Analysis of Fiber Optics and Fundamental Behavior

Rahul Sharma[1], Dr.Shailesh Kumar Singh[2]
[1]*M.Sc. Physics,* [2]*Head of Department*
[12]*Monad University, Hapur*

Abstract- Fiber optic systems are an important telecommunications infrastructure for broadband networks around the world. Wide bandwidth signal transmission with low latency is a key requirement in today's applications. Fiber provides tremendous and unparalleled transmission bandwidth and negligible latency, and is now the preferred transmission medium for long-haul and high-data-rate transmissions in telecommunications networks. This article outlines fiber-optic communication systems and their key technologies, and discusses their trends for the next generation of technology.

Keyword- Fiber Optic Systems, Bandwidth, Signal Transmission, Telecommunications, Propagation of Light

I. INTRODUCTION TO FIBRE OPTICS

Fiber optic communications has exploded in the past two decades. Fiber is an integral partof the existing communications infrastructure and can be found along roads, buildings, hospitals and machinery.The fiber itself is a strand of glass that relies on silica, and its dimensions resemble the dimensions of a human hair, surrounded by a transparent layer. Light can be moved along the fiber at large distances at very high data rates, providing an ideal means of transmitting information. This section explains some of the terms related to fiber optics engineering.

- Fibre Basics
- Structure
- Light in a fiber
- Transmission Characteristics of Fiber
- Attenuation
- Dispersion
- Jargon Buster
- EDFA
- TDM
- DWDM

a. Fibre Structure

The diagram shows the typical structure of fibers used in communication links. It has inner glass core with outer coating. This is covered with a protective pad and an outer cover. This fiber design is lightweight and has a very low loss, making it ideal for transmitting information over long distances.

b. Light in a fibre

Light is spread along the fiber through the entire internal reflection process. There is light inside the glass core and paint through the careful design of the refractive index.

The loss along the fiber is low and the signal is not subject to electromagnetic interference affecting other transmission methods, such as radio links or copper cables. However, the signal is decomposed by other means of fiber, such as dispersion (described below) and nonlinear effects (resulting from high energy density at the heart of the fibers).

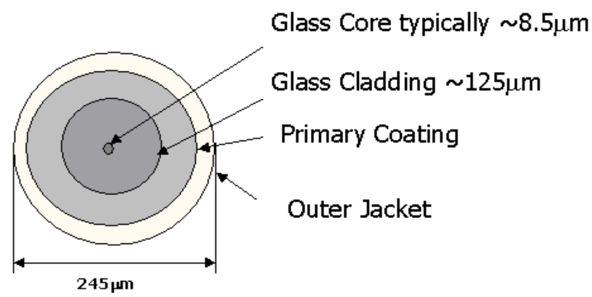


Fig.1: Internal reflection process

II. BACKGROUND

1. Warren-Smith et al. (2019) propose they offer a comparison between four high-temperature fiber optic sensors based on networks. Three commercial sensors are available, including chiral and microscopic optical fibers, and the Bragg network is written using a femtosecond laser in the coated fiber with depression in single-mode and regenerated fiber from Bragg. They compared them with a network of femtosecurity laser technology manufactured in the company in pure optical fiber of pure silica. They tested the sensors at 100 ° C increments up to 1100 ° C for at least 24 hours. The four sensors were found to operate up to 900 ° C. However, the sensors based on silica micro-fibers showed greater stability in the wavelength of the reflected sensor compared to other sensors at temperatures of 700 ° C and above. In addition, they verified the stability of the high temperature of the suspended silica core fibers with the phytosanetic laser ablation clamps, which show an improved stability of up to 1050 ° C, after thermal planking. This research can be used as a guide to identify fiber types, packaging and network types for high temperature detection applications.

2. **Kumagai *et al*. (2019)** studied they illustrate the low-fiber personal coupler for silicon photons with a stress-free fiber bending technique, which achieves low insertion of <0.5 dB and

Telcordia-1221GR-CORE of high reliability even with a radius of extreme fiber curvature of about 2 mm.

3. Shi *et al*. (2019) studied they show that the LMA can simultaneously emit the LP11 dual-band mode in two near-infrared regions through the MSC coupling. The MSC mode adapter is designed to achieve dual-channel mode conversion at a time that corresponds to wavelength zones of 1.0 and 1.5 microns, where each channel converts the broadband mode from LP01 to LP11 with high purity of the mode. As a demonstration of the concept, we applied the Ytt (Yb) fibrous laser and Erbium fiber (Er) with a parachute output of LP11 in two colors with lock mode. The laser consists of two laryngeal ventilators with a common MSC mode adapter. The LP11 conditional pulse width is generated at a maximum of 11 and 8.1 nm for the laser diode using Yb and Er, respectively. The provided fiber laser represents a promising source of light in the field of structured lighting and high-speed optics.

4. Schrenk (2019) study the radio analogue circuit designs avoid excessive transmission, as they ignore the digitization and processing of radio signals on the head and tail of the mobile optical interface. Typically, according to Density Modification / Direct Detection methodology, these systems do not comply well in terms of optical spectral efficiency and sensitivity. Here, I propose and experimentally demonstrate an optical electron drive for homogeneous transmission of fiber radio. The complexity is greatly reduced by relying on a cost-effective component that is well adopted in communications networks and data centers: EML. By taking advantage of the complete optical blocking of the interconnected laser partition, homogeneous reception is facilitated by EML's electrical absorption. The frequency of the radio carrier is fully translated between the electric and optical field, although coherent reception is used without additional signal processing. When a commercially available EML device is used, a vector size of 4.6% is achieved for the radio transmission of the fiber to the multiplexed radio signal by multiplying the square orthogonal frequency from 100 MHz to 100 MHz in a range of 27.5 km, 1: 128 dividing the fronthaul network. The extension of 1 GHz broadband radio signals has been verified. In addition, wireless transmission of two-way analogue fibers is performed using one EML through the simultaneous use of its modulation property. The signal integrity can be maintained by double frequency division, as shown by a small penalty of error size of 0.7% vector to receive the downlink while transmitting a symmetrical uplink radio signal with the same EML. However, a complete, cost-effective dual-fiber radio solution is provided based on a single-fiber analog head-to-head radio interface and a single radio frequency transmitter for optoelectronics.

5. Trukhina*et al*. (2019) Experimental test results are proposed for the bending effect of many optical fibers in the Brillouin effects. Diagnostic problems have shown unauthorized access to fiber optic communication lines. The results of the tests showed the advantage of Brillouinreflectometry method for early diagnosis of "problematic" sectors in optical cables.

6. **Ignatikov et al.(2019) study of** the problem of supplying the Russian market with high-quality radiation-resistant optical cables and fibers from a private industry arose because of the overall replacement of imports. Until recently, Russian optical cables, resistant to ionizing radiation, relied solely on imported optical fibers, but the long-term experience of Russian scientists, obtained during the research and development of laboratory samples and related experiments, made it possible to master mass production for specialized fiber optics, their properties are not inferior to their foreign counterparts. When one of these works was performed, during fiber optic tests, radiation attenuation was found in the radiation intensity, which was not mentioned in the previous literature. For fiber-optic cable covers, the materials were selected as a static gamma radiation experiment and demonstrated their suitability for operating under ionizing radiation exposure conditions.

7. Pathak *et al.* (2018) studied the pH sensor for high-sensitivity and wide-spectrum U-fiber was manufactured and demonstrated using a layer of TiO2 with a different layer of gel gel and described in this document. Lay TiO2 layer on U-shaped fibers to improve fading area in pH detection film. A wide range detection film is prepared using three different indicators for different pH ranges. The highest sensitivity of 0.68 dB / pH was obtained for the dew sol layer at 1550 nm with a good linear response. It is also proven that the sensor proves stability, durability and fast response time.

8. Guo& Chen (2018) study of in this document, a fiber-optic warning system is proposed based on vibration detection. The system consists mainly of laser source, common optical cable sensor and STM32 processor microprocessor, a main computer. There are two optical couplers in the optical sensor cable, making the fiber optic interference structure. The main computer interface can clearly see the vibration time and signal strength.

9. Shcherbakov*et al.* (2018) study they provide experimental results on signal transmission in optical fiber bonds with direct density modulation and direct detection of photoelectric current in fiber output. Diode dispersion fibers (DCF) are used to compensate for the accumulated dispersion of the transmission fiber length. Despite the remaining total dispersion, we observed a marked reduction in the depth of low energy in the signal.

10. Barbut, (2018) study of in this article is a brief description of the evolution of optical fiber networks in Romania in the past 7 years. Transitions from trunk and FTTB networks were transferred to FTTH networks or internal fiber networks as well as in cities as support for future services such as 5G and multiple operators and alternatives.

III. MEATHMETICAL MODEL

To understand light propagation through optical fibers, consider Figure 2Consider the light beam.

(i) When entering the nucleus at point A, it will pass through the nucleus until it reaches the basic lining at point B. As long as the light beam intersects the liner boundary at small angles, the beam will reflect back to the nucleus. To move to point C, where the reflection is repeated, that is, the overall internal reflection occurs. The total internal reflection occurs only when the angle of injury is greater than the critical angle. If the optical fiber beam enters a steep angle

(ii). When this beam crosses the limits of the underlying lining, the angle of the intersection is too large. Therefore, reflection does not happen again to the heart and the beam of light is lost in the casing. This means that for optical fibers to be routed, the light beam must enter the nucleus at an angle smaller than a given angle called the fiber acceptance angle. The beam will be lost entering the fiber at an angle greater than the acceptance angle in the paint.

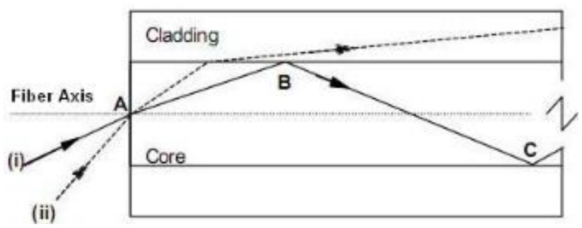


Fig.2: Propagation of light in an optical fiber

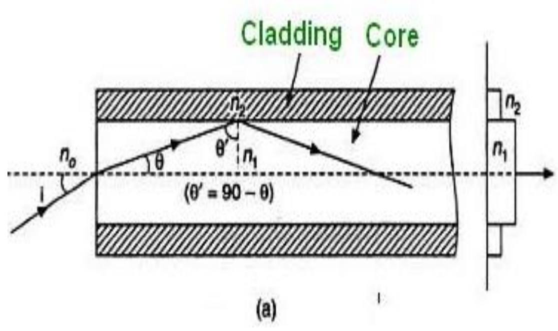
Consider optical fiber with refractive index core n1 and refractive coating n2. Let the falling light form the angle i with the central axis as shown in figure (3-a,b). After that, the light breaks at an angle and falls on the front of the core lining at an angle where,

$\theta' = (90 - \theta)$ (1)

Under the Snell Act at the point of light input in the fiber optics we obtain,

$n_0 \sin i = n_1 \; sin\theta$ (2)

Where n0 is the refractive index of the center outside the fiber. For air n0 = 1.



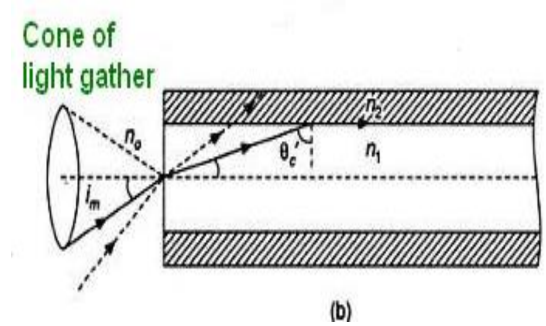


Fig.3: Refractive index

IV. CONCLUSION

The fiber optic communication industry is constantly evolving.First, the growth of industry experience. This has been great for a decade. There is still much to be done Completed to support faster data speed requirements Switching technology and smarter networks. An architecture that can dynamically change dynamically. Response to traffic patterns, but also cost. Efficient it is expected that this trend will continue to develop in the future. The progress that the laboratory has made will be Extend to the real implementation and bring new ones the development of fiber optic communication.

V. REFERENCES

[1]. S. C. Warren-Smith *et al.*, "Stability of Grating-Based Optical Fiber Sensors at High Temperature," in *IEEE Sensors Journal*, vol. 19, no. 8, pp. 2978-2983, 15 April15, 2019.doi: 10.1109/JSEN.2019.2890847.

[2]. T. Kumagai *et al*., "Low-Loss and Highly Reliable Low-Profile Coupler for Silicon Photonics," *2019 Optical Fiber Communications Conference and Exhibition (OFC)*, San Diego, CA, USA, 2019, pp. 1-3.

[3]. F. Shi *et al.*, "Mode-Locked All-Fiber Laser Emitting Two-Color High-Order Transverse Mode," in *IEEE Photonics Technology Letters*, vol. 31, no. 7, pp. 497-500, 1 April1, 2019. doi: 10.1109/LPT.2019.2892843

[4]. B. Schrenk, "The EML as Analogue Radio-Over-Fiber Transceiver—A Coherent Homodyne Approach," in *Journal of Lightwave Technology*, vol. 37, no. 12, pp. 2866-2872, 15 June15, 2019. doi: 10.1109/JLT.2018.2870537

[5]. A.I. Trukhina, I. V. Bogachkov and N. I. Gorlov, "Researches the Influence of Bends in Optical Fibers of Various Kinds on the Brillouin Traces," *2019 Systems of Signals Generating and Processing in the Field of on Board Communications*, Moscow, Russia, 2019, pp. 1-4. doi: 10.1109/SOSG.2019.8706732

[6]. I.S. Ignatikov, I. A. Ovchinnikova, I. B. Peshkov, E. Y. Gecha and V. N. Gordienko, "About Radiation Resistance of Optical Cables and Fibers," *2019 Systems of Signals Generating and Processing in the Field of on Board Communications*, Moscow, Russia, 2019, pp. 1-4. doi: 10.1109/SOSG.2019.8706785.

[7]. A.K. Pathak, T. Khanikar and V. K. Singh, "U-bend optical fiber pH sensor using multiple sol-gel coating over TiO2," *2018 3rd International Conference on Microwave and Photonics (ICMAP)*, Dhanbad, 2018, pp. 1-2. doi: 10.1109/ICMAP.2018.8354501.

[8]. J. Guo and Y. Chen, "An Optical Fiber Warning System Based on Vibration Sensing," *2018 14th International Conference on Computational Intelligence and Security (CIS)*, Hangzhou, 2018, pp. 93-95. doi: 10.1109/CIS2018.2018.00028

[9]. V. Shcherbakov, A. F. Solodkov and A. A. Zadernovsky, "Intensity Modulation Response of Analog Fiber-Optic Link with Dispersion Compensating Fiber," *2018 International Conference Laser Optics (ICLO)*, St. Petersburg, 2018, pp. 349-349. doi: 10.1109/LO.2018.8435702

[10]. C.Barbut, "Fiber Optic Deployments in Romania between Metropolitan Fiber Optic Networks and Indoor Fiber Optic Infrastructure," *2018 10th International Conference on Electronics, Computers and Artificial Intelligence (ECAI)*, Iasi, Romania, 2018, pp. 1-3. doi: 10.1109/ECAI.2018.8679021