Optimized Dispersion Compensation with Post Fiber Bragg Grating in WDM Optical Network

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Abstract—In this paper demonstrates the possibility for dispersion compensation in a 10 Gbps WDM with the help of fiber Bragg Grating created with the Fiber Grating component. This component allows design of apodized and chirped fiber gratings that are able to provide dispersion compensation in optical system. The physical idea behind this compensation scheme is the creation of an apodised linear chirped grating allows us to create a time delay between different spectral components of the signal. Because of this different velocity of propagation of different spectral components, the pulse spreads. If we create fiber grating with period linearly reducing along the grating, because the higher frequencies will reflect after longer propagation in the grating a time delay between lower and higher frequency components will appear which is just opposite to this created in the SMF. Therefore propagating and reflecting our pulse in this device will allow to compensate the dispersion broadening of transmitting pulse.

Index Term—Dispersion, fiber bragg grating and wave division multiplexing

II DESIGN OF WDM SYSTEM WITH POST FBG

A WDM system uses a multiplexer at the transmitter to join the signals together, and a de multiplexer at the receiver to split them apart. With the right type of fiber it is possible to have a device that does both simultaneously, and can function as an optical add-drop multiplexer.

We will now show how the amount of compensating dispersion affects system performance. We will use an Ideal Dispersion Compensation FBG as the dispersion compensation module as shown in figure 1. In this case, we selected a post-compensation scheme because it is simple compared to the symmetrical compensation scheme. All schemes perform similar in low power regions. Project is given in Dispersion compensation post with FBG.

The transmitter section includes one wave division multiplexer which has four input points. Each of its point is feeding with a modulated signal comes from Mach zehnder modulator. There are four modulators are used. Each modulator has an optical carrier signal for which four CW lasers are used whose frequencies are 193.1 THz, 193.2 THz, 193.3 THz & 193.4 THz respectively. Each laser has a power of 20 dB. The electrical information signal is generated by Pseudo random bit sequence generator and is modulated in NRZ format.

The receiver section has 1x4 WDM DMUX. The information signal can be received by its one out pin. Now this signal can be converted into electrical signal with the help of optical receiver PIN diode. The received electrical signal is filtered by low pass Bessel filter. The received signal can be examine by BER analyzer.

Wavelength division multiplexing (WDM) is a technology which multiplexes a number of optical carrier signals onto a single optical fiber by using different wavelengths (i.e. colours) of laser light. This technique enables bidirectional communications over one strand of fiber, as well as multiplication of capacity [1]. The term wavelength-division multiplexing is commonly applied to an optical carrier (which is typically described by its wavelength), whereas frequency-division multiplexing typically applies to a radio carrier (which is more often described by frequency). Since wavelength and frequency are tied together through a simple directly inverse relationship, the two terms actually describe the same concept.
part of the pulse and the lower (propagating slower) in the
trailing one.

The total accumulated dispersion of the SMF is 16x80
= 1280 ps/nm. We swept the total dispersion of FBG
from -30 to -3000 ps/nm. The bit rate is set to 10 Gbps.
In this simulation, we want to investigate the

dispersion-limited performance of the system. To avoid
triggering fiber nonlinearity, we keep the received
power at -3 dBm. Effects of residual dispersion to
nonlinear effects will be considered in other examples.
This simulation shows that in the linear regime (low
power), completely compensating fiber dispersion
gives the best result[3]. Over-compensating degrades
the system performance.

II SIMULATION OF WDM SYSTEM WITH POST
FBG

In this techniques I will use ideal dispersion
compensation FBG to reduce dispersion. An 80 km long
optical fiber will conduct a user defined bit sequence.
The signal can be analyzed with the help of optical time
domain visualizer and spectrum analyzer.

We will now show how the amount of compensating
dispersion affects system performance. In this case, we
selected a post-compensation scheme because it is
simple compared to the symmetrical compensation
scheme[4]. All schemes perform similar in low power
regions. Project is given in Dispersion compensation
post with FBG. We can analyze different parameters
like Q factor, Min BER , eye height and BER pattern.
In this simulation Q factor is better as shown in figure
2. This demonstrates the possibility for dispersion
compensation with the help of fiber Bragg Grating
created with the Fiber Grating component.

This component allows design of apodized and chirped
fiber gratings [5][6] that are able to provide dispersion
compensation in optical system. Fig 3 shows min BER
graph.

Fiber Bragg Grating with following properties has
been used: frequency 193.1 THz, reflective index
=1.45, length = 6 mm, apodization uniform, index of
modulation 0.0001, linear chirp with a linear parameter
0.0001, number of segments 101 and maximum
number of spectral points 1000.

This is noted that this linear chirping reduces the period
of grating during the propagation of the pulse in the
grating. Therefore the higher frequencies will travel
more in the grating before being reflected than the
lower one[7]. The threshold value of signal is shown in
figure-4 and eye height in figure 5.
Figure shows that Q factor is 17.1824, Min BER is 1.08833e-066, Threshold is 0.000261783, Eye Height is 0.00420359.

In this simulation we are observing that the Q factor is 17.1824, Min BER is 1.08833e-066, Threshold is 0.000261783, Eye Height is 0.00420359. In this technique we can see the dispersion in 193.1 Thz is reduced from 2.16587e+008 ps/ns to 1.19493e+008 ps/ns, noise is also reduce. OSNR ratio is improved. The power of these signals is decreased this is only one drawback and it can be overcome by using optical amplifier at output side. For 193.2 Thz, dispersion increases, power of signal is decrease. We can see only for this signal the results are not in our favor while other signals are received with fine parameters. For 193.3 Thz, dispersion is reduced from 3.59741e+007 ps/nm to 1.84029e+008 ps/nm while noise reduces and OSNR improves. For 193.4, dispersion is reduced from 6.33977e+007 ps/nm to 1.09279e+006 ps/nm, noise is reduced and OSNR improved.
It is shown in this paper that the recent advances in fiber bragg grating technology now allow the realization of a high performance, high speed optical fiber with good in line dispersion compensation. The characteristics of optical fiber are analyzed in 4x1 WDM environments. The dispersion is computed by sending a NRZ modulated pulse as an in put for 80 Km length WDM network this is observed that the over all dispersion at the receiving end is approximate 40ps/nm/km. This is impossible to remove all dispersion but in our simulation we have succeeded to compensate dispersion. That’s why fiber bragg grating is worthy compensation system in optical fiber communication. A narrow bandwidth is observed for data transmission in fiber bragg grating. In our simulation this is widened at a satisfactory value but for 40 Gbps system and for more length of 320 km(4 loop of 80 Km) it is required to compensate more dispersion than this simulation. So the future work this paper is chosen as to solve the problem using fiber bragg grating beyond 320km and 40 Gbps system.

REFERENCE


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