Dpsk Modulated Ss-Wdm Scheme For Fso Communication System Under Turbulence Model

Parneet Kaur, Dr. Amandeep Singh Sappal

Abstract: Nowadays, Free space is becoming an area of research for in order to take advantages of beneficial properties of it. But FSO link is much contingent on the effect of varying weather conditions. A number of researches have been proposed to increase the aperture averaging, amplification of the signal. Out of these researches WDM spectrum slicing is becoming more successful approach to achieve high quality signal. In this paper an advanced spectrum slicing approach is proposed using the DPSK modulation scheme. two different Turbulence models named Log normal and Gama-Gama are considered for the analysis of the proposed scheme in FSO communication system. The simulation is performed using Optisystem software. The simulation results are analyzed by varying the attenuation factor and also by varying the turbulence. The simulation results demonstrate that the proposed model is performing well for the FSO system and in comparison of both Turbulence models the proposed scheme is effective for the Log Normal with respect to Gama Gama.

Index Terms: wavelength division multiplexing (WDM), Free space optics (FSO), Radio Frequency (RF), Spectrum slicing, Optisystem, Turbulence model, phase shifting key.

1. INTRODUCTION

Free space optical correspondence is the trend setting innovation utilized broadly in now days for short separations which is exceptionally financially savvy, adaptable, license free and high capacity links [1]. Essentially, FSO is a correspondence innovation where free space go about as medium between transceivers. It is a promising technology to give high speed, improved-limit, cost-effective, secure and simple to deploy wireless networks . Though radio frequency (RF)- based remote communication connections are powerless against degradation from multi-way propagation, FSO connections are helpless against degradation from atmospheric impacts and pointing errors [2]. In particular, the atmospheric effects may prompt a critical degradation in the performance of the FSO communication frameworks together with misalignment impacts.Different systems have been proposed to improve the performance of FSO link out of those few were focused on aperture averaging, diversity [3] or amplification of signal [4]. Various WDM frameworks have been exhibited effectively in [5,6]. In spite of the fact that WDM access network use Spectrum Slicing in the distribution connects to help different clients at extremely high bit rate, is an engaging proposal and FSO can possibly accomplish higher unwavering quality and limit. FSO execution is antagonistically influenced by the environment through which it propagates. The factors those are basic cause of interference in the FSO systems are the atmospheric turbulence and the fog. These particles change the light attributes and impede the passage of light. This thus cause in diminishes the power density of transmitted signal or beam and also effects the effective distance of the FSO connection [7]. So as to overcome this issue certain methods like SS-WDM were implemented.

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2 SPECTRUM SLICING WAVELENGTH DIVISION MULTIPLEXING

2.1 Spectrum Slicing Wavelength Division Multiplexing (SS-WDM)

It is supported as a wonderful option in contrast to various coherent lasers which encourages various users [8]. It is a versatile system which supports higher transfer speed. This features its ability which can be increase capacity as per the framework created by the user in a specific region [7]. This mechanism is utilized to balance the optical signals and can possibly accomplish high speed communication without the need of optical–electrical–optical procedure. It improves the optical framework dispersion tolerance factor which hinders the transmission of the signal.

2.2 Spectrum Slicing Wavelength Division Multiplexing (SS-WDM) With FSO

Bidirectional transmission and multiplication of bandwidth represent the WDM (wavelength division multiplexing) as versatile and reliable that can give wide inclusion over atmospheric effects in FSO. Spectrum slicing is the significant applicant that gives affirmation to distribution of multi wavelength intensity source in various end users [5]. In any case, so far revealed frameworks supports low information speed and number of channels, yet FSO can support rapid and give high transfer speed. An optimal technique for Spectrum slicing FSO is required. This proposed model is implemented using DPSK modulation format and is analyzed for 2 different turbulence models. The simulation model of proposed spectrum sliced WDM that is designed using Optisystem simulation tool is shown in Fig. 1. A CW laser is the lightening source which is further connected to 4 WDM Demux for dispersing the light. As shown in figure the signal is divided into four channels and modulated using DPSK modulation scheme, each channel is having a different frequency with channel spacing.

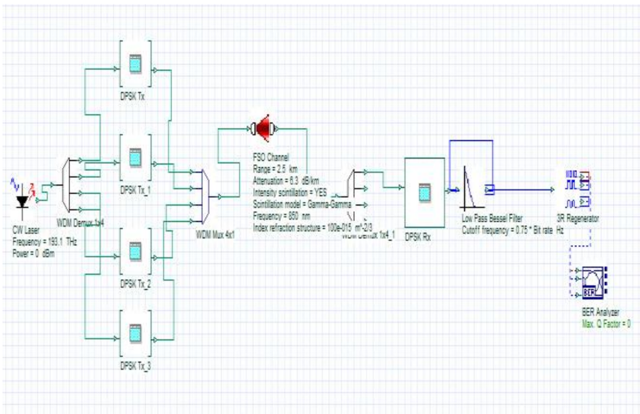

***Fig. 1.** Proposed System's Framework.*

3 PRESENT WORK

The simulation model of the proposed system is of multi-channels spectrum sliced WDM system, the number of channel those are considered in the proposed model are 4 in count. The continue wave laser source is behaving as an light source to the proposed model which is further sliced into 4-channels using an arrayed-waveguide grating (AWG) demultiplexer. The optical signal which is sliced is further modulated using Mach-Zehnder modulator (MZM). A DPSK modulation scheme is applied to the proposed model and is analyzed. Mach-Zehnder Modulators used in the in transmitter end are used for conversion of data to optical format. After this all channels are multiplexed by AWG MUX to combine the modulated and split signal. Once the signal is combined the multiplex signal is than transmitted over FSO Once the signal is transmitted over FSO at the receiver end the signal is received this received signal is passed to the demux which again distribute the signal. Once the signal is distributed further PIN photo detectors are placed in the model so as to convert the optical signal to the electric one, later filtration process is performed to achieve the final received signal. BER and quality factor calculation are done by using the BER analyzer module to investigate the performance of proposed system In the proposed model two different Turbulence model are considered for analyzing the performance of proposed scheme in terms of quality factors. The Turbulence models are as follow:

1. Log-normal
2. The gamma–gamma

3.1 Log-Normal Turbulence model

In this model for the calculation of the pdf of the irradiance fluctuation in a turbulent atmosphere, the beam is first represented by its component part of electric field E. Maxwell's electro-magnetic equations for the case of a spatially variant dielectric like the atmosphere, helps in deriving the following expression [11]

$$\nabla^2 E + k^2 n_{as}^2 E + 2\nabla[E.\nabla \ln(n_{as})] = 0 \text{ -------(1)}$$

where k is the wave number and can be defined as k = 2π/λ, and the last section of Equation 1 is represented the turbulence-induced depolarization of the signal in a low atmospheric turbulence.

3.2 The Gamma–Gamma Turbulence model

This model is characterized in [11], which depends on the modulation procedure where the change of light radiation crossing a turbulent climate is expected to comprise of little scale (scattering) and huge scale (refraction) impacts The previous incorporates commitments because of cells smaller than the coherence radius ρ0

$$Rf = (Lp / k)^{1/2} \text{ -----------(2)}$$

whichever is smaller Large-scale fluctuations on the other hand are generated by the turbulent cells larger than that of the first scattering disk L/k ρ0, whichever is larger. The small-scale cells are pre-assumed to be modulated by the large-scale cells Consequently, the normalized received irradiance I is defined as the multiplication of two independent random processes which are denoted by Ix and Iy, The relation between two is shown in below equation

$$I = IxIy \text{ ------------(3)}$$

Ix and Iy arise from the large-scale and small-scale turbulent eddies, respectively, and are both proposed to obey the gamma distribution defined in [11].

5 SIMULATION RESULTS AND DISCUSSIONS

In the paper, the simulation is carried out using Optisystem. which is further analyzed by using the optical module for signal quality calculation name as BER analyzers. The quality factors is analyzed by varying attenuation at different turbulence values. Along with this BER versus attenuation is also considered to analyzing the effect of proposed model of D-PSK modulation scheme with inclusion of Turbulence models in FSO environment.

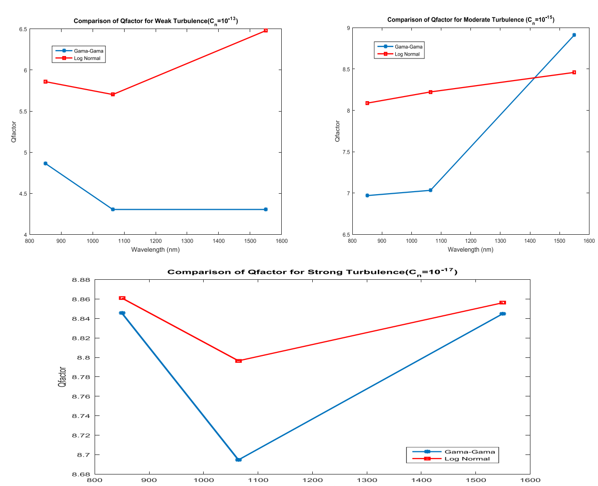

***Fig 2:** Q-factor comparison v/s attenuation at different Turbulence*

In above fig 2 an comparison between the performance of proposed model over Quality factor in two different Turbulence models is performed. The two Turbulence models Gama-Gama and Log Normal effects are analyzed at different turbulence values. The turbulence value those are considered are 10^{-13}, 10^{-15} , 10^{-17} named as Weaker, Moderate and Stronger turbulence levels. From fig 2 it is observed that with variation in attenuation the Quality factor of the system is also varying. Simulation results shows that the spectrum slicing

WDM scheme proposed is providing effective results in terms of Quality factor for log normal model with respect to the quality factor achieved by the Turbulence model Gama-Gama. This graph in fig 2 also helps in concluding that the DPSK based SSWDM scheme is providing less effected signal with log normal Turbulence model at the receiver end.Table 1 is representing the exact results of the quality factor that is achieved by the DPSK based Spectrum sliced WDM model for both Gama Gama and Log normal Turbulence models.

TABLE 1
VARIATION IN QUALITY FACTOR BY VARYING TURBULENCE

WAVELENGTH	VARIATION OF Q- FACTOR					
	WEAK TURBULENCE ($C_N=10^{-13}$)		MODERATE TURBULENCE ($C_N=10^{-15}$)		STRONG TURBULENCE ($C_N=10^{-17}$)	
	GAMA-GAMA	LOG NORMA	GAMA-GAMA	LOG NORMA	GAMA-GAMA	LOG NORMA
850 NM	4.8	5.85	6.96	8.08	8.84	8.86
1064 NM	4.3	5.70	7.03	8.22	8.69	8.79
1550 NM	4.3	6.47	8.91	8.45	8.84	8.85

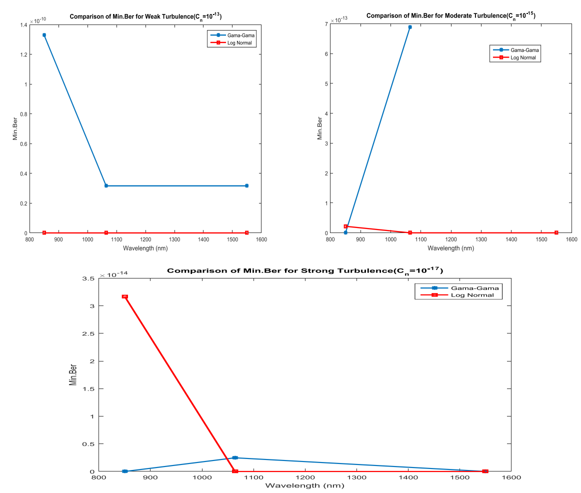

Fig 3: *BER comparison v/s attenuation at different Turbulence*

he evaluation is bit error rate. The BER versus attenuation curves are plotted for the both Turbulence models Log normal and Gama- Gama. The curves shown in fig 3 are illustrating that as the quality factor the BER is also less for the Log normal.

TABLE 2
VARIATION IN BER FACTOR BY VARYING TURBULENCE

WAVELENGTH	VARIATION OF BER					
	WEAK TURBULENCE ($C_N=10^{-13}$)		MODERATE TURBULENCE ($C_N=10^{-15}$)		STRONG TURBULENCE ($C_N=10^{-17}$)	
	GAMA-GAMA	LOG NORMAL	GAMA - GAMA	LOG NORMAL	GAMA - GAMA	LOG NORMAL
850 NM	1.32E-010	2.79E-015	0	2.18E-014	2.27E-028	3.17E-014
1064 NM	3.16E-011	0	6.88E-013	8.83E-056	2.47E-015	0
1550 NM	3.16E-011	0	2.01E-324	0	4.46E-019	2.76E-020

Table 2 is providing a clear picture to the Effect on BER by using varying turbulence values at different attenuation levels. The proposed scheme is analyzed for a attenuation factor of 850, 1064,1550 nm respectively, and in all 3 cases the proposed model is having less BER for Log normal Turbulence model in comparison with Gama-Gama model.

6 CONCLUSION

In this paper an novel approach for the FSO based communication system with spectrum slicing is proposed. Also the proposed system is analyzed for two different Turbulence models as Log normal and Gama Gama. As a performance analysis BER and quality factor parameters are considered and are analyzed at varying attenuation level with 3 level turbulence as weak, Moderate and string levels. Simulation results shown that in FSO communication system with DPSK based spectrum slicing WDM approach is providing effective results in term of BER and Quality factor, also as a comparison with advanced Turbulence models the scheme is effective for the Log normal with respect to Gama-Gama. This also concludes that the scheme presented in this paper is promising and cost effective solution as a comparison with existing spectrum slicing WDM schemes for the FSO communication systems

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