ISSN No:-2456-2165

An Experimental Analysis on IOR and It's Effects with Respect to Optical Fiber Media for Long Haul Applications

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Abstract:- Today the global world is running with Light speed which demands the same interconnectivity nothing but internet speed. The Internet speed mainly depends on the medium of the signal traveling, to attain higher speeds the best medium is the optical fiber. Optical fiber is made up of glass or plastic material with dia slightly higher than human hair. The Light propagates in the fiber-based on the principal operation of Total Internal Reflection. The Optical Fiber has unlimited bandwidth but the speed of data is limited by different parameters. So In this experimental study, these parameters are analyzed concerning IOR for that that the Experimental Setup was made by considering two Optical Fiber Cables with different IOR and Fusion Splicing Machine for Joining Fibers. For detailed analysis, OSNR (Optical Signal to Noise Ratio) meter, OTDR (Optical Time Domain Reflectometer), and Optical Power Meter byare used.

The Examination was initialized by understanding various optical fiber parameters related to IOR like materials used for construction, various terms defining IOR, and then by the process of fusion splicing, and then we are trying to connect fibers with the same IOR and Different IOR. Based on this practical experiment various losses like Splice Loss,Attenuation, OSNR, etc. are calculated and concluded as if the fibers with the same IOR spliced together giving better results with very fewer losses and High speeds rather than Different IORs.

Keywords:- *Optical Fiber, Refractive Index, Fusion Splicing, Attenuation, OSNR, OTDR & LSPM.*

I. INTRODUCTION

➢ *Light Propagation in Optical Fiber.*

The optical fiber has two concentric layers called the core and the cladding. The inward core is the light conveying part. The encompassing cladding gives an alternate refractive file that permits the all out inward impression of light through the core. The record of the cladding is under 1%, lower than that of the core. Normal qualities for instance are a core refractive file of 1.47 and a cladding list of 1.46. Fiber makers control this distinction to acquire wanted optical fiber qualities. Most fibers have an extra covering around the cladding. This cradle covering is a safeguard and has no optical properties influencing the engendering of light inside the fiber.

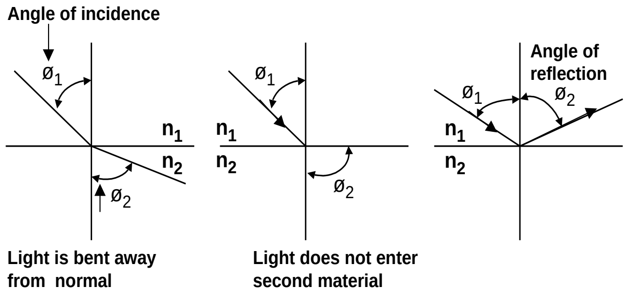


Fig1 Refraction and Reflection of Light

The figure shows light going through a fiber. Light infused into the fiber and striking core to cladding interface at more prominent than the basic point, reflects into the core, since the point of rate and reflection are equivalent, the mirrored light will again be reflected. The light will keep crisscrossing down the length of the fiber. Light striking the interface at not exactly the basic point passes into the cladding, where it is lost over distance. The cladding is generally wasteful as a light transporter, and light in the cladding becomes lessened reasonably. Proliferation of light through the fiber is administered by the files of the core and cladding by Snell's law.

Such complete interior reflection shapes the premise of light spread through an optical fiber. This investigation considers just meridional beams those that go through the fiber pivot each time, they are reflected. Different beams called Skew beams travel down the fiber without going through the hub. The way of a slant beam is commonly helical folding over and around the focal pivot. Luckily, slant beams are overlooked in most fiber optics examination.

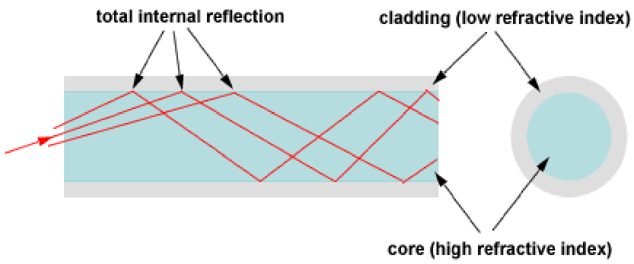


Fig2 Total Internal Reflection

➢ *GEOMETRY OF OPTICAL FIBER*

Optical fiber comprises of a core of optically straightforward material normally silica or borosilicate glass encompassed by a cladding of a similar material yet a marginally lower refractive file. Fiber themselves have tiny widths. The figure shows a cross-part of the core and cladding measurements of usually utilized fibers. The widths of the core and cladding are as per the following. Fiber sizes are normally communicated by first giving the core size followed by the cladding size. In these manner 50/125 methods a core width of 50μm and a cladding distance across of 125μm.

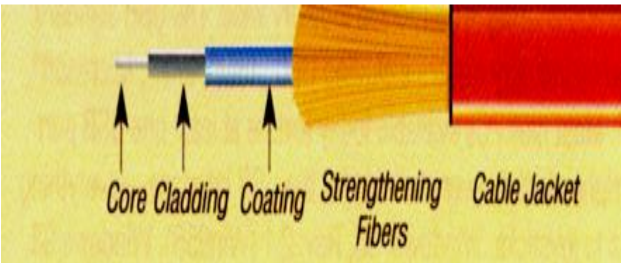


Fig3 Optical fiber Geometry

➢ *SPECS OF OPTICAL FIBER*

- *Attenuation*

Attenuation is characterized as the deficiency of optical control over a set distance, a fiber with lower attenuation will permit more ability to arrive at a collector than a fiber with higher attenuation. Attenuation might be sorted as intrinsic or extrinsic.

- Intrinsic Attenuation It is lost due to inherent or within the fiber and it may appeared due to absorption and Scattering.
- Extrinsic Attenuation It is lost due to external sources. Extrinsic attenuation may occur as macro and micro bending

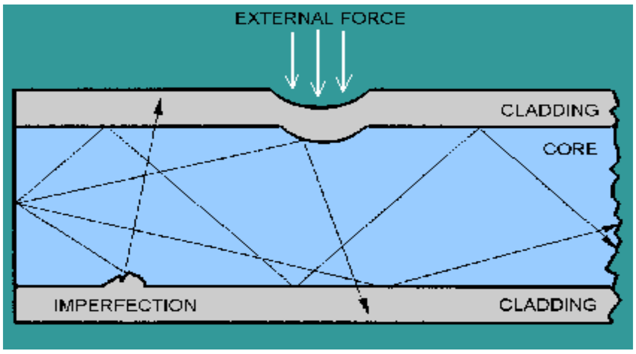


Fig4 Sources of attenuation

- *Bandwidth*

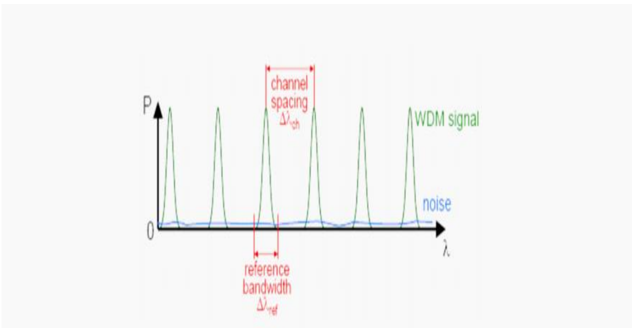
It is characterized as the measure of data that a framework can convey to such an extent that each beat of light is recognizable by the collector. System bandwidth is estimated in MHz or GHz. When all is said in done, when we say that a framework has a bandwidth of 20 MHz, implies that 20 million pulses of light each subsequent will go down the fiber and each will be discernable by the recipient.

- *Index of Refraction or Refractive Index*

I.O.R. is a shortening for Index of Refraction. Its unit esteem is n. The index of refraction is the proportion of the speed of light in a vacuum to the speed of light in a fiber. Strands are made for the most part from silica glasses. The high virtue glass is known as the host material or substrate. Its mass refractive index for the most part characterizes the refractive index of the fiber cladding. Adding dopant materials to the host material structures the fiber center. To change the refractive index of optical fiber, unadulterated silica is often doped with dopants. For instance, adding germanium can build the refractive index, while adding fluorine decreases it. The refractive index of doped material can be dictated by the straight connection between the doped material's mole rate and permittivity.

- *OSNR*

Optical signal-to-noise ratio (OSNR) is utilized to measure the level of optical noise impedance on optical signals. It is the ratio of administration signal ability to noise power inside a substantial data transfer capacity. OSNR fills in as a benchmark indicator for the evaluation of the exhibition of optical transmission frameworks. OSNR is significant on the grounds that it proposes a level of impedance when the optical signal is conveyed by an optical transmission framework that incorporates optical speakers.



$$OSNR = 10dB \cdot Log_{10}\left(\frac{S}{N}\right)$$

Where
S represents the (linear) optical signal power and
N is the (linear) optical noise power

Fig5 OSNR Calculations

➢ *SPLICING*

Spicing is a process of creating a everlasting link between two fibers. The splicing engage wounding off the boundaries of the two fibers to be joined. This cut has to be carefully made to have a smooth surface and is generally achieved by a special cutting tool. The two ends, thus, prepared are then brought together and made to butt against each other. The fibers are then fixed permanently and reinforced. The fixing process can be achieved in several ways. It could be mechanically fixed permanently through the use of epoxies or fusion.

- *Fusion splicing*

The fusion splicing method is the most well known procedure utilized for accomplishing low join misfortunes. The fusion can be accomplished either through an electrical circular segment or through the gas fire. The interaction includes cutting the strands and fixing them in miniature positioners the fusion splicing machine. The filaments are then adjusted either physically or naturally center adjusting (on account of the S.M. fiber) measure. Thereafter, the activity that happens includes the withdrawal of the filaments to a predefined distance, preheating the fiber closes through the electric curve and uniting the fiber closes in a position, and splicing through high-temperature fusion.

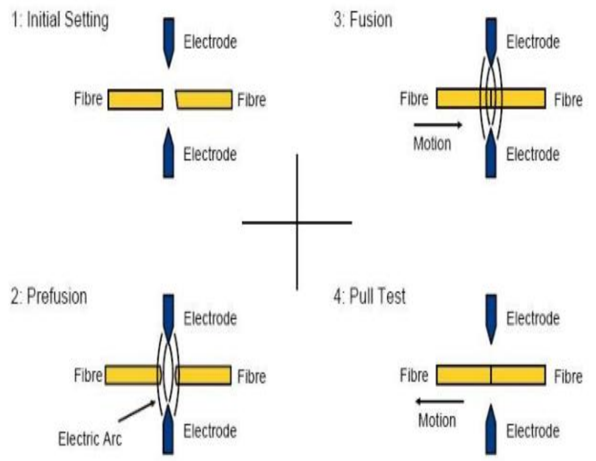


Fig6 Steps of Fusion Splicing

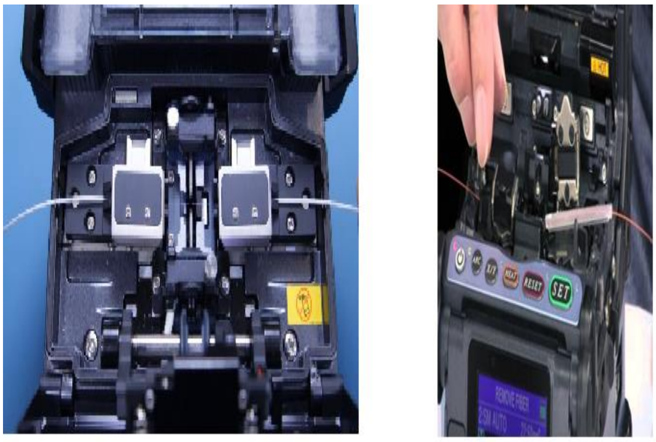


Fig7 Fiber Jointing Using with Fusion Splicing Machine

II. LITERATURE REVIEW

Dony Yang et al. [1] have broke down optical back spread (OBP) method that used two profoundly non straight strands to make up for transmission fiber non-direct impacts. Chung [2] has looked into the arising advancements for propelling the fiber optic information correspondence data transfer capacity for the cutting edge broadband organizations. Mohd Fareq Abd et al.[3] have proposed a keen correspondence stage framework (SCPS) based station to check the inclination of framework execution used to deal with and uphold the correspondence network in misfortune regions Jianjun Yu [4], tentatively exhibited interestingly, millimeter-wave(mm-wave) age in the E-band (71–76 GHz and 81–86 GHz) in view of photonics age strategy.

\XuGuang Huang et al. [5] utilized a straightforward ease and profoundly affectability fiber optical sensor framework to quantify the refractive list (RI). Liu Yu-Ran. [6] introduced a novel fiber-optic disorder synchronization framework permitting bidirectional significant distance correspondence. Partha Mitra. [7] have built up a technique to figure the data limit of a nonlinear channel and processed the decline in channel limit with regards to fiber optic correspondence frameworks. Another strategy to configuration long stretch fiber optic correspondence frameworks has been planned by Peddanarappagari and Peddanarappagari Kumar V [8].

Marta Beltrán et al. [9] tentatively exhibited a straightforward, practical crossover gigabit fiber remote framework for inbuilding remote access. Ongoing advances in creating NOLM-based all-optical preparing methods were introduced by Turitsyn, Keith et al. [10] for application in fibre optic correspondence. J.C.Thacker [11] looked into the utilization of fiber optic correspondence for satellite interchanges because of its low weight, huge transfer speed limit and straightforward engineering for information transporting, electromagnetic impedance (EMI), safety and cost-viability.

Jamieson [12] examined the fiber optic framework as a methods for ensuring correspondence line against the impacts of atomic blast. Joachim Horwath [13] played out the trial field preliminaries for optical interchanges from and to high altitude stages (HAPs) to send information at multi Gigabits each second. Xi Chen et al. [14] methodically investigated the security variables of Optic based Information Communication Infrastructure's (OICl) actual layer. The above writing uncovers that Fiber optic correspondence framework has enormous extension on IOR for huge number of utilizations like correspondence, robotization of power circulation framework, military applications etc.for a nation like India.

- *EXPERIMENTAL SETUP*

For Experimental analysis, Two optical fibers are taken with different specs as listed below the table.

Table 1: Optical fiber cables with Different IOR

S.NO	**Fiber Make**	**Capacity**	**IOR**
1	Strellite	24F	1.4670
2	HFCL	24F	1.4620

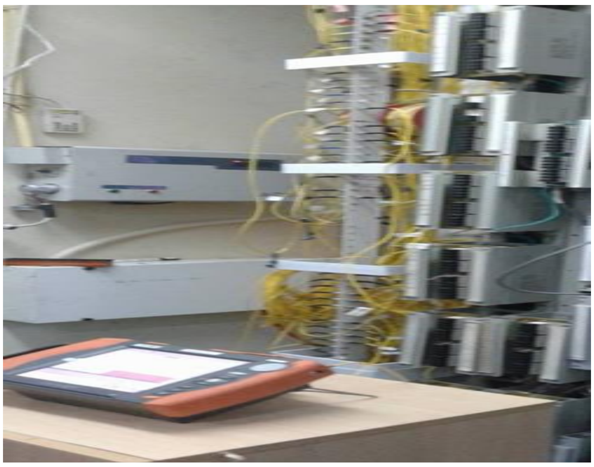


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Fig 8 Experimental Setup

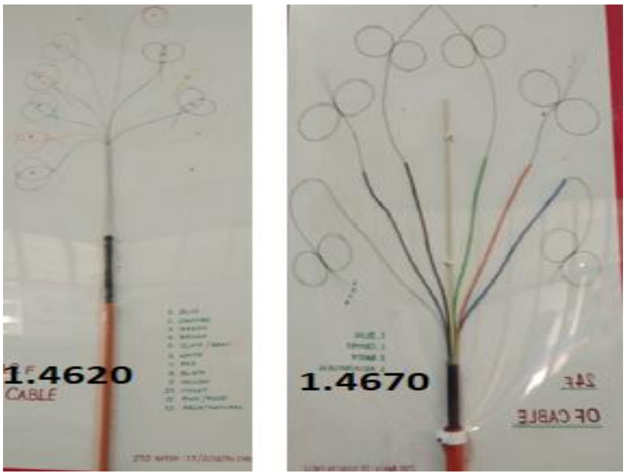
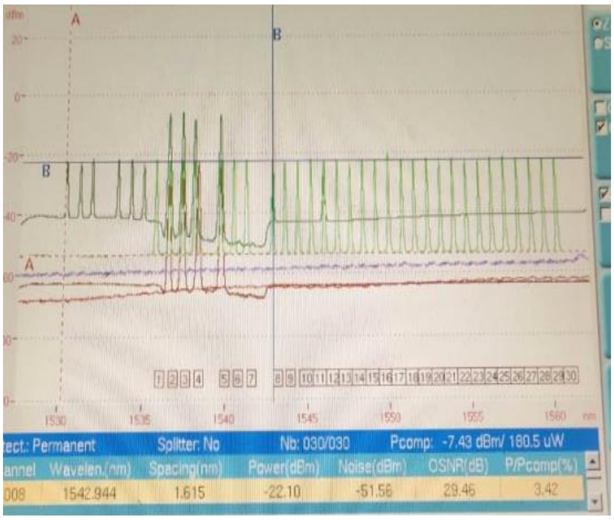


Fig 9 Experimental Setup and Optical fiber cable with different IOR

III. EXPERIMENTAL ANALYSIS

➢ *OSNR*



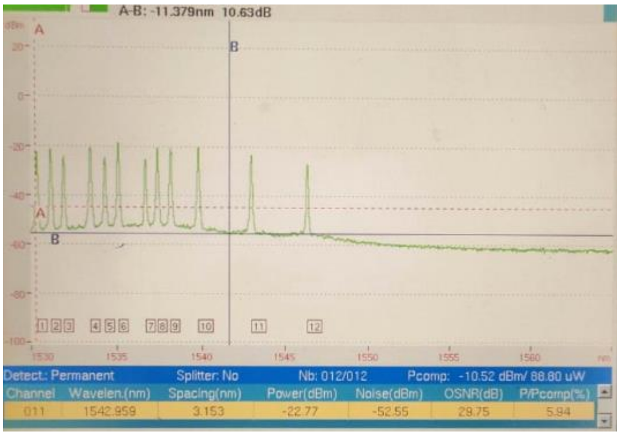


Fig10 SNR with Different IOR and Same IOR after Fusion splicing

The Test was Conducted and analyzed using OSNR(Optical Signal to Noise Ratio) Meter and found that the optical fibers which are spliced with the same IOR resulting more OSNR levels compared to different IORS

➢ *Splice Loss*

Similar to the above Observations Splice losses are also reduced to a quite good level while fibers are spliced with the same IOR rather than different.

Fig11 Splice loss with same IOR and Different IOR after Fusion splicing

Table 2Attenuation Analysis using LSPM Method

S.NO	IOR of fibers	Loss in dB	dB/km	Decision
1	Same	2.815	0.218	Accepted
2	Different	4.876	0.487	Rejected

The Table listed above clearly exploring the fibers joined with different IORs rejected for link budget rather than the same IOR. So to optimize the attenuation levels in the Link same IOR fiber spliced for long haul results better results.

IV. CONCLUSION

The Experimental analysis was executed using OSNR (Optical Signal to Noise Ratio) meter, OTDR (Optical Time Domain Reflectometer), and Optical Power Meter. During this experimental analysis, OSNR is examined using OSNR Meter and concluded for Long Haul Communications same IOR Optical Fiber cables are preferred in the same way the Splice loss are also can be optimized using same IOR Fibers. For Attenuation analysis, LSPM Method was implemented for link budget analysis and found that especially for long haul applications same IOR Fibers are preferred and acceptable. Hence this Experimental study concluding that for Long haul optical Communications optical fiber cable laid and joined with the same IORs resulting in good parameters rather than different ones.

REFERENCES

[1]. Dony Yang ,and Shiv Kumar, —Comparison of optical back propagation scheme for fibre optic communication optical Fibre Technology,19, pp. 4-9,2013.

[2]. Chung, —Emerging Technology for fibre optic data communication Handbook of fibre optic data communication, III Edition,chapter 25, 2008.

[3]. Mohd Fareq Abd. Malekb and MohdSharazel Razallia, —A Novel Approach for Evaluation of Enhancing Networks Procedia Engineering,pp53, 497 – 503,2013.

[4]. Jianjun Yu, 1Ze Dong, and Nan Chi1, —Photonics Millimeter-Wave Generation in the E-Band and Bidirectional Transmission IEEE Photonics Journal, Vol. 5, No. 1, 2013.

[5]. XuGuang Huang, and Jing Shun Pan, —Simple Fibre-Optic Refractive Index Sensor Based On Fresnel Reflection and Optical Switch IEEE Sensors Journal, Vol. 13, NO. 5, pp. 1571- 1574, 2013.

[6]. Liu Yu-Ran, Fan Li, Xi Fang and Xia Gyang-Qiong Simulation of bidirectional Long-distance Chaos Communication Performance in a Novel Fibre-optic chaos communication system J. of Lightwave Technology, Vol. 31,No.3, pp 461-467, 2013.

[7]. Partha Mitra, —The Channel Capacity of a Fibre Optics Communication System: Perturbation Theory Journal of Lightwave Technology, Vol. 20, No. 3, pp. 530-537,2002.

[8]. Peddanarappagari Kumar V. and, —Volterra Series Approach for Optimizing Fibre-Optic Communications System Designs Journal of Lightwave Technology, Vol. 16, No. 11, pp. 2046-2055, 1998

[9]. Alexander Lebedev, Marta Beltrán, Xianbin Yu, Roberto Llorente, Idelfonso Tafur Monroy, —Combined single-mode/multimode fibre link supporting simplified inbuilding 60-GHz gigabit wireless access Optical Fibre Technology 18, 226–229, 2012.

[10]. Sergei K. Turitsyn, Keith J. Blow, —Nonlinear loop mirror-based all-optical signal processing in fibre-optic communications. Optical Fibre Technolog y 14,pp299–316, 2008.

[11]. J.C.Thacker, —Fibre optics systems for space applications ,optics and laser technology. April 1982.

[12]. Jamie Jamieson, —Fibre optics military communication Butterworth & Co (Publishers) Ltd, vol 5 no.4,Aug 1982.

[13]. Joachim Horwath, and R. WalterLeeb —Optical Communications for High-Altitude Platforms IEEE Journal of Selected Topics In Quantum Electronics, Vol. 16, NO. 5, September/October 2010.

[14]. Xi Chen, Zhao Ziyan, Li lianqi, —Research in security of optic-based information communication architecture for next generation power system applications International Conference on Power System Technology, pp. 1-5, 2010.