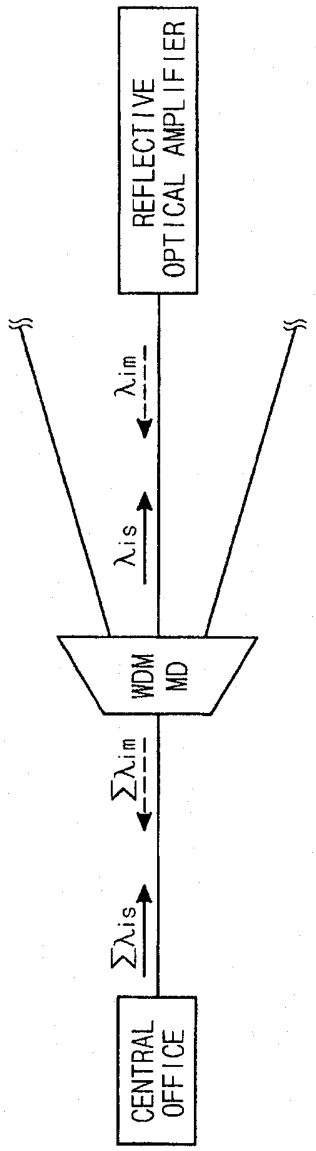

REFLECTIVE OPTICAL AMPLIFIER
λim
λis
WDM MD
Σλim
Σλis
CENTRAL OFFICE

Fig.1

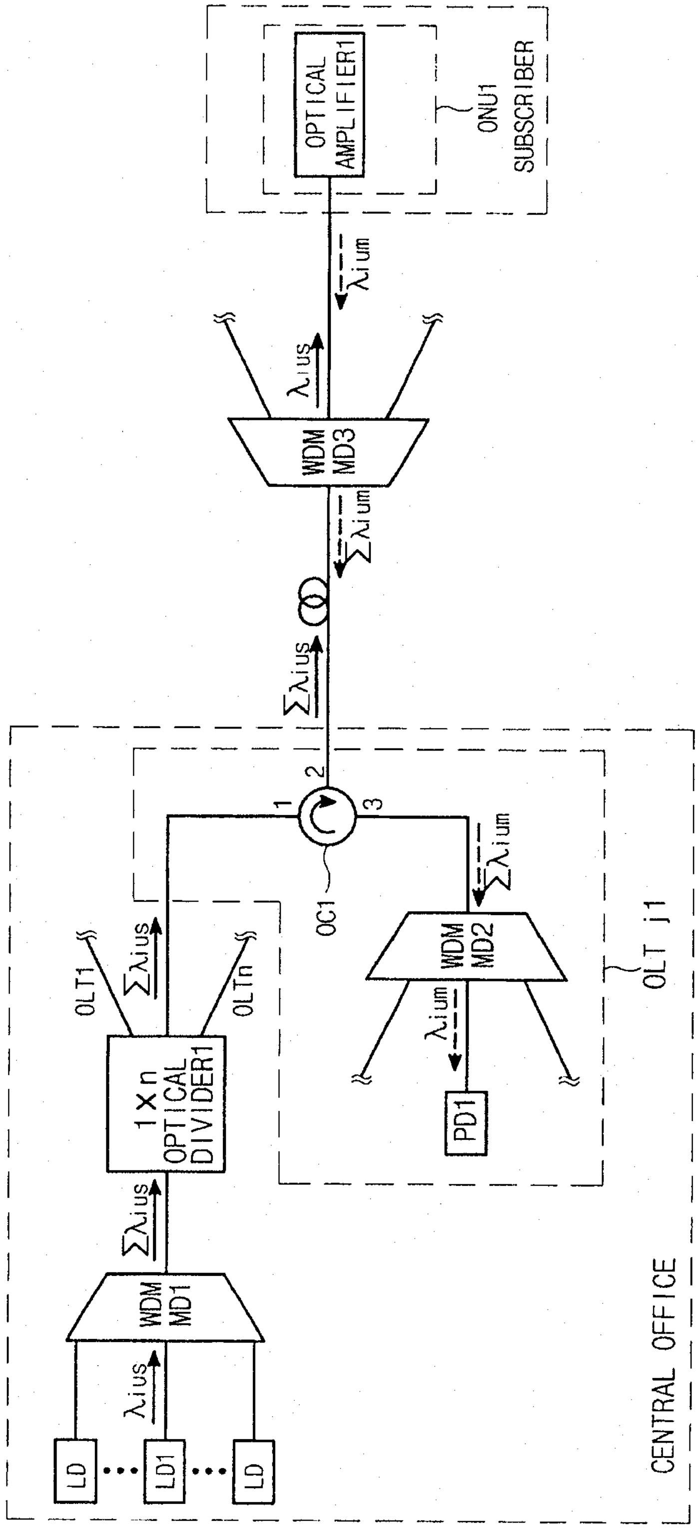

OPTICAL AMPLIFIER1
ONU1
SUBSCRIBER
WDM MD3
WDM MD1
WDM MD2
1 X n OPTICAL DIVIDER1
OLT1
OLTn
OLT j1
OC1
PD1
LD
LD1
LD
CENTRAL OFFICE

Fig.2

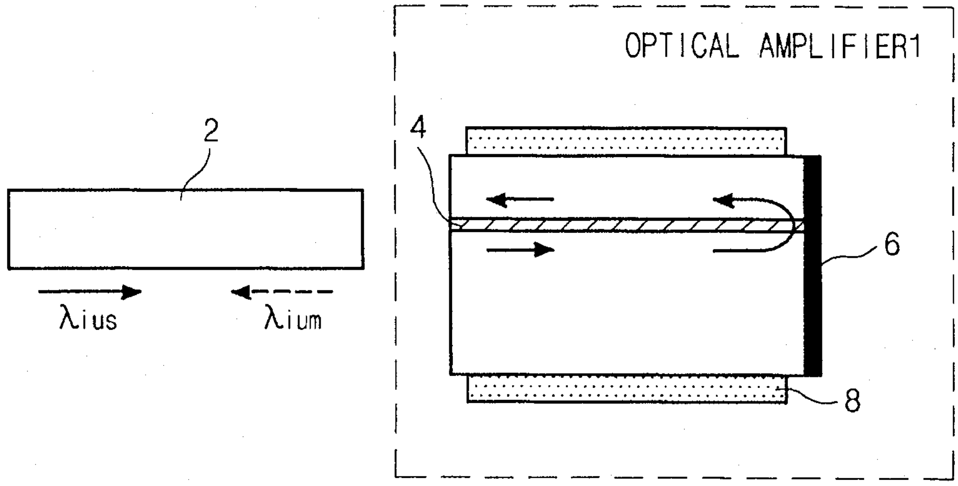
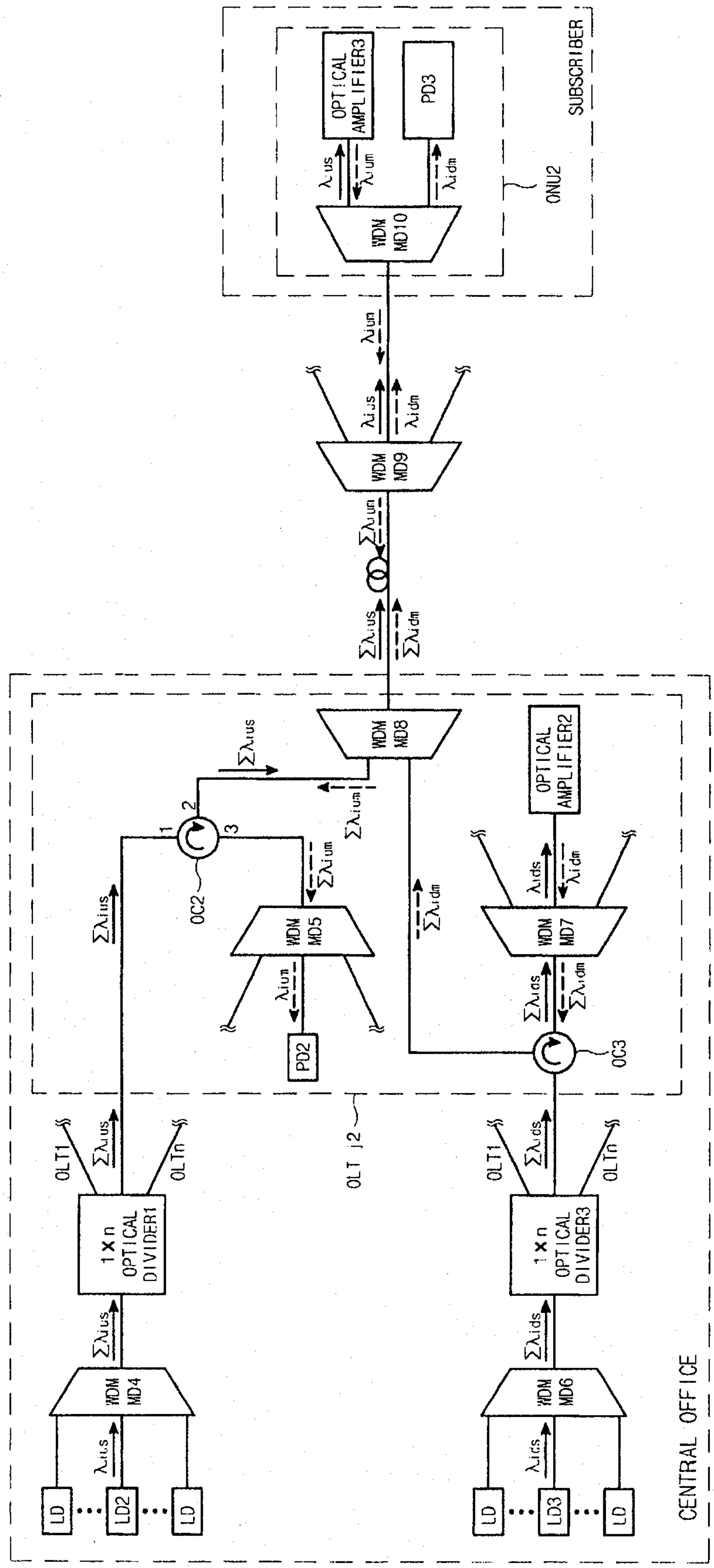


Fig.3


SUBSCRIBER
OPTICAL AMPLIFIER3
PD3
WDM MD10
ONU2
WDM MD9
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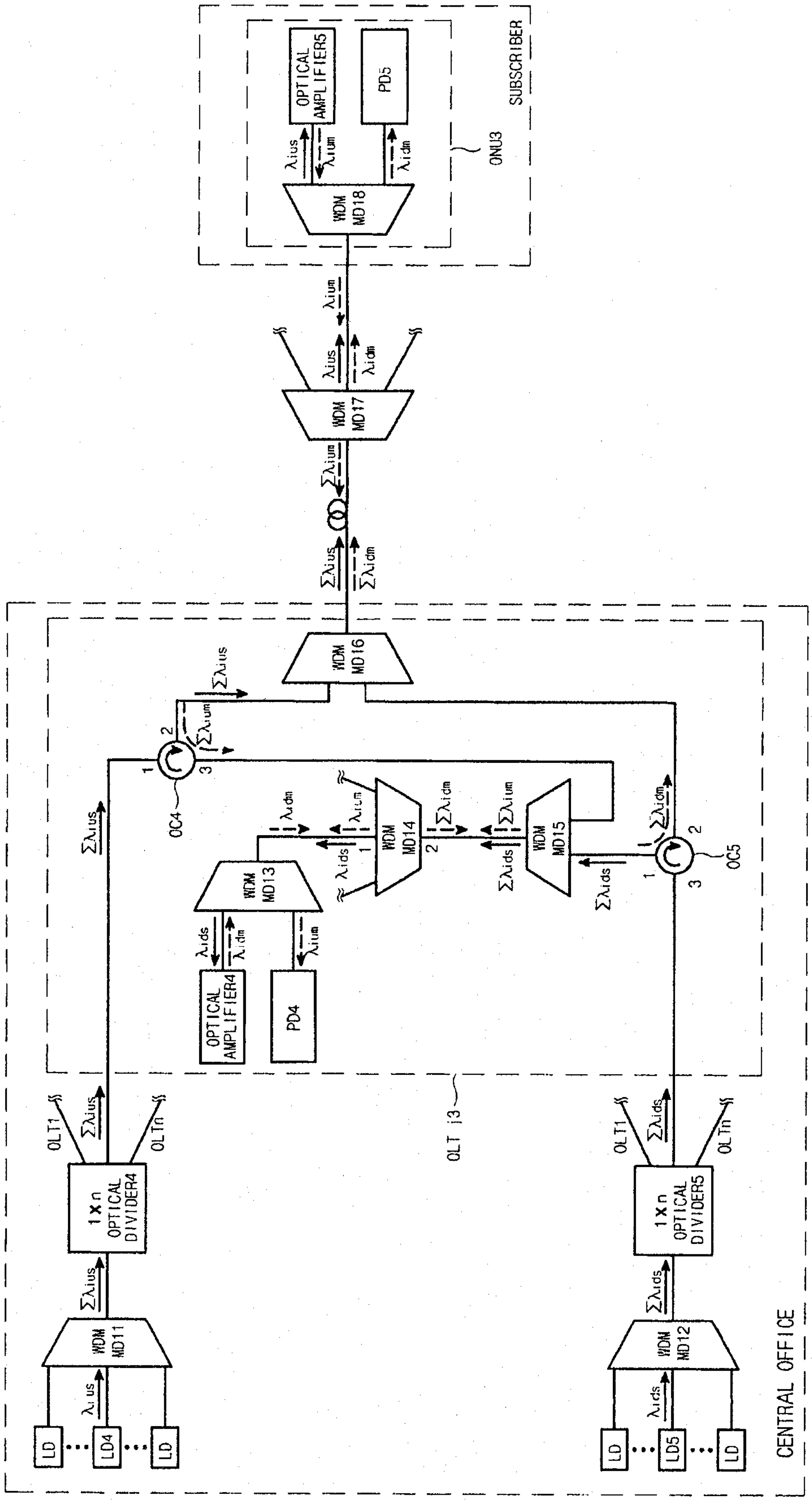
OPTICAL AMPLIFIER2
OC2
WDM MD5
PD2
WDM MD7
OC3
OLT j2
OLT1
OLTn
1 X n OPTICAL DIVIDER1
1 X n OPTICAL DIVIDER3
WDM MD4
WDM MD6
LD
LD2
LD3
CENTRAL OFFICE

Fig.4


SUBSCRIBER
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WDM MD17
WDM MD16
WDM MD15
WDM MD14
WDM MD13
OPTICAL AMPLIFIER4
PD4
OC4
OC5
OLT j3
1 x n OPTICAL DIVIDER4
1 x n OPTICAL DIVIDER5
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OLTn
WDM MD11
WDM MD12
LD
LD4
LD5
CENTRAL OFFICE

Fig.5

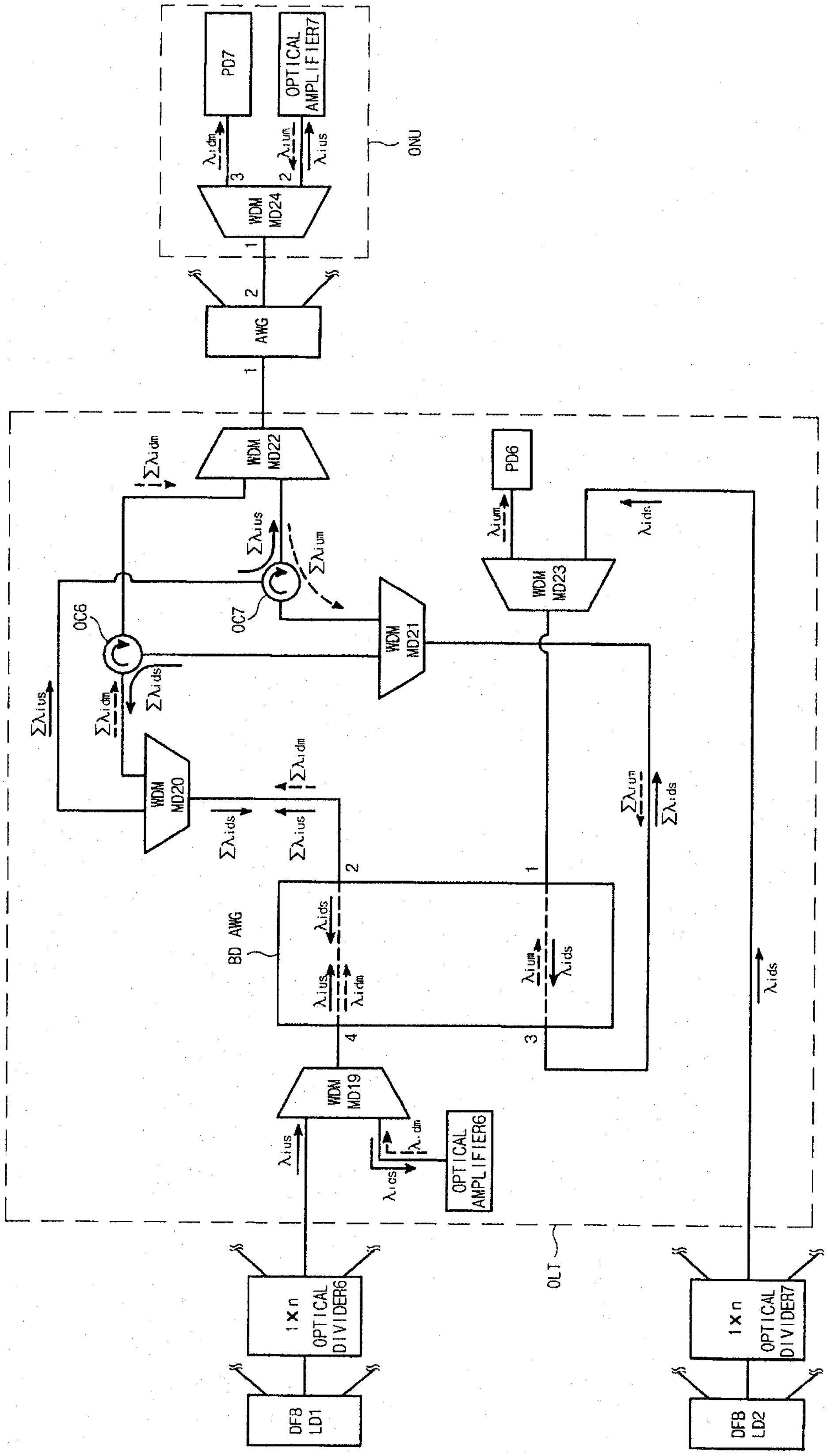
PD7
OPTICAL AMPLIFIER7
ONU
WDM MD24
AWG
WDM MD22
OC6
OC7
WDM MD21
WDM MD20
PD6
WDM MD23
BD AWG
WDM MD19
OPTICAL AMPLIFIER6
OLT
1×n OPTICAL DIVIDER6
DFB LD1
1×n OPTICAL DIVIDER7
DFB LD2

Fig.6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2005/001676

A. CLASSIFICATION OF SUBJECT MATTER

H04B 10/00(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04B10, G02B, H01S, H04J

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

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

SEARCH TERMS:PASSIVE, OPTICAL, SEMICONDUCTOR, AMPLIFIER, CIRCULATOR

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y ------ A	JP 2003-347668 A (NIPPON TELEGR & TELEPH CORP <NTT>) DEC. 05, 2003 SEE ABSTRACT, FIGURE 1; SEE PARAGRAPH [0034]~[0076]	1,2,5,6,8 ------------------- 3,4,7,9-16
Y ---- A	US 5,550,666 A (LUCENT TECHNOLOGIES INC.) AUG. 27, 1996 SEE ABSTRACT, FIGURES 1~3 SEE PAGE 3 LINE 14 ~ PAGE 11 LINE 45	1,2,5,6,8 ------------------ 3,4,7,9-16
A	US 5,559,624 A (LUCENT TECHNOLOGIES INC.) SEP. 24, 1996 SEE ABSTARCT; FIGURES 1,9~12	1-16
A	KR 2005-0040149 (SAMSUNG ELECTRONICS CO.) MAR. 24, 2005 SEE ABSTARCT, FIGURES 1~3,8	1-16

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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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
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 FEBRUARY 2006 (17.02.2006)	**20 FEBRUARY 2006 (20.02.2006)**

Name and mailing address of the ISA/KR	Authorized officer
Korean Intellectual Property Office 920 Dunsan-dong, Seo-gu, Daejeon 302-701, Republic of Korea	JANG, JIN HWAN
Facsimile No. 82-42-472-7140	Telephone No. 82-42-481-5711

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2005/001676

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