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Security Issue on Spectral – Encoded Optical OCDMA with Bipolar Coding and Modified PN Code.

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Abstract: ***A simple code scheme for security enhancement of an optical code-division multiple- access (OCDMA) communication system is demonstrated. I have analysed the security enhanced OCDMA scheme based on bipolar coding and modified PN code. To guarantee successful transmission of OCDMA signal and to prevent eavesdropping simultaneously for an authorized user, I also present analytical results. Effect of increasing fiber length on quality factor and received power has been studied.***

Index Terms-WDM (wavelength division multiplexing), Bipolar coding, OCDMA (code division multiple access), security.

1. Introduction

Optical code-division multiple-access (OCDMA) is considered as one of the promising technologies for future broadband optical access networks. It has features like all-optical processing, full asynchronous and potential security, etc.In an OCDMA system, a unique code is assigned to each user. In the transmitter, input ultra short pulse sequence is encoded by the encoder corresponding to the code. In the receiver, the code is used to recover the original pulse sequence [1]-[4]. Up to recent days, various OCDMA schemes have been proposed and demonstrated based on time spreading, phase coding, spectral encoding, or two-dimensional encoding. All these approaches used on-off keying for data modulation.However,when a single user is active in the network,OOK(on-off keying)based OCDMA can't guarantee physical layer security. This is because eavesdropper easily intercepts the information data by using a band-limited photo-detector which integrates the energy in a bit period and decodes noise-like OCDMA waveforms into clean data signal [2]. To solve this problem, a security enhanced OCDMA system based on spectral encoding with bipolar coding and modified PN code is demonstrate[5].In addition, I present analytical and simulated results to prevent eavesdropping by scanning a narrow BPF. The effect of fiber length on quality factor and received power is analyzed.

2. Configuration of optical CDMA encoder/decoder

A pseudorandom noise (PN) code has correlation properties similar to those of white noise. There is always one more symbol "1" than"0"in each code. A modified PN code is made by adding a stuff bit symbol"0"to compensate the difference and to reduce channel interference. In this paper, I use a modified PN code of code length 32[5]. Fig.1 shows the set- up for security enhanced OCDMA system based spectral encoding with bipolar code. I used a CW laser array for light source. The output of the light source was demultiplexed into 32 spectral chips .According to the code, 16 spectral chips (i.e. Fig 1(a)), were connected to the upper WDM, and the other 16 spectral chips, Fig 1(b) were connected to the lower WDM to make complementary code (code and code- bar).The wavelength of chips was from 1530.33 to 1555.13nm with 100GHZ spacing. I modulated the output of each WDM by a Mach-Zender modulator with NRZ PRBS signal, but data and data bar were assigned to the upper and lower arms, respectively. The two modulated optical outputs were synchronized to each other by adjusting the electrical delay of the data and combined by 3dB fiber coupler. Thus, NRZ signal patterns were complementing each other in time and the optical output of the encoder became true noise waveform, as shown in Fig2(a & b).After 25 km transmission of conventional SMF,spectrally encoded signal was decoded by authorized user having the same code with the transmitter. The decoder consists of a multiplexer, and two demultiplexer, one demultiplexer (DEMUX1) was set according to code and the other demultiplexer (DEMUX2) was set according to code –bar. A optical phase shift of 180 degree was provided to complement data-bar into data. The two received signal were then added and amplified.

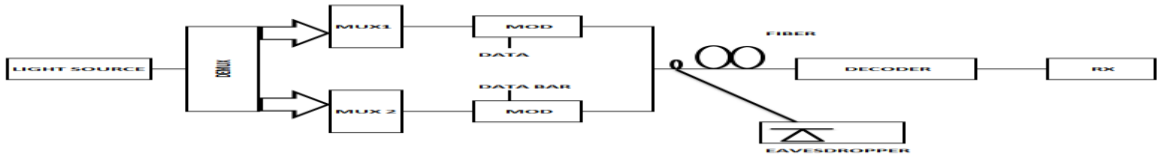

Fig.1.Setup for security enhanced OCDMA system based on spectral encoding with bipolar code.

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3. Results and Discussions

Measured spectra after transmitter i.e.(code and code-bar).

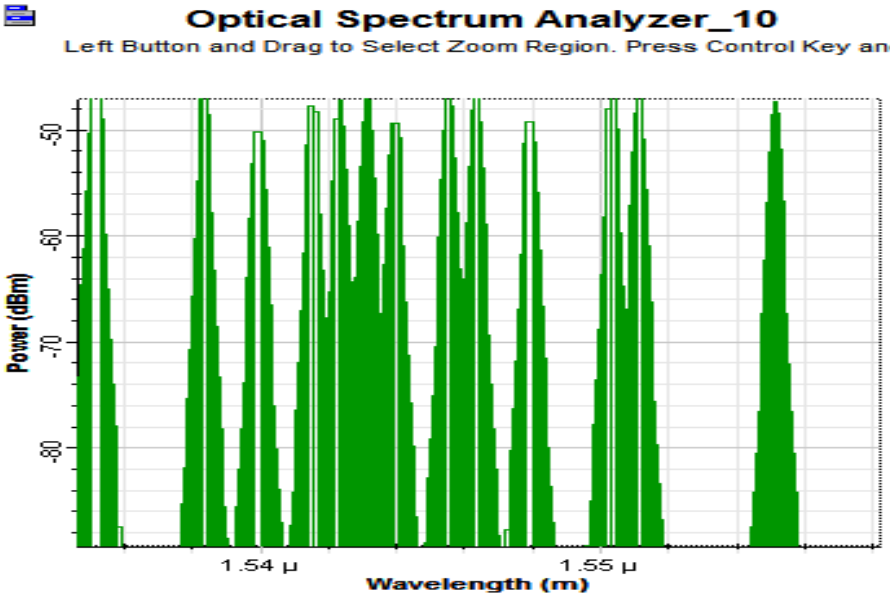

Fig.1 (a) Code

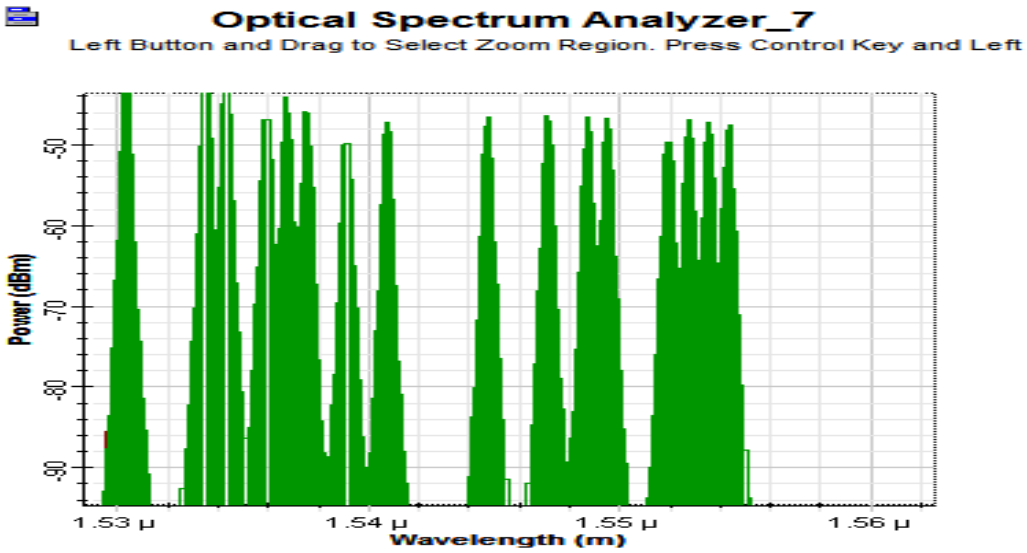

Fig.1 (b) Code-bar

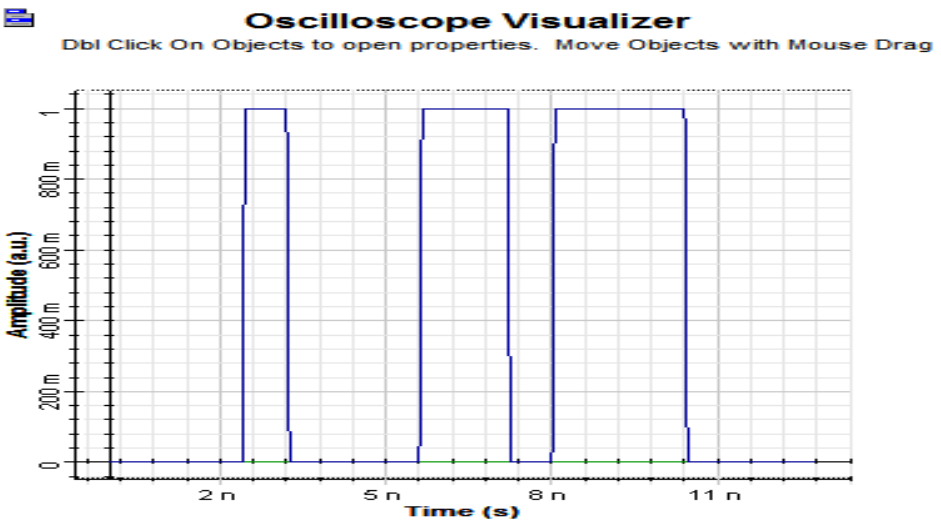

Fig.2 (a) Data

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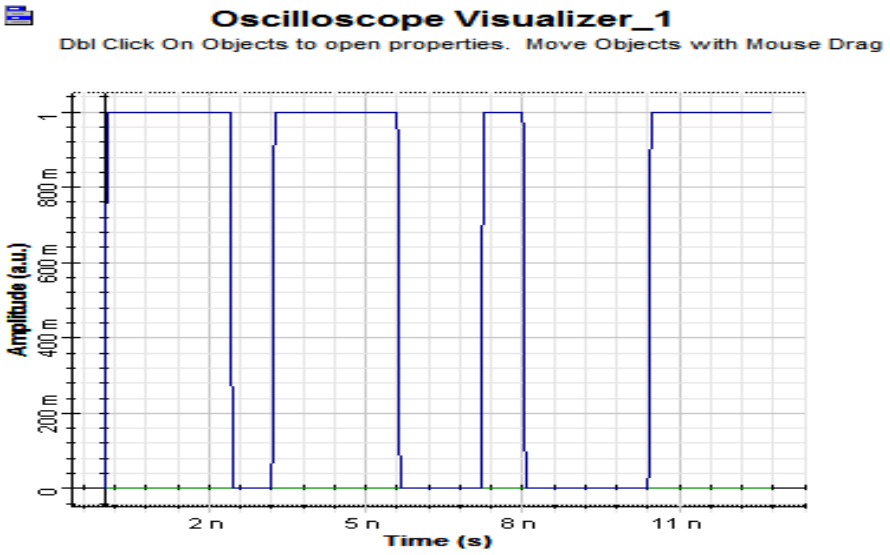

Fig.2 (b) Data -bar

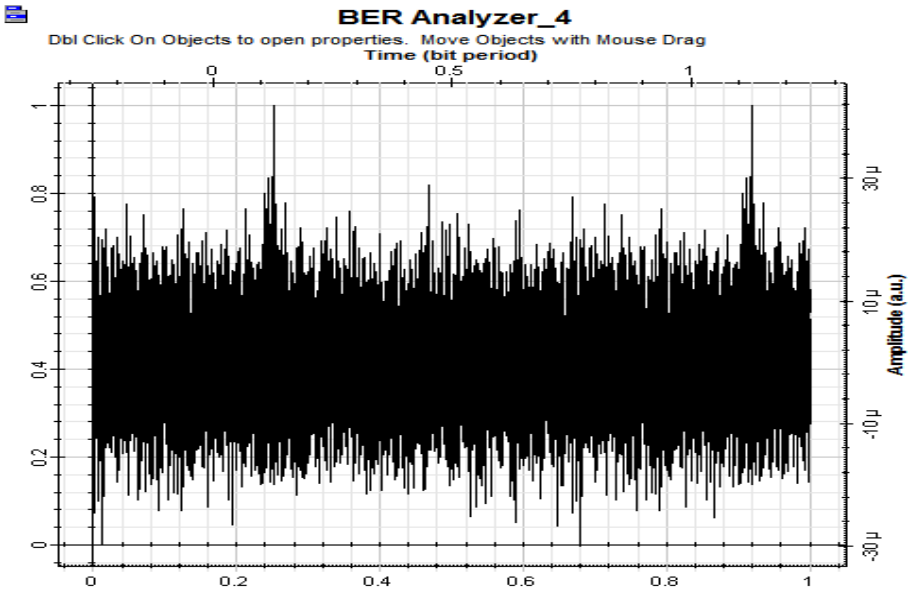

Fig.3 (a) eye-diagram for eavesdropper

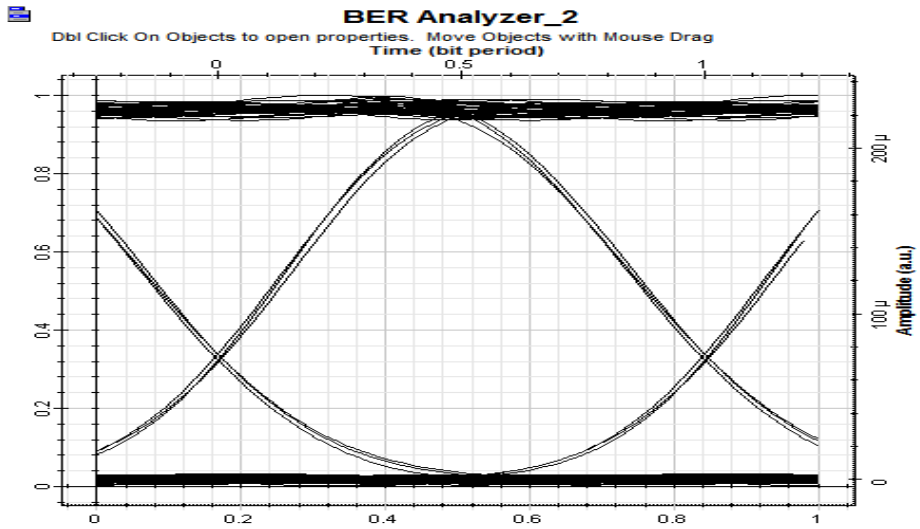

Fig.3 (b) eye- diagram for authorized user

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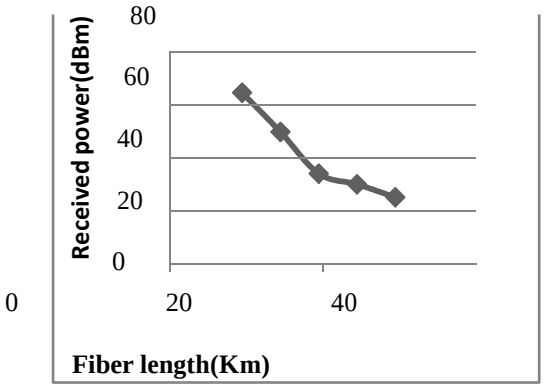

Fig4 (a) Effects of fiber length on received Power

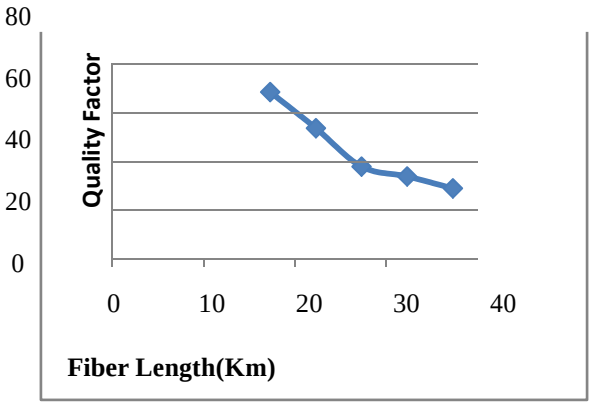

Fig4 (b) Effects of fiber length on quality factor

Fig3 (a) shows an eye-diagram for eavesdropper when one user is transmitting data using 2- code keying. The eye diagram for eavesdropper becomes true noisy due to code switching scheme. This means that there is no intelligible signal at the eavesdropper.Fig3 (b) shows an eye diagram for authorised user. A clear eye-diagram is observed. Authorized users clearly decode the original data.

Fig4 (a) shows the effect of increasing fiber length, as the length of the fiber increases, power at the receiver decreases.Fig4 (b) shows the effect of increasing fiber length on quality factor, as the length of the fiber increases, Quality factor decreases.

4. Conclusion:

I present and analysed the security enhanced OCDMA system based on bipolar coding and modified PN code. I also present the simulated results to prevent eavesdropping by scanning BPF.The results shows an error free operation for authorised user.

Reference:

[1] W. K. Lee, et. al., "Tunable optical CDMA encoder/decoder based on modified PN code using FBG array," in Tech. Digest of OFC2006, paper OWI52, 2006

[2] D. E. Leaid, et al., "Experimental investigation of security issues in OCDMA: a code-switching scheme," IEE Electron. Lett., vol. 41, no. 14, July, 2005

[3] Z. Jiang, et al., "Experimental investigation of security issues in OCDMA," in Tech. Digest of OFC2006, paper OThT2 2006.

[4] F. Xxue, et al., "Security issues on spectral-phase-encoded optical CDMA with phase-masking scheme," in Tech. Digest of OFC2006, paper OThT3 2006.

[5] Hwan Seok Chung, Sun Hyok Chang, Bong Kyu Kim and Kwangjoon Kim, "Experimental Demonstration of Security-Improved OCDMA Scheme Based on Incoherent Broadband Light Source and Bipolar Coding" Optical Fiber Technology, Vol.14, pp: 130-133,2009.

[6] J.P.Heritage and A.M.weiner ,"Advances in spectral optical code-division multiple –access communication,"IEEE J.Sel.topics quantum elec[tron.,vol.13,pp.1351-1369,sep.2007.

[7] D.E.Leaired,and A.M.Weiner,"Experimental investigation of security issues in OCDMA,"J.Lightw.technol.,vol.24,pp.4228- 4234,nov.2006

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