ABSTRACT

This is mini project of optical fiber communication which utilizes Opti System as simulation tool to study and visualize various parameters of Optical Fiber Communication. Data is generated using Continuous Wave Laser which is then modulated. For our simulation we utilize 10 Giga bits of data per second using random. Different parameters like input power, length of fiber and attenuation coefficient are changed to investigate and compare BER, output power and so on.

Optical Fibre Based Communication System:

In optical fibre communication data is transmitted utilizing visible light in certain wavelength. As, light is used to transmit data communication speed of optical fibre communication system is very high. For a simple OFC data is modulated in light of coherent sources like LED and LASER converting electrical signal to optical signal i.e., electro-optical convertor then the optical source is transmitted through glass or fibre called optical fibre that spans transmission line, amplifier can be utilize in transmission line to minimize attenuation. Then the signal is converted to electrical signal using optoelectronic receiver.

Simple block diagram of OFC is given below:

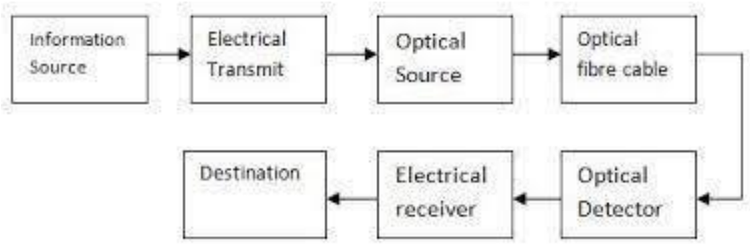

Figure 1 Block Diagram of OFC system

The above process is simulated in Opti System and result is visualized.

Opti System Simulator:

OptiSystem is an innovative, rapidly evolving and powerful software design tool that enables users to plan, test and simulate almost every type of optical link in the transmission layer of board spectrum of optical networks from LAN, SAN, MAN to ultra-long haul. It offers transmission layer optical communication system design and planning from component to system level, and visually presents analysis and scenarios.

It is created to address the needs of research scientists, optical telecom engineers, system integrators, students and a wide variety of other users, OptiSystem satisfies the demand of the evolving photonics market for a powerful yet easy to use optical system design tool.

Methodology:

The design model of the transmission system is shown in figure below. The whole system consists of three sections- the transmitter, the receiver and the transmission medium which is in this case optical fibre. Pseudo-random bit sequence generator is used to scramble data signal in terms of bit rates. MZ modulator has two inputs (optical signal and electrical signal) and one output (optical). Then the input signal is modulated with semiconductor laser that is represented by CW laser (wavelength=1550 nm) 193.4THz through Mach- Zehnder modulator. CW laser to generate optical signals supplies input signal with 1550 nm wavelength and input power of 0.05mW or -13.0102999 dBm which is externally modulated at 10 Gbits/s. with a non-returnzero (NRZ) pseudorandom binary sequence in a Mach-Zehnder modulator with 30 dB of extinction ratio. The optical fibre used is single mode fibre because has higher data rate and long-distance transmission. Photodetector (PIN) Diode Positive Intrinsic Negative to translate the optical signal into an electrical signal. The initial settings for the design are shown in Figure below are: Input power 0.05mW, Reference wavelength 1550nm, fibre length 50km, and Attenuation coefficient of cable 0.5dB/km.

In receiver side the signal is amplified by optical amplifier with gain of 20dB, which is given to photodiode for this simulation we use PIN photodiode. 3R regenerator is used to reshape and get original signal. To know about the transmitter and receiver signal we sue BER analyzer and optical power meter.

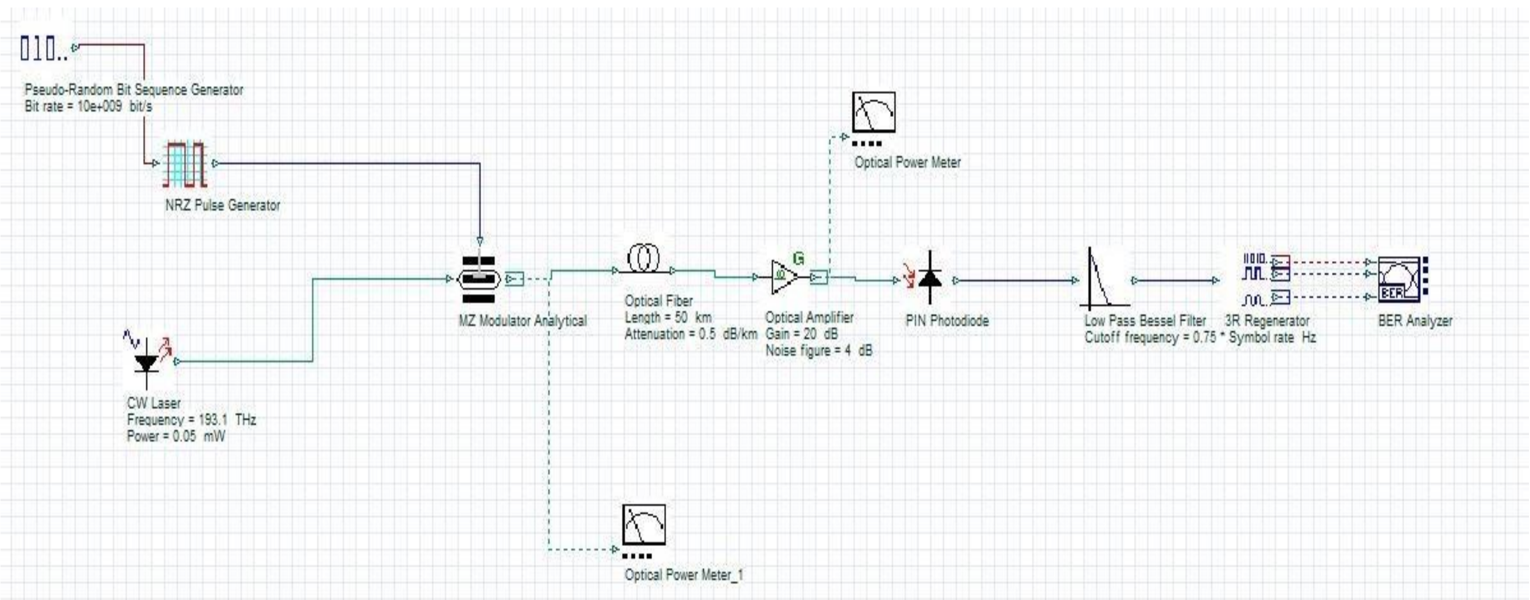

Figure 2: Simulation design of OFC in Opti System

Simulation and its Results

The parameters are varied and for different iteration power and BER are measured. These factors are then visualized in graph by changing parameters of transmission.

The results especially BER is visualized by changing length, input power and attenuation coefficient

Results varying the length

Here the length of optical power is varied and minimum BER is measured using simulation.

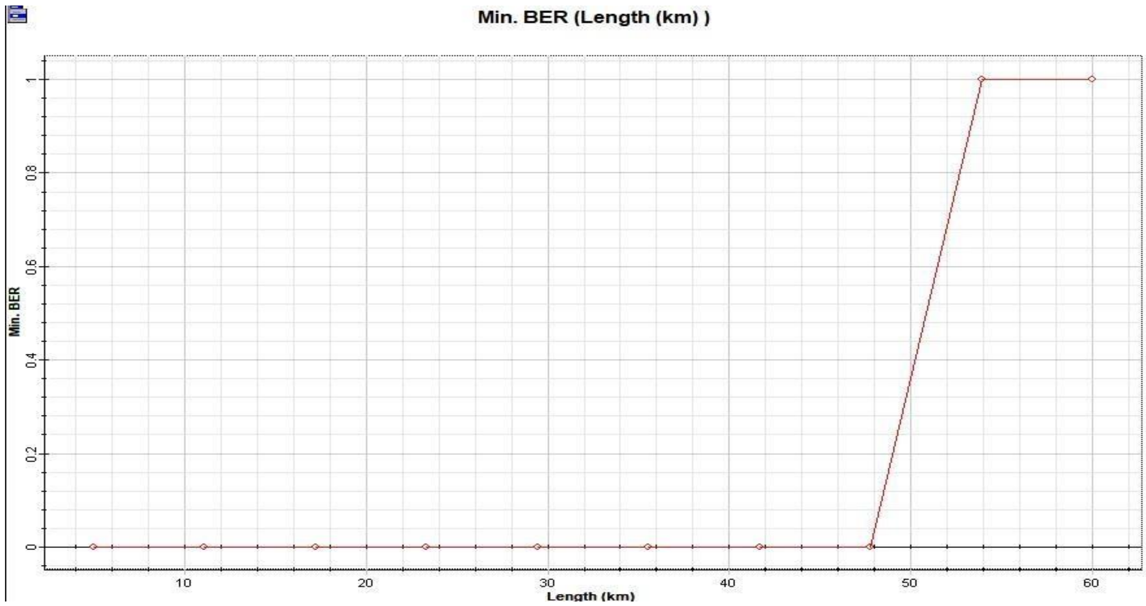

Figure 3: Minimum. BER vs Length

Results varying power of Optical source

The graph below shows the change in minimum bit error rate upon changing power of CW laser in input.

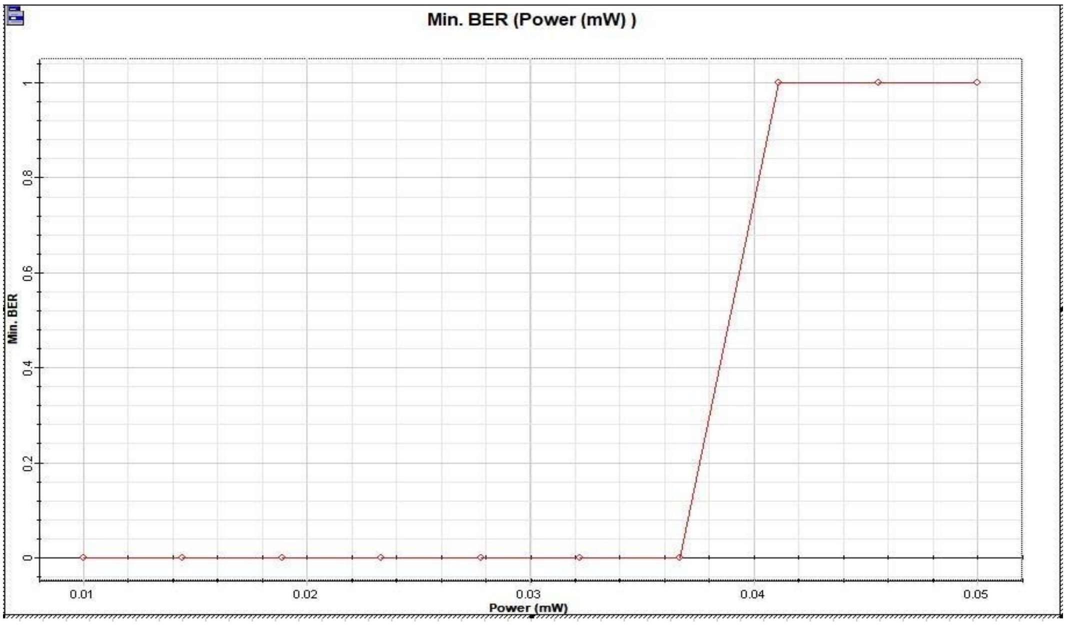

Figure 4: Min BER vs Input Power(mW)

Result of varying length and Output Power

The graph below shows the change in output power upon variation in length in the optical fibre cable

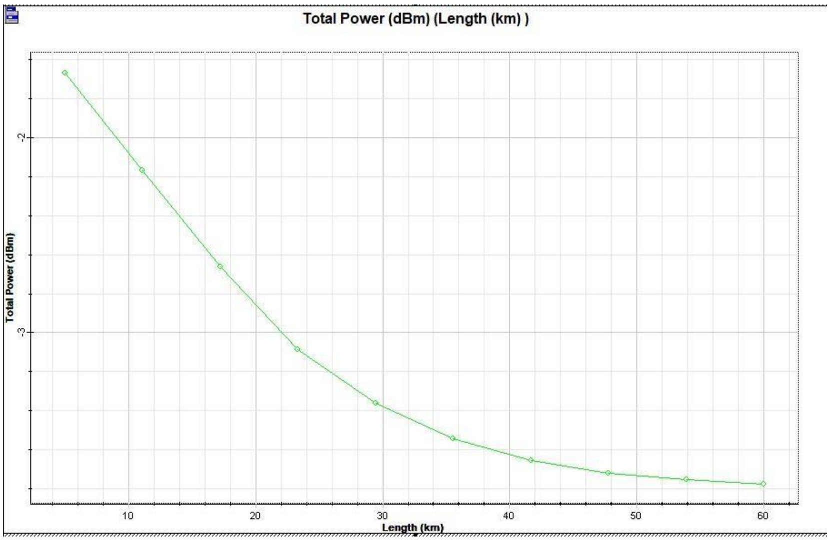

Figure 5: Output Power vs Length

Results upon varying attenuation coefficient of OFC (Optical Fibre Cable)

The graph below shows the variation of output power upon varying the attenuation of the OFC.

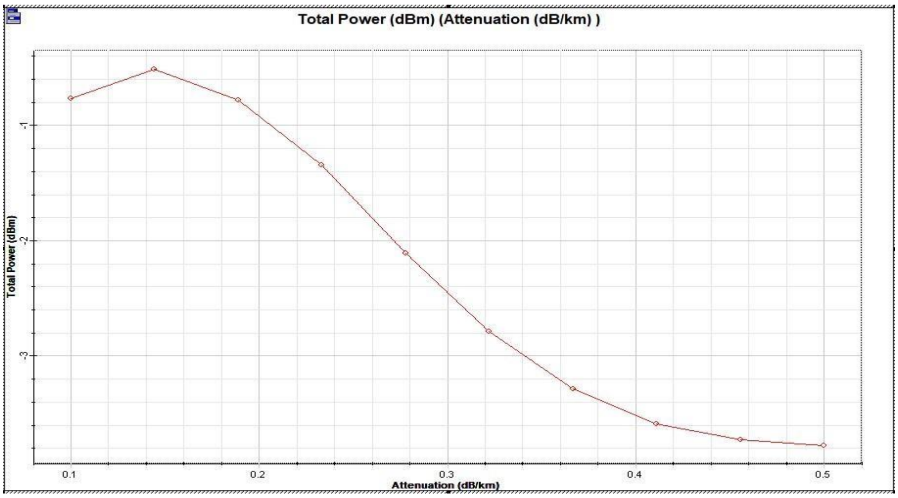

Figure 6: Output power vs Attenuation coefficient

Eye Diagram of BER at different length

The acceptable BER is considered at 10^-9 for telecommunication whereas for Optical Fibre Communication 10^-13 is considered for data transmission.

The graph shows that for cable lengths 35.55 km and attenuation of 0.3222 dB/Km we have acceptable BER.

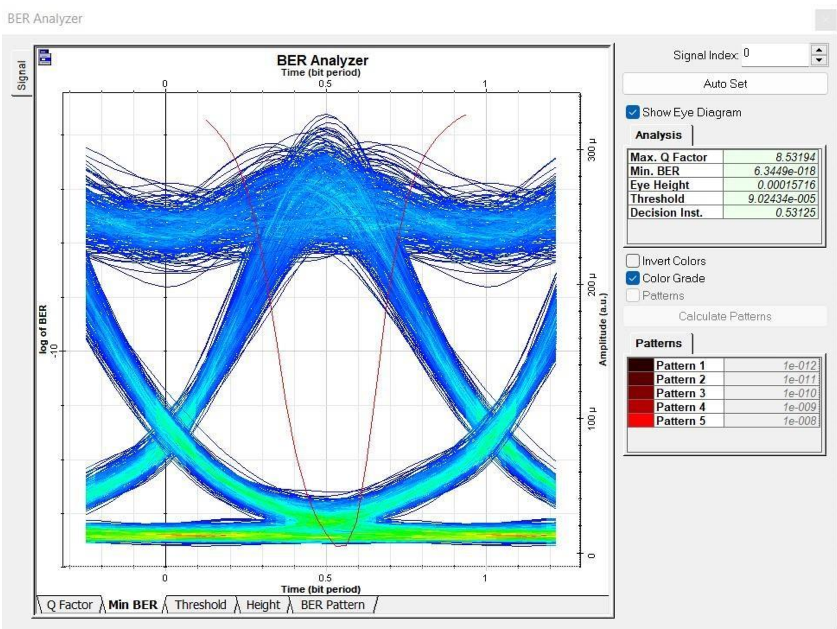

Figure 7: Min BER graph at 35.55 km

By keeping attenuation constant and changing length we get acceptable BER at 0.5dB/Km attenuation we get acceptable BER at 29.444 Km

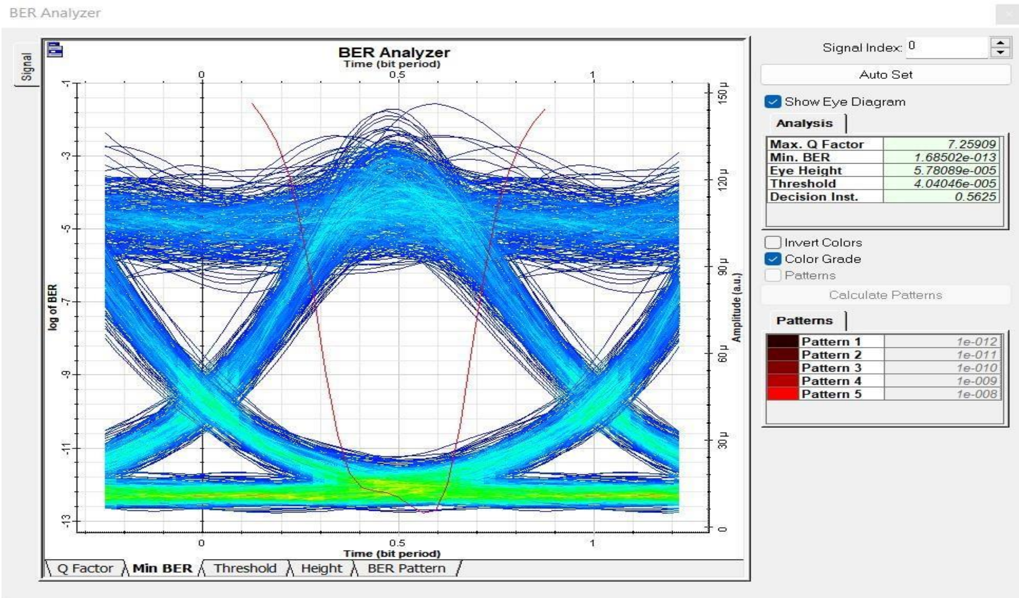

Figure 8: BER at 29.444 keeping attenuation 0.5dB/Km

At 0.5dB/Km, BER in length greater than 29.444 Km the BER becomes greater than 10^-13 as seen in figure below:

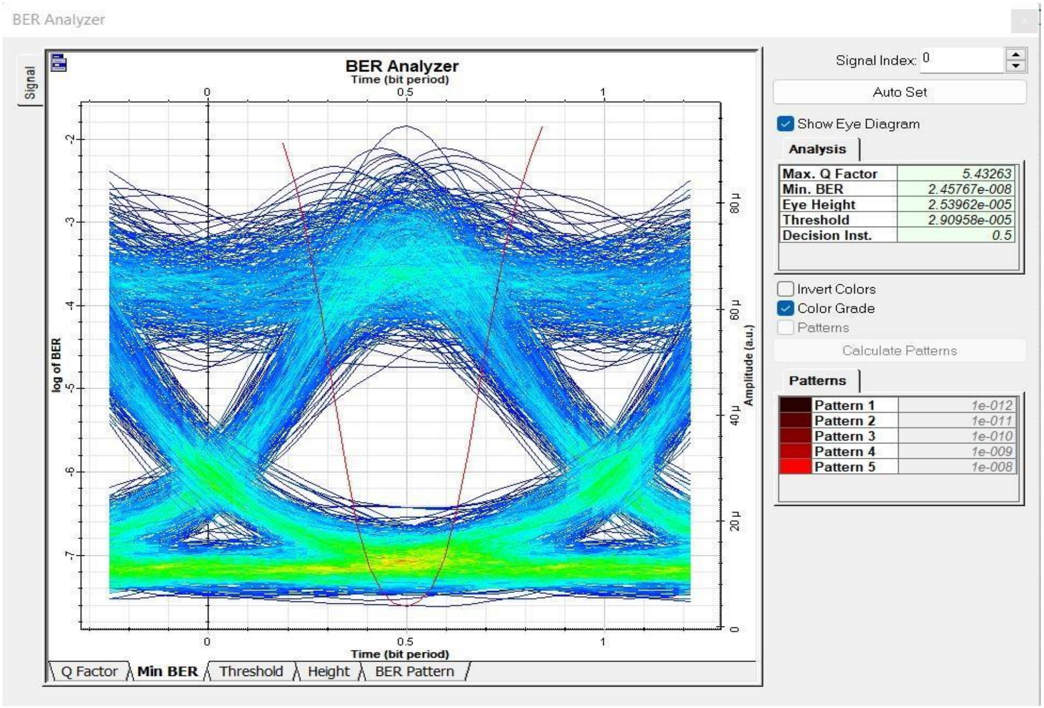

Figure 9: BER greater than 10^-13 at greater length

CONCLUSION

The above results give us concept of usable length of fiber without amplifier or signal booster. It also gives quite good understanding of relation of input power with BER or length and attenuation with BER and output power and so on.

So, by using Opti System we can develop OFC system according to parameter requirement and modify components for evolution or further development of those system without the need of performing these tests physically.