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Performance Analysis of ROF System Using NRZ Coding

Khushbu Shrimali[1], Ankit Patel[2]

[1]*PG Student (SVBIT College, Gandhinagar, Gujarat, India)*
[2]Asst. Prof. in ECE Dept. (SVBIT College, Gandhinagar, Gujarat, India)

Abstract – *A Radio over Fiber has the special characteristic feature of having both a fiber optic link and a free space radio. Radio over Fiber (ROF) access facilitates high capacity multimedia services. The ROF system model developed in OptiSystem have integrated systems for both RF wireless and optical fiber whereby, the ROF network model consists of a central station, a remote access unit and an optical fiber link model that uses commercially available parameters. Here we simulate the ROF system using OptiSystem software and its parameters Q Factor and BER compared for various fiber length using NRZ coding.*

Key Words: **ROF, NRZ Coding, Q Factor, BER, Fiber Length**

1. INTRODUCTION

Radio over Fiber (ROF) is a newer technology where, light is modulated with radio frequency signals and transmitted over the optical fiber to facilitate wireless access and transmission. The convergence of wired and wireless networks is a promising solution for rapidly growing bandwidth demands in the communication systems. Radio-over-fiber is a promising solution for the increasing demand for transmission capacity and flexibility, as well as offering economic advantage due to its broad bandwidth and low attenuation characteristics.

Radio over Fiber is an analog optical link which transmits modulated RF signals. It transmits RF signal downlink and uplink, to and from central station (CS) and to base station (BS). The main requirements of ROF link architecture are duplex operation (downlink-uplink), reasonable length and high performance optical components.

ROF systems have enhanced cellular coverage, lower attenuation losses, higher capacity, larger bandwidth and immunity to radio frequency interference. The basic configuration of a ROF link is shown in Figure, where the system consist of a central station and remote access unit (RAU) connected by a single mode fiber. Figure 1 shows a typical Radio over Fiber System

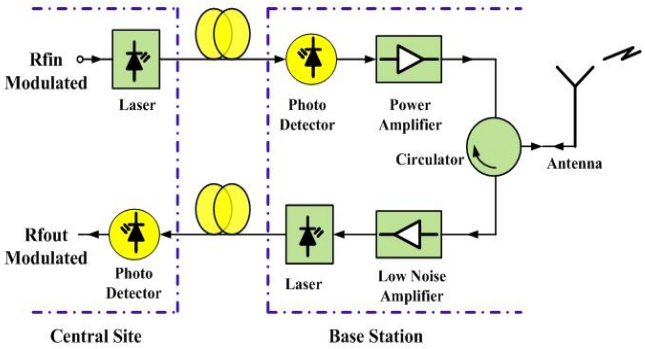

Fig -1: Radio over Fiber System

2. ROF DESIGN USING OPTISYSTEM

In present optical transmission systems, communication traffic is conveyed by optical carriers whose intensity is modulated by the communications traffic that is the optical carrier is Amplitude Modulated (AM). Generally the communications traffic used to modulate the optical carrier will have a Non Return to Zero (NRZ) format though sometimes it can have a Return to Zero (RZ) format.

There are two technologies for modulation, i.e. direct and external modulators. In direct or without external modulation format the RF signal varies directly with the bias of a semiconductor laser diode and the external modulators are either integrated with Mach-Zehnder interferometers or electro absorption modulator. Intensity-modulation (IM) is preferred mainly due to the simplicity of the corresponding optical receiver/detector that is based on a photo-detector, for example a photodiode, which operates as a simple amplitude threshold detector. For particular applications, in general for the soon coming 40Gbit/s optical communication systems, it has been proposed to use other modulation formats which have greater immunity against non-linear propagation effects and also for greater polarization mode dispersion (PMD) and chromatic dispersion (CD) tolerance. These characteristics can open the road to a new design of optical transmission systems for example with higher transmission powers and longer sections free of repeaters. Figure 2 shows the simulation model of an ROF system designed using OptiSystem.

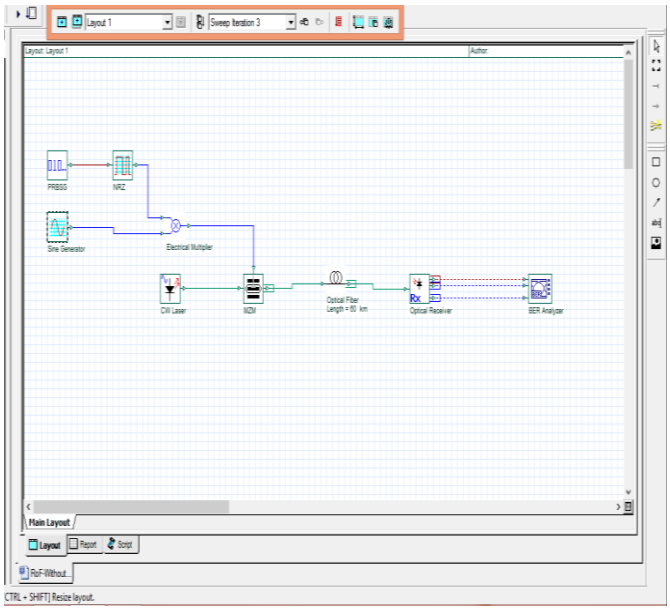

Fig -2: simulation of an ROF system in OptiSystem

In fig -2, two RF signals having a different frequency are power combined and modulated with optical signals from the CW laser in the Mach-Zahender Modulator. The modulated signal is transmitted over an optical fiber with a reference wavelength of 1555 nm and fiber length of 20 km, 40 km and 60 km to optical receiver. Then output is observed in BER analyzer.

Parameter	Value
Bit rate	2.5 Gbps
Power	5 dBm
Wavelength	1555 nm
Fiber length	20 km, 40 km, 60 km

Table -1: Consideration parameters

3. RESULTS

BER ANALYZER

In digital transmission the number of bit errors is the number of received bits of a data stream over a communication that have been altered due to noise, interference distortion bit or synchronization errors. The bit error rate or bit error ratio (BER) is the number of bit errors divided by the total number of transferred bits during a studied time interval [1].

In BER analyzer, we can analyze the output of Q Factor and minimum BER for different fiber length of 20 km, 40 km and 60 km.

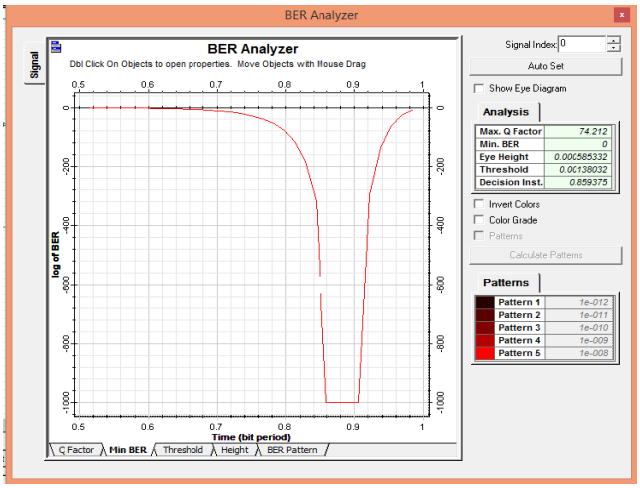

Fig -3: Minimum BER for 20 km

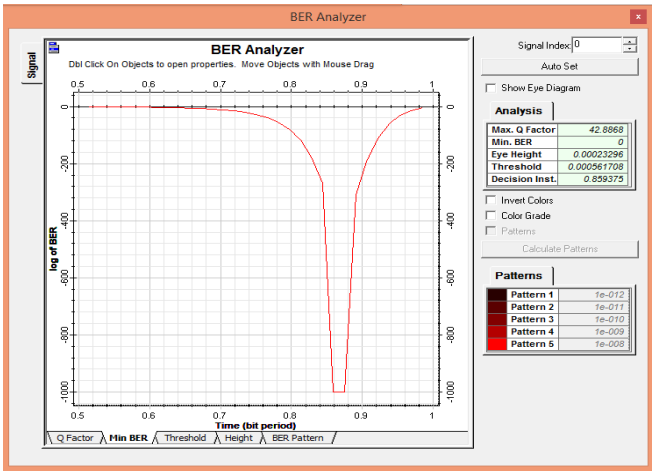

Fig -4: Minimum BER for 40 km

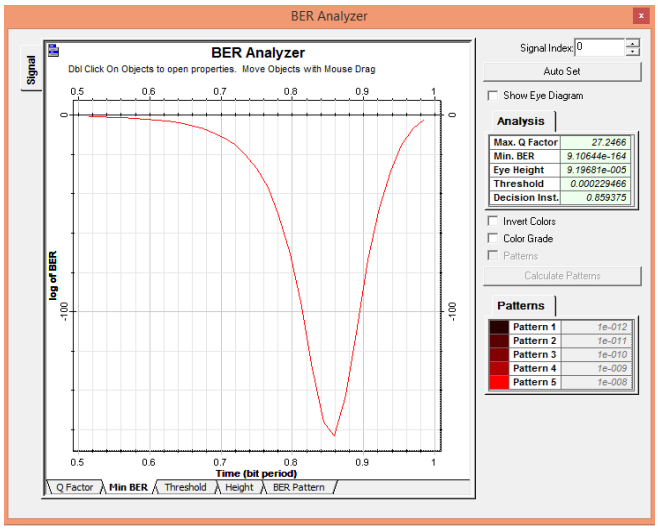

Fig -5: Minimum BER for 60 km

From this graph, we can say conclude that Q Factors are decreases when length is increases and getting the better output of minimum BER.

4. CONCLUSION

A Radio over Fiber (ROF) system were designed and simulated using the OptiSystem software and its parameters such as Q Factor and minimum BER compared for NRZ coding was done. It was observed that due to high peak power, NRZ may suffer from more nonlinearities.

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