

A Review on Full Duplex Radio Over Fiber Using Fiber Bragg Grating

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Abstract— A communication system has an incredible way of expanding the high broadband limit and to accomplish a much better network coverage. Radio over Fiber holds an extraordinary potential to yield a superior efficiency for the present wireless broadband communication systems. Radio over fiber take into account an untethered access to the systems for applications like low line losses, wide coverage area and capacity or limit. The wireless network is view of radio-over-fiber (RoF) innovation is an extremely valuable arrangement so as to meet the steadily expanding interest for larger transmission bandwidth. In this paper, review of cost effective full duplex RoF transport system with remodulation using Fiber Bragg Grating (FBG) has been presented.

Keywords- Radio over Fiber (RoF), Fiber Optic Sensor and Fiber Bragg Grating (FBG) Sensor

I. INTRODUCTION

The innovation of communication in colossal data transmission was the worldwide interest either for industrial field or buyer interest. Essentially, radical interest of high transmission capacity on communication was reason for another communication application which obliged higher transmission capacity, for example, web feature and sound and others new application. Lately, optical communications systems are at last feeling the transmission capacity requirements as of now in other sort of communication systems, for example, remote and satellite communication frameworks. Truth be told, administration suppliers are seeking an approaches to build their fiber optic system limit. Optical fiber communication is a mode of transmitting data or information from one destination to another by sending light pulses through an optical fiber. Initially grew in 1970s, fiber-optic correspondence frame-works have altered the information transmission industry and have assumed a noteworthy part in the appearance of the information age. Due to its preferences over electrical transmission, optical fibers have generally supplanted copper wire interchanges in centre systems in the created world. It increases the transmission speed and also helps in decreasing the total cost of the communication system. So the interests for transmission limit and transfer speeds are turning out to be increasingly testing to the carriers and service suppliers. Under the situation, with its huge bandwidth and excellent transmission execution, optical fiber is turning into the most positive conveying media and laying increasingly imperative part in data industry.

RADIO OVER FIBER SYSTEM

Get to transmission capacity necessities for conveying fast information and video services are expected to grow to gigabits/ second in future wired and wireless access networks. Today's wired networks, based on passive optical network (PON) access technologies, have the capability of providing huge bandwidth to end users using optical fiber, but are not flexible enough to allow convenient roaming connections. On the other hand, wireless-based access solutions offer portability and flexibility to users, but do not possess abundant bandwidth to meet the ultimate demand for multichannel video services with high definition (HD) quality. To exploit the advantages of both wired and wireless technologies, carriers and service providers are actively seeking convergent network design to convey numerous services to serve settled and portable clients or mobile users. In this regard, wireless network based on RoF technology is a very beneficial solution to increase the capacity, coverage and bandwidth [1]. The concept of RoF actually refers to transport information over optical fiber by modulating the light with the radio signal. In this network a central station (CS) is connected to numerous functionally simple base stations (BSs) via an optical fiber as shown in Figure 1.

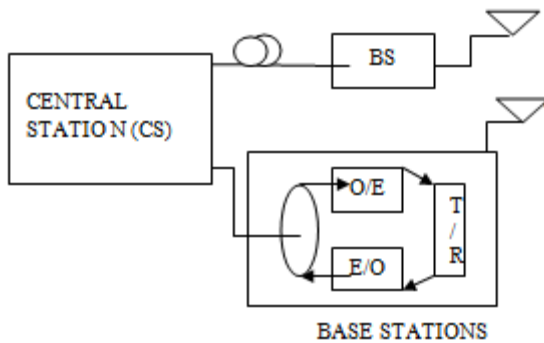


Figure 1: Radio over Fiber System.

The microwave signal is converted to optical signal at the CS, and then distributed to the remote BSs by optical fiber that provides broad bandwidth and low attenuation characteristics [2].

Almost all process in including modulation, demodulation, coding and routing is performed at the CS. The main function of BS is to convert optical signal to wireless one and vice versa. In narrow band communication systems and WLANs, RF signal handling capacities, for example, frequency up-change, carrier modulation and multiplexing are performed at the BS and immediately fed into the antenna. RoF makes it possible to centralize the RF signal preparing capacities in one shared area (head end), and after that to utilize optical fiber, which offers low signal loss (0.3 dB/km for 1550 nm, and 0.5 dB/km for 1310 nm wavelengths) to distribute the RF signals to the BSs. By doing so, BSs are simplified significantly, as they only need to perform optoelectronic conversion and amplification functions. The centralization of RF signal preparing capacities empowers equipment sharing, dynamic allocation of resources, simplified system operation and maintenance. These benefits can translate into major system establishment and operational savings particularly in wide scope broadband wireless communication systems. RoF technology has the following important features:

- 1) It is transparent to modulation techniques.
- 2) Low power consumption.
- 3) Simple and small base stations.
- 4) Centralized operation is possible.
- 5) Support multiple wired and Wireless standards

But this technique has the following challenges such as fiber optic network implementation cost, optical communication component's non-linearity and fiber dispersion.

FIBER OPTIC SENSORS

Electrical sensors have for a considerable length of time been the standard component for measuring physical and mechanical phenomena. Despite their ubiquity, these sensors have inherent limitations such as transmission loss or

misfortune and vulnerability to electromagnetic obstructions (noise) that make their utilization testing or unreasonable in numerous applications. Fiber-optic detecting is a great answer for these difficulties, utilizing light as opposed to power and standard optical fiber set up of copper wire.

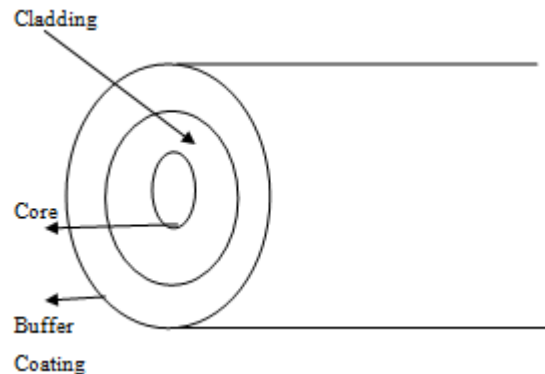


Figure 2: Fiber Optic Cable.

The huge measure of development in the course of recent decades in the optoelectronics and fiber-optic correspondence businesses has essentially diminished optical segment costs and enhanced quality. By utilizing these economies of scale, fiber-optic sensors and instruments have moved from test look into applications in the lab to expansive use and applicability in field applications, for example, basic health checking. In a general sense, a fiber-optic sensor works by tweaking at least one properties of an engendering light wave, including force, stage, polarization, and frequency, in light of the natural parameter being measured. Outward (hybrid) optical sensors utilize the fiber just as a component to transmit light to and from a detecting component, while characteristic optical sensors utilize the optical fiber itself as the detecting component. At the core of optical detecting innovation is the optical fiber – a thin strand of glass that transmits light inside its core. An optical fiber is made out of three fundamental segments: the core, the cladding, and the support covering. The cladding reflects stray light again into the core, guaranteeing the transmission of light through the core with negligible misfortune. This is accomplished with a higher refractive list in the core in respect to the cladding, creating an aggregate inner impression of light. The external cushion covering serves to shield the fiber from outer conditions and assurance required.

FIBER BRAGG GRATING

One of the normally utilized and extensively conveyed optical sensors is the fiber Bragg grating (FBG), which mirrors a wavelength of light that movements because of varieties in temperature or potentially strain. FBGs are developed by utilizing holographic impedance or a stage veil to uncover a short length of photosensitive fiber to an intermittent conveyance of light intensity or light. The refractive list of the fiber is forever changed by the power of light it is presented to. The resulting periodic variation in the refractive index is called

a fiber Bragg grating. At the point when a wide range light beam is sent to an FBG, reflections from each fragment of substituting refractive index interfere valuably just for a particular wavelength of light, called the Bragg wavelength, described in equation. This successfully purposes the FBG to reflect or mirror a particular frequency of light while transmitting all others.

$$\lambda_b = 2n\Lambda$$

In equation, λ_b is the Bragg wavelength, n is the effective refractive index of the fiber core, and Λ is the spacing between the gratings, known as the grating period. Since the Bragg wavelength is a element or function of the spacing between the gratings, FBGs can be produced with different Bragg wavelengths, which empower diverse FBGs to reflect exponential wavelengths of light.

Changes in strain and temperature affect both the effective refractive index n and grating period Λ of an FBG, which brings about a move in the reflected wavelength..

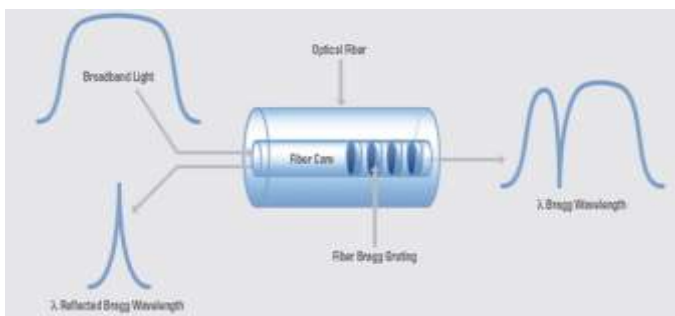


Figure 3: Operation of an FBG Optical Sensor.

Figure 4 shows an expanded view of Fiber Bragg Grating (FBG).

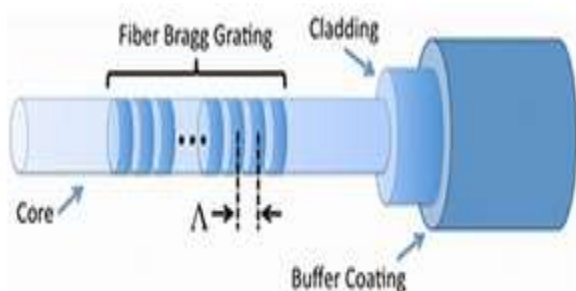


Figure 4: An Expanded View of an FBG.

The change of wavelength of an FBG due to strain and temperature can be approximately described by equation:

$$\frac{\Delta\lambda}{\lambda_0} = (1 - p_e) * \epsilon + (\alpha_A + \alpha_n) * \Delta T$$

Where $\Delta\lambda$ the wavelength is shift and λ_0 is the initial wavelength.

The principal expression depicts the effect of strain on the wavelength shift, where p_e the strain-optic coefficient, and ϵ is the strain experienced by the grating. The second expression depict the effect of temperature on the wavelength shift, where α_A is the thermal expansion coefficient and α_n is the thermo-optic coefficient. α_n depicts the change in refractive index while α_A portrays the extension of the grating, both because of temperature. Since a FBG reacts to both strain and temperature, you have to represent impacts and recognize the two. For detecting temperature, the FBG must stay unstrained. To utilize packaged FBG temperature sensors to guarantee the FBG inside the bundle is not coupled to any twisting or bending, tension, compression, or torsion forces. The extension coefficient α_A of glass is for all intents and purposes negligible; consequently, changes in the reflected wavelength because of temperature can be principally portrayed by the adjustment in the refractive index α_n of the fiber. FBG strain sensors are to some degree more unpredictable in light of the fact that both temperature and strain impact the sensor's reflected wavelength. For appropriate strain estimations, adjust for the temperature impacts on the FBG. To accomplish this by introducing a FBG temperature sensor in close warm contact with the FBG strain sensor. A straightforward subtraction of the FBG temperature sensor wavelength move from the FBG strain sensor wavelength move expels the second articulation of second condition, yielding a temperature repaid strain esteem.

II. CONCLUSION

According to previous approaches review of cost effective full duplex ROF transport system has been done. With remodulation using Fiber Bragg Grating (FBG) to achieve minimum dispersion for Full Duplex RoF and different techniques for compensation of chromatic dispersion for long haul communication in case of ROF link have been discussed. Fibre Bragg Grating with addition of other schemes can help in recovering from dispersion and also will be providing signals of good quality and reduced BER..

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