International Journal of Applied Research 2019; 5(1): 448-450

ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2019; 5(1): 448-450
www.allresearchjournal.com
Received: 23-11-2018
Accepted: 27-12-2018

Bijendra Mohan
BKD Government Boy High School, Darbhanga, Bihar, India

Corresponding Author:
Bijendra Mohan
BKD Government Boy High School, Darbhanga, Bihar, India

Study of single-mode and multimode fibre in LAN environment

Bijendra Mohan

Abstract
This paper studies and evaluates single-mode and multimode fiber transmission by varying the distance. It focuses on their performance in LAN environment. This is achieved by observing the pulse spreading and attenuation in optical spectrum and eye-diagram that are obtained using OptSim simulator. The behaviours of two modes with different distance of data transmission are studied, evaluated and compared.

Keywords: Fibre, LAN and Environment

Introduction
The goal of an optical fibre communication system is to transmit the maximum number of bits per second over the maximum possible distance with the fewest errors [1]. Since fibre transmission is a dispersive medium, implying that pulses spread as they travel through the fibre, some form of dispersion compensation is applied at each repeater stage. There is a limit to the highest frequency, i.e. how many pulses per second, which can be sent into a fibre and be expected to emerge intact at the other end. This is because of a phenomenon known as pulse spreading which limits the "Bandwidth" of the fibre.
Multimode fibre has a larger core diameter and it carries the signal strength in a variety of ways. This results in dispersion of the signal or spreading of the optical pulse in time. This limits the data rate or bandwidth. Single-mode fibre, in contrast, has a core diameter (less than 10 μm), which is small enough to prevent "multipath" effect. Single-mode fibre is the type used in long haul telecommunications. Table 1 provides comparisons between multimode fibre and singlemode fibre [2].

Table 1: General specifications of fibre

Waveguide Conductor	Bandwidth-Distance Product (MHz-Km)	Attenuation (Db/Km)
Multimode Fiber	>400	2.0
Single-Mode Fiber	>25000	1.0 (Typically < 0.5)

Related works
There are several works focusing on analysing fibre performance by exploiting different aspects of fibre. Work in paper focuses on the modulation scheme for long-haul systems, i.e. the format used to create the optical the optical pulses. Such approach, however, has given more attention to the modulation format. While research paper in [3] and [4] focus more on limitation to WDM transmission distance due to cross-phase modulation induced spectral broadening in dispersion compensated standard fibre systems and also on optimization of WDM transmission of multi-10 Gbit/s, 50 GHz-spaced channels over standard fibre. A work in [5] studies FIR filter pre-emphasis for high-speed backplane data transmission. However, the work does not include research on the transmission modes.

Simulations
An all-optical network simulator is used for the performance analysis of fibre in LAN environment.

The simulator is OptSim 4 from RSoft Design Group. This software is an intuitive modeling and simulation environment supporting the design and the performance evaluation of the transmission level of optical communication systems. It provides suitable platform for automated design of all optical networks. OptSim features many attributes and the simulation in based on its performance analysis monitors (e.g. Q value, BER, Power spectra and OSNR, eye diagram). It also provides a wide and complete choice of measurement (e.g. jitter, eye opening/closure, electrical/optical spectra, chirp, optical instantaneous phase/frequency and power).

This applies two different scenarios; one for single mode fibre and the other is for multimode fibre. For each case, simulation is done using different length of the fibre, i.e., the distance of data transmission. The block diagrams for single mode and multimode fibre are shown in Fig–1 and Fig–2.

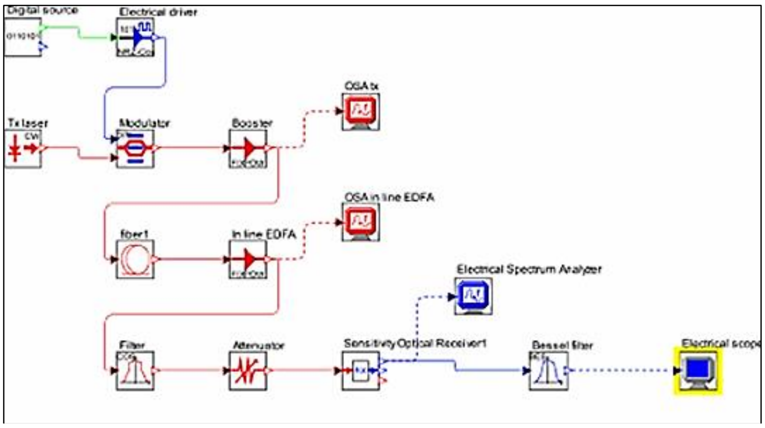

Fig 1: Block diagram for single-mode fibre

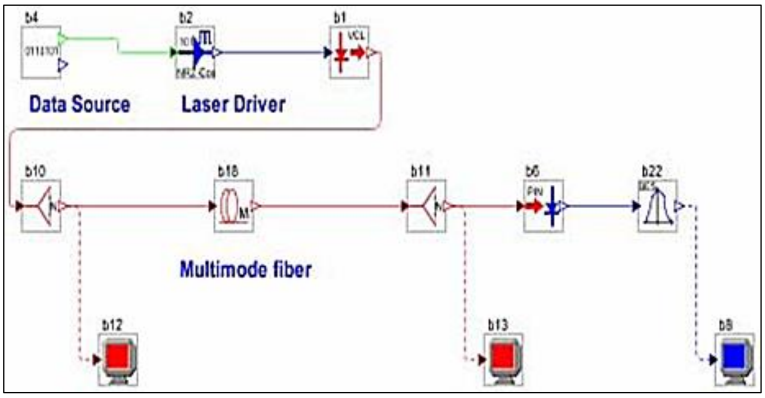

Fig 2: Block diagram for multimode fibre

The block diagrams depicted typical digital fibre optic links. Electrical data signals converted to optical signals via a modulator. It is then boosted by an optical amplifier before launched into an optical fibre. The signals are amplified by an optical Erbium doped fibre amplifier (EDFA) after each span. At the receiving end, a sensitivity optical receiver (Fig. 1) and a photodiode (Fig. 2) detect the optical signal and convert it back to electrical signal. Filter is used to filter out all the amplifier noise. The optical spectrum of the transmission is collected at the Optical Spectrum Analyzer (OSA), which is the red monitor icon. This analyzer is situated before and after the fibre medium as to see its performance after certain distance. This is where the range of the fibre lengths plays an important role. The optical spectrum under OSA in line with EDFA and the eye diagram at the received electrical scope are analyzed. Both results are taken after data transmission has fully passed the fibre that is under examination. In order to analyze pulse spreading and attenuation, optical spectrum before and after data transmitted has to be studied.

Results and Analysis

Simulation is carried out for both single-mode and multimode fibre with different data transmission distance. The main objective is first to study the pulse spreading, and second to study the attenuation of the modes with respect to different transmission distance. Fig. 3 shows the optical spectrum before transmission while Fig. 4 shows the optical spectrum after transmission.

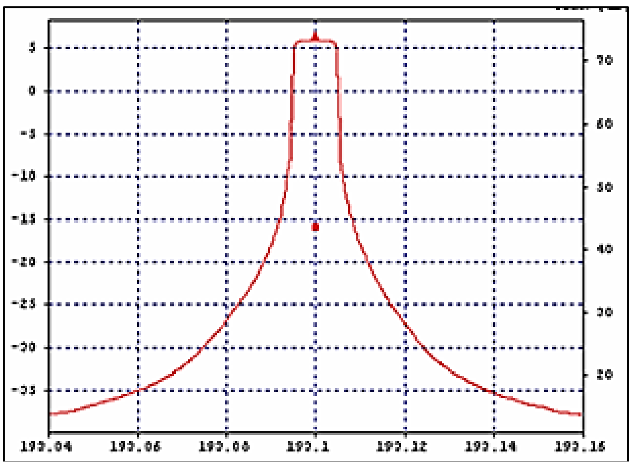

Fig 3: Optical spectrum before transmission

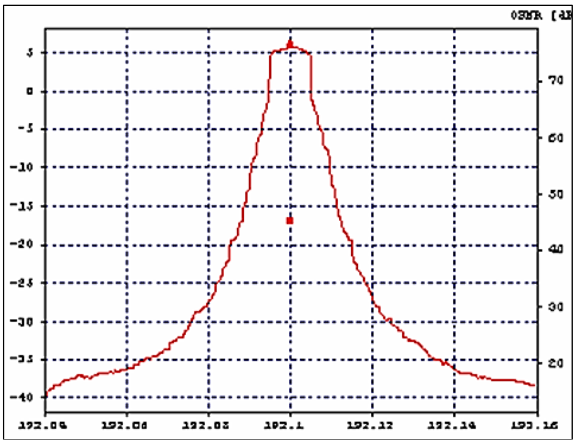

Fig 4: Optical spectrum after transmission

Comparing the two graphs in Fig. 3 and Fig. 4, it can be clearly seen that the value of OSNR has been reduced from 46 dBm to 44 dBm. This proves that the pulse is spreading. It can also be noticed that the spectrum from before entering fibre transmission is smoother compared to the one received after transmitting along the fibre.

The figures below show the eye diagram plots with different transmission distance, Fig. 5 shows eye diagram for multimode at 10 Gb/s after transmission of 50 m, Fig. 6 after 100 m and Fig. 7 after 200 m. In this simulation, the reference number is chosen to be 10^{-12}. It is observed that the attenuation increases as the distance increases. This can be seen through the eye opening, which created by signals superimposed. The eye opening of the plots indicates the region which is lower than the reference number.

This means that the region represents signal that has bit error rate less than 10^{-12}. The larger the eye opening implies less attenuation of eye-opening, hence better transmission. Fig. 5 shows a very wide eye-opening, thus less error occurred during transmission. Fig. 6 shows less wide eye-opening, which indicates more error occurred compared to Fig. 5. Fig. 7 shows that the region of eye-opening is closing, smaller and reduced. Hence, it is observed that as the distance of transmission increased, greater channel loss is obtained and due to absorption, scattering and bending, that cause the eye opening to be reduced.

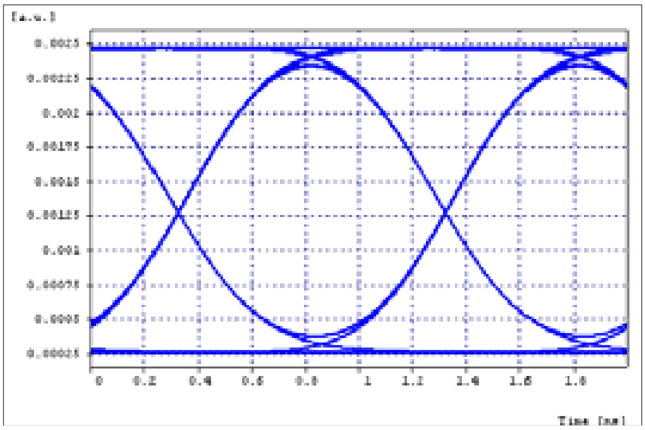

Fig 5: Eye diagrams after 50m

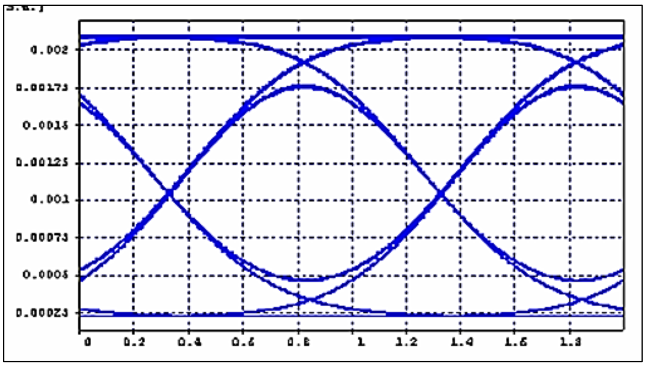

Fig 6: Eye diagrams after 100m

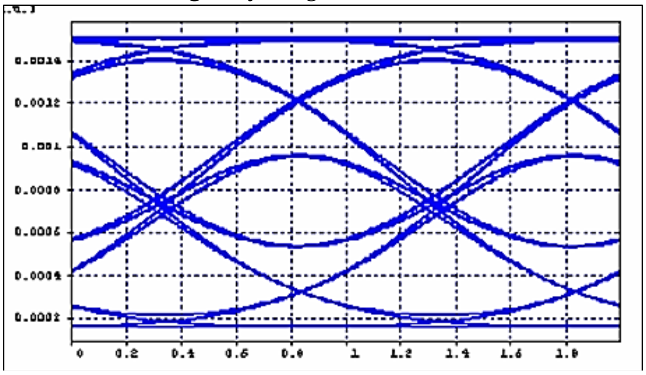

Fig 7: Eye diagrams after 200m

Conclusion

This paper presents the comparative studies of single mode and multi-mode fibres in Local Area Network (LAN). It is found that in comparison to single mode fibre, multi-mode fibre is more fruitful.

Reference

1. Kapron FP *et al*. Radiation losses in glass optical waveguides. Appl Phys Lett 1970;17(10):423-425.
2. IEEE 802.3-2002. Information Technology - Telecommunication & Information Exchange Between Systems - Local and Metropolitan Area Networks – Specific Requirements. Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD). Access Method and Physical Layer Specifications 2002.
3. TIA/EIA-455-203. FOTP-203 - Launched Power Distribution Measurement Procedure for Graded - Index Multimode Fibre Transmitters 2001.
4. TIA/EIA-455-54-B. FOTP-54 - Mode Scrambler Requirements for Overfilled Launching Conditions to Multimode Fibres 2001.
5. TIA/EIA-455-204. FOTP-204 - Measurement of Bandwidth on Multimode Fibre 2000.
6. Schlager JB *et al.* Measurements for Enhanced Bandwidth Performance Over 62.5 um Multimode Fibre in Short-Wavelength Local Area Networks. IEEE J Lightwave Technol 2003;21(5):1276-1285.