

POLARIZATION MODE DISPERSION COMPENSATOR FOR WDM NETWORK

The present invention relates to optical transmission. More particularly, the present invention relates to a system for performing optical polarization mode dispersion (PMD) compensation of dense wavelength division multiplexed (DWDM) optical signals.

BACKGROUND TO THE INVENTION

The input data stream of an optical transmission system may be viewed as a series of light pulses representing digital bits. Receiver in an optical transmission system convert each bit period in the data stream into digital ones and zeros by determining, for each bit period, whether a light pulse has been received (digital one) or not (digital zero).

Polarization mode dispersion (PMD) is a phenomenon that may distort the light pulses of the data stream and thus compromise the ability of the receiver to determine if the bit level is a zero or one. The different polarizations of light traveling at different speed will arrive at the receiver at different times. The PMD values may vary by time or wavelength thus it is difficult to predict.

PMD can be caused by internal as well as external factors. Internal factors may originate from the manufacturing process of the fiber itself mainly imperfections on the internal cladding. External causes that may cause PMD include temperature changes, vibration and even movement in wind direction. The variations on the dispersion are different therefore making it impossible to predict. Therefore, the PMD values also vary thus making it difficult to predict as well.

WO 03040777 describes an integrated system for performing dispersion compensation on wavelength channels in WDM or DWDM transmissions. The system includes a tunable integrated dispersion compensation module that performs chromatic dispersion compensation and polarization mode dispersion compensation on each of the wavelength channels in the transmission. Feedback is used to adjust the tunable integrated dispersion compensation module until receiver performance is optimized. However, a major problem arises as the number of channels increase, the number of parallel operating cascades of polarization controller and its optical birefringement

elements increase. The system will be unable to cope therefore requiring additional upgrades resulting in higher cost.

U.S. 7,257,290 describes a method for performing optical polarization mode dispersion compensation of wavelength division multiplexed (WDM) optical signals. The method comprises the steps of providing a compensation stage with an optical transmission medium to be used as parallel operating cascade of polarization controllers and optical birefringent elements to compensate dispersion of the WDM optical signals when being transmitted spectrally dispersed into the different wavelength channels in parallel through the parallel cascades. This invention uses an open loop monitoring system. Therefore, the PMD monitoring value is taken before the optical switch and this value is only taken once. Therefore, the chances of the PMD not corrected are still present.

As higher transmission rates are being introduced by the network providers, the more susceptible the network will be to PMD as there is a co-relation between higher transmission bit rates with the PMD limit. Though new fibers with low PMD values are introduced, cost of installing new or changing existing fibers will be too much to consider.

Therefore, it is highly desirable to provide a cost effective system that can overcome at least one of the above-mentioned limitations.

SUMMARY OF THE INVENTION

It is a first object of the present invention to provide a polarization mode dispersion (PMD) compensator which uses a sharing strategy.

It is a second object of the present invention to provide a close loop monitoring system to ensure better quality signal.

According to a first aspect of the present invention, there is provided a PMD compensator strategy by sharing the polarization mode dispersion (PMDC) using optical add/drop multiplexers (OADM).

In yet another aspect of the present invention, a closed loop monitoring system is implemented by tapping each transmitted signal using a splitter into a de-multiplexer which is connected to a polarimeter before reaching the receiver; thus ensuring better signal quality.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will now be described in greater detail, with reference to the accompanying drawing, in which:

Figure 1 is a block diagram of a communication system using shared polarization mode dispersion and optical add/drop multiplexer of the present invention

DETAILED DESCRIPTION OF THE DRAWINGS

Referring to Figure 1, a typical optical communication model using shared strategy consist mainly of a multiplexer 101 from the transmitter end, a splitter 102, a demultiplexer 103 extended out from the splitter 102, a series of polarimeter 104, an analog to digital converter ADC micro-controller circuit 105, a display for monitoring 106, a first and a second compensator 107, 108, an optical add/drop multiplexer comprising a first circulator 109 and a second circulator 110, and a de-multiplexer 111 at the receiver end.

A transmitted signal originates from the transmitter and will pass through the multiplexer 101 which converts the digital signal into light wave signals. These signals will traverse along the optical fiber and will be exposed to the risk of polarization mode dispersion. In order to identify and correct the dispersed signal, a splitter 102 is used to tap into the signal and divert it into a de-multiplexer 103. Acceptable splitters 102 include either a 90/10 or a 95/5 splitter 102 whereby the higher ratio goes to the receiver while the lower ratio is directed to the de-multiplexer 103. The de-multiplexer 103 will then channel the signal into a polarimeter 104. A miniature optical polarimeter is preferred as it can be electronically integrated into the transmission system. The polarimeter 104 will enable a degree of polarization (DOP) reading to be collected via the voltage outputs generated by the signal. The DOP reading is then fed into the ADC micro-controller circuit 105. The ADC micro-controller 105 will determine whether the DOP reading from the

polarimeter **104** is within the acceptable range. If the DOP value is lower than the predetermined value, the ADC micro-controller **105** will urgently request the OADM to drop the corrupted signal channel into the PMDC **107** and the elements in the PMDC **107** is to be adjusted until it produces an acceptable DOP. Once achieved, the signal is
5 added back to the link through the OADM **110** and the DOP performance is monitored again. The ADC micro-controller **105** can be connected to a personal computer **106** to display the DOP readings from the polarimeter **104**. If the DOP reading from the polarimeter **104** is within an acceptable range, the ADC micro-controller **105** will then send the signal to the PMDC **108** which will then be fed back to the OADM **110** and
10 subsequently added back to the main link. The compensated signal will then make its way to the intended receiver via another de-multiplexer **111** for further processing

In normal operations, more than one channel light wave signals will be traveling along the main fiber link. The present invention is able to handle the increasing loads by using
15 multiple channelled polarimeters **104** and also the sharing of the PMDC which uses the OADM. This will be a cheaper alternative as opposed of replacing or upgrading the fiber transmission lines.

CLAIMS

1. A system for performing polarization mode dispersion compensation of multiple light wave signals comprising:

a multiplexer (101) arranged to multiplex a plurality of light wave signals into a single wavelength-division multiplexed signal for transmission across a fiber transmission line,

a splitter (102) arranged to split the wavelength-division multiplexed signal into a high-ratio portion and a low-ratio portion, and

a demultiplexer (103) arranged to demultiplex the low-ratio portion wavelength-division multiplexed signal into the plurality of light wave signals, characterized in that the system comprises a compensation module comprising a plurality of polarimeters (104) wherein each polarimeter (104) is arranged to receive one of the plurality of light wave signals from the demultiplexer (103), and wherein each polarimeter (104) is connected to a controller (105) that verifies whether each of the light wave signals require compensation, and wherein the controller (105) is arranged to control an optical add/drop multiplexer to drop each light wave signal requiring compensation into a compensator (108) to rectify the dispersed signal.

2. A system according to claim 1, wherein the splitter (102) consists of a 90/10 or 95/5 ratio rate and is located between a sender and a receiver.

3. A system according to claim 1, wherein the de-multiplexer (103) is capable of receiving a plurality of transmission signals from the splitter (102) at one time and sorting the signals into separate individual logical channels as output.

4. A system according to claim 1, wherein each of the polarimeters (104) caters for an individual logical channel.

5. A system according to claim 1, wherein the controller (105) is an ADC microcontroller (105) which receives input from the polarimeter (104) and checks if the signal conforms within acceptable standards.

6. A system according to claim 1, wherein the compensator (108) is a polarization mode dispersion module used to correct dispersed signals.

7. A system according to claim 1, wherein two polarization mode dispersion modules are used to correct dispersed signals simultaneously.