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Performance Enhancement in Wireless Network by Considering Attenuation Factors

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ABSTRACT

In this day and age, there is an ever-increasing need for wireless communication. There is a substantial amount of work that has to be done in the field of wireless communication. In the context of cloud computing and Internet of Things technologies, wireless connectivity has been utilized rather often. As a result, there is a need to find a solution in order to obtain the optimal configuration of wireless communication in order to experience the least amount of attenuation. Present paper is considering the factors that influencing the performance of wireless network. Major factor, that is influencing quality of service in wireless network is attenuation. This paper is reviewing the existing research that are considering attenuation factors. Present research is focused on Radio over Fiber Technology (RoF) and considering its architecture.

Keywords: Wireless network, attenuation, Radio over Fiber Technology.

I. INTRODUCTION

A wireless network allows devices to stay connected to the network yet wander untethered to any cables. Access points enhance Wi-Fi signals, so a device may be distant from a router yet still be connected to the network. RoF is a novel technology that combines the benefits of wireless and optical networks. Fiber-based transmission, such that used by RoF, offers a large bandwidth and is not subject to electrical interference. Optical fibres may be useful for high-speed networks of the future. RoF's greater data capacity, transmission range, and ability to service a greater number of users have led to its rising adoption. The optical signals in the RoF system are sent wirelessly between the CS and the BSs. Technologies like 3G, 4G, and WiMAX might be included into RoF systems as well. The acronyms A, B, G, N, and AC refer to the five different Wi-Fi technologies. The frequency of 2.4 GHz is used by bands B and G; the frequency of 5 GHz is used by bands A and AC; and the frequency of both 2.4 and 5 GHz is used by band N. Your decision, whether it be for your house or your company, will come down to one of three options: Wireless G, N, or AC networking.

1.1 Attenuation in wireless sensor network

Attenuation of a signal refers to a decrease in the intensity of a communication signal that occurs during transmission. Transmission refers to the process through which data is sent, such as an email or a phone conversation. A signal is the current that is responsible for the transmission of data from one network to another.

1.2 Need of Radio over Fiber Technology

In the early stages of the development of the telecommunications sector, services like as GPRS and GSM were content to make do with rather modest data transmission speeds. Users, on the other hand, choose for services that are able to deliver solutions that are flexible, accessible at any time and in any location, and that offer higher data transmission speeds. Additionally, the ever-increasing number of users will rapidly use all of the available bandwidth if nothing is done. A possible solution to the problem of squeezing more people into a given area is to make the cells in which they are housed smaller. There are times when the phrases "micro-cell" and "Pico-cell" are used to convey this idea. Researchers have been motivated to examine the use of additional operating bands as a potential solution [10] due to the congestion that has occurred in the unlicensed ISM frequency range. The millimeter-wave spectrum is becoming more regarded as the key operating band by a growing number of engineers. In the optical frequency spectrum, it can be located anywhere between 40 and 90 GHz and possesses a broad bandwidth. When we put these tactics into effect, however, we will be confronted with yet another challenge. If the cell size were to be decreased, then a greater number of BSs would be required to ensure complete coverage of the whole region. If the frequency is increased, there will be additional costs related with the installation of new equipment and the maintenance required to maintain it operational. To find solutions to these problems, researchers are developing a technology known as RoF, which stands for radio over fibre. The combination of the advantages offered by optical and wireless networking results in the creation of a system that possesses unparalleled levels of speed, scalability, and mobility when it comes to the transfer of data.

1.3 RoF Architecture

Optical generation and transmission of Mmm-wave wireless signals is doable in a cutting-edge RoF system. As can be seen in Figure 1, a great number of receivers make use of one of the most expensive and complicated optical mm-wave signals. This paves the door for the creation of a mm-RoF communication base station that is simple, compact, and requires little area. Academic research conducted over the course of the past three decades has discovered evidence of a variety of positive effects. These advantages include, but are not limited to: the control of high-frequency signals; the transfer of enormous volumes of data; and expanded ranges. Because of chromatic dispersion in the fibre and nonlinear optical platform, this technology's efficiency in converting light into radio frequency is quite low. This is one of the causes for the low efficiency.

The principle behind RoF is to send a radio signal that has been modulated into light through an optical fibre, which makes it possible to send data without using wires. Digital signals are sent through the use of conventional optical technologies. The system is primarily an analogue transmission system [11] due to the fact that the communication between the control unit and the BS is transmitted on a radio carrier frequency.

However, it's possible that the data transfer will be digital. Within a RoF network, the link between the transmitter and the receiver is made up of optical fibre. A modulating optical laser source is subjected to an electrical signal within an AT transmitter. It is not necessary to transform the signal once again before it is transmitted over an optical connection since the signal has now been relocated to the optical domain. Light detectors within the receiver are responsible for converting optical signals into electrical ones. Figure 1.1 presents the configuration of the RoF network for your perusal.

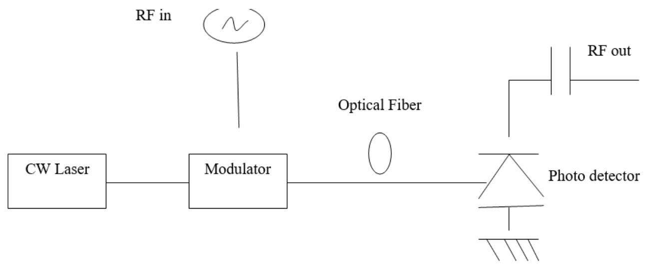

Figure 1 Topology of RoF Network

The use of RoF, which is a well-liked technology, is necessary in order to deliver high-speed wireless Internet access. As more people use digital devices and more digital applications are developed, the radio frequency band is getting increasingly congested. One of the solutions to this problem is to send radio frequency (RF) impulses over the optical spectrum, which is just one of several possibilities. In addition to that, it incorporates optical wireless technology, which provides the user with increased mobility. For the purpose of radio over fibre transmission, radio signals are converted into pulses of light before being sent down a fibre optic line. It is feasible to modulate the signal directly; however, external modulation is far more prevalent since it has a wider modulation bandwidth and operates with more consistency. Operating at higher frequencies, which generally range from a few gigahertz to a few gigahertz, enables a greater bandwidth as well as more compact radio cells. Because of the lower cell size, the capacity may be raised even more by increasing the rate at which cells reproduce to cover the whole surface. This is made feasible by the fact that the cells are smaller. After the optical fibre link between the central station and the RAUs has been established, the RAU is the component that enables the wireless connection for the subscriber.

II. LITERATURE REVIEW

Optoelectronic wireless systems make use of a variety of techniques, each with its own specific purpose, in order to generate optical signals at radio frequencies. The optical heterodyne technique and pulsed lasers are only two of the numerous tools and technologies that are currently available to researchers in the scientific community. Through the use of IM, which is achieved through the modulation of laser either locally or remotely, RF signal is produced.

The major focus of the research that was conducted by V. Sarup and colleagues (2015) was on recent tendencies as well as possible future paths for rof systems. This study investigates the history of radio over fibre technology, as well as its current state and prospects in the future. Techniques such as RoF-PON networks, OFDM, optical millimetre wave generation, and DWDM are some of the ones that are investigated in depth, and potential applications in the field of RoF communication systems are presented. This article provides a concise summary of the most recent research as well as creative approaches for RoF systems. Research into these approaches not only reveals the effects that elements such as fibre length, MF, and other such things have on more conventional methods like as DWDM and OFDM, but it also makes a compelling case for the use of cutting-edge technology. The primary objective of this research is to evaluate the work that has already been done on RoF connections in an effort to focus any future work towards the development of integrated networks that operate more optimally. [1] According to the findings of research that was carried out by Mazin Al Noor et al. (2011), an increasing number of people are opting to make use of wireless networks in order to connect to the internet and other sources of information. Because of its dependability in delivering data to its intended destination, broadband communication networks greatly relied on it. This was true regardless of whether the receiver was located within or outside the network. Even if you don't think it has a direct connection to the recent political upheavals, you can't deny that there has been a significant growth in the use of mobile phones and the internet. This surge has already surpassed the usage of fixed lines and has brought about significant changes in people's day-to-day lives. It is feasible to construct a network of communication devices that can only be utilised by individuals. This is made possible by the broad availability of wireless communication links as well as properties of mobile devices that allow for mobility. A significant number of radio access points are necessary in order to maintain robust and mobile wireless connections within the context of a personal network, which assumes that a user will always have access to his or her own communication environment. In order to move forward with "all-around wireless," we require radio access points that are not only inexpensive but also simple to maintain, as well as signal processing that is streamlined and centralised radio network services. Researchers from all around the world have been looking into "green communication" as a viable solution that is both environmentally benign and financially realistic. This is because the high RF energy consumption of mobile base stations is a fundamental concern in the wireless communication system. In order to support the expansion of networks and mobility, there is an urgent need to simplify antenna stations, increase broadband CC, and extend the range over which wireless signals can be broadcast in order to centralise signal processing. Doing these things will help support the growth of networks and mobility[2]. Christina Lim et al. (2010) discussed the technologies for fiber-based wireless networks as well as the components that make up these networks. In order to provide mobile connections for ultrahigh capacity communications, researchers are actively looking on submillimeter-wave and millimeter-wave (mm-wave) fixed wireless access employing WDM technology in hybrid fiber-wireless networks. at spite of the fact that such radio networks rely mostly on centralised switching and routing operations, the architecture of these networks involves the installation of high-throughput antenna base-stations at strategically chosen places in order to ensure optimal coverage. These sites might be picked at random. When transferring mm-wave wireless data inside of a hybrid network, there are a number of challenges that need to be conquered. A few examples of these challenges are LOECE, FCD, and degradation due to nonlinearities across the connection. Find a way to prevent wireless signals from being disrupted as they travel through the network. In this research, we present a comprehensive overview of strategies currently in use for optically transferring mm-wave wireless signals and the issues that result from doing so. One of the technological difficulties in setting up a hybrid network is finding a way to prevent wireless signals from being disrupted as they travel through the network. In addition to this, we investigate the various subsystem topologies that may be applied in order to incorporate fiber-wireless technologies into the optical networks that are now in use [3]. An Economic and Technological Analysis of EPON and WiMAX in FiWi Networks was carried out by Navid Ghazisaidi and his colleagues. If the next generation of broadband access networks were hybrid fiber-wireless networks, there is a possibility that the environmental, cost, and capacity concerns might be alleviated. Both WiMAX and EPON have the potential to significantly improve the capabilities of fixed wireless local area networks (LANs) [4]. In 2005, Anthony Ng'oma and his colleagues were the first to showcase broadband wireless communication systems that were based on technologies including radio over fibre. Soon, all broadband communication networks will be required to provide wireless coverage to the end-user domain, which includes both inside and outside. If integrated broadband services are to be provided via these networks, then the data transmission capacity of such networks will need to be far larger than what is now needed of wireless networks. Because high operating frequencies suffer very significant losses while travelling through the walls of buildings, applications that take place within buildings require higher operating frequencies and smaller radio cells. Maintaining the radio antenna components in their most fundamental form might potentially assist reduce the initial investment as well as the continuing costs associated with such systems. One solution is to make use of technologies that allow for signal processing to be centralised in a single place, such as radio over fibre. This thesis studies high-frequency microwave communications across small distances, as well as ideas for long-range radio antennas and the feasibility of employing single-mode and multimode fibres for this role. Researchers are investigating OFM as a potential replacement for the traditional radio-over-fiber systems already in use. In OFM, a sweeping optical signal is picked up by a photodetector located at the radio access node. Prior to this, the signal is first subjected to periodic filtering at the headend. The sweeping frequency is not particularly high, hovering about 3 GHz as an illustration. Components of the sweep signal are created at extremely high frequencies (more than 21 GHz) following the photodetection that takes place at the RRAU. Through the use of bandpass filtering, the antenna is able to amplify and transmit just the microwave signal that is required. The frequency of the optical signal is gradually increased while its intensity is gradually decreased in order to create microwave carriers with the required modulation [5]. W offered the initial notion to equalise the pulse distortion that was being experienced. Chen et al. in 2010. WDM approaches for high-throughput OC networks have ushered in a new age of dispersion correction solutions for the industry, which has resulted in the market seeing increased competition. Fiber-based dispersion correction offers a potential solution for updating WDM communication systems as a result of its excellent dispersion properties as well as its compatibility with transmission optical fibres. In recent years, there has been an explosion of interest in dispersion correction modules and fibres as a result of the bright future that they provide. In this line of study, the efficiency of dispersion correction fibre modules, also known as DCFMs, in 40 Gbps networks was optimised to its full potential. Initially, optical fibres were constructed that had dispersion properties that were carefully determined. A dispersion optical fibre with an improved refractive index profile might, in theory, achieve zero dispersion and a high figure of merit (FOM). The next step was for them to construct a high-performance dispersion optical fibre by utilising their top-secret plasma chemical vapour deposition (PCVD) process. Dispersion compensating fibres, also known as DCFs, and pigtail fibres, which are used to link DCFs to transmission fibres, are the two types of fibres that are utilised in the construction of modules that remedy signal dispersion. Some of the distinctive characteristics of DCFMs are a low IL, dispersion that is well suited for transmission fibres, and a considerable deal of stability in the face of changes in the environment. The wavelengths covered by the DCFMs extend from 1525 nm all the way up to 1625 nm, and they are flexible enough to be utilised for both dispersion tuning and slope correction. The compliance of the DCMs with GR-1221-CORE and GR-63 was experimentally investigated and found to be confirmed [6]. H. B. Kim et al. (2005) investigated the framework of a radio-over-fiber wide area network that was developed particularly for use in rural regions. Recently, there has been a lot of interest in "wireless last mile" as a cheaper option to traditional landline Internet connection. This is because it requires less infrastructure than xDSL and cable modem networks, which are the two most common types of Internet connections. In spite of the growing need for broadband connection in more sparsely populated rural areas, the majority of ongoing initiatives have concentrated their efforts on more densely populated regions. It is still necessary to have a big number of BS in order to cover broad areas, despite the fact that the population density is lower than in regions that are more densely inhabited. The findings of their investigation suggest that radio over fibre should be implemented while constructing wireless broadband networks in rural areas. Wavelength division multiplexing is utilised in order to provide the dynamic allocation of bandwidth to base stations based on the requirements of the users. The layout, the admittance policy, and the timetable were all subjected to a comprehensive review. In addition, a capacity analysis is carried out as part of the investigation of the benefits offered by the architecture [7]. Koonen et al. (2008)

conducted research and analysis on the technologies involved in radio transmission through fibre. Broadband wireless services may be efficiently delivered in access and in-building networks owing to radio-over-fiber technology. These methods include optical frequency multiplication and flexible optical routing, which are dispersion-robust RoF transport methods. G.J.'s research focused on the laser heterodyne. Simonis et al. (1990) investigated this phenomenon and discovered that it was helpful for the production, dispersion, and optical control of microwaves. Using YAG ring lasers, microwave signals may be created and transmitted optically with a great degree of tunability (from DC to 52 GHz) and a very narrow microwave line width. This is made possible by the use of Nd:yag lasers, which are driven by diode lasers. Two superb optical signals are produced by these lasers. It is feasible to electrically modify the amplitude by up to 20 dB and the phase by up to 5 pi by including a doped superlattice active area into a waveguide built of III-V semiconductors. This is accomplished by incorporating a doped superlattice active region. The simplicity with which integrated optics and fiberoptic communications can manage the various elements of a phased-array antenna makes it possible to apply this technology without much difficulty. As a result, the technology is widely used. The millimeter-wave fiber-radio business is about to undergo a sea change as a result of a newly discovered class of small optical sources [10]. Davidson and his colleagues looked at the use of semiconductor lasers as a signal generator for mm-wave wireless communications as part of their research. Novak et al. (1995) provided a review. They have the potential to be utilised in the generation of optical signals in the millimetre wave band that have modulation depths that are close to 100%. This method makes use of optical filtering in order to separate the co-existing optical modes in a high-speed photodiode from the spectrum of the pulsed laser. In this article, we demonstrate one possible use for mm-wave wireless communications using feeding microstrip patch antennas. It has the potential to be beneficial for optical fiber-based wireless local area networks and indoor microcellular networks [11]. D. Kim et al. (1995) provided an explanation of how ultra-stable mm-wave signals may be produced by employing hybrid mode-locking of a single DBR laser. To our knowledge, this is the first time that it has been demonstrated that a hybrid modelocked distributed Bragg reflector semiconductor laser is capable of producing exceptionally efficient and ultrastable millimeter-wave signals. The strategy of exposing the saturable absorber area of the laser to a weak RF signal (- 1 dBm) is considerably different from the technique that is often utilised in conventional hybrid modelocking systems. The utilisation of an electro-absorption modulator allows for the generation of a signal with a frequency of 34 GHz and a phase noise of less than -70 dBc per Hz at a frequency offset of 5 kHz from the output of the laser [12] . L.D. The research conducted by Westbrook et al.(1996) enables the transmission and reception of analogue signals in both directions via a single fibre optic line. They show that it is possible to use a single electroabsorption device with a low insertion loss as a photodetector-receiver or a modulator-transmitter at either end of an analogue fiber-optic link. This was demonstrated by the fact that they were able to do so. They created a way of simultaneous, bi-directional analogue fiber-optic transmission utilising a single low-insertion-loss EA device for use in low-power, low-cost long-distance antenna applications. This system has RF insertion loss of -42dB in both directions and negligible intermediation distortion [13]. An electroabsorption waveguide device was presented by Stohr et al. in 1999. This device had the potential to be utilised in RF fiber-optic networks as a full-duplex transceiver that was both cost-effective and efficient. It was specified which experimental features of the spectrum modulation and detection of the dual-purpose transceiver should be determined. Both the extinction ratio and the sensitivity were measured at 12 dB and 0.8 A/W respectively. It was determined that there was an insertion loss of 7 dB. The modulation bandwidth and the detection bandwidth both exceeded 17 GHz individually. Using a dual-lightwave technique might perhaps allow for the achievement of the best possible outcomes in modulation and detection at the same time. Optical RF subcarrier transmission with full duplex and error-free operation-multiplexed signals across a nondispersive distance of 10 kilometres. It exhibits a point-to-multipoint optical ring construction with -shifted single-mode fibre. [14] Optical RF subcarrier transmission with full duplex and error-free operation-multiplexed signals across a nondispersive distance of 10 kilometres. According to T's research, this full-duplex radio-on-fiber gadget operates at 60 GHz and uses an electro-absorption transceiver that is equipped with two RF connectors. Kuri et al. (2000). They study the practicability of a full-duplex radio-on-fiber system that is based on an optical transceiver operating in the 60 GHz band. Our two-RF-port EAT module is the first optical transceiver operating at 60 GHz anywhere in the world. At frequencies up to 60 GHz, the EAT module's distinct RF input and output ports with impedance-matching circuitry make it possible to achieve the highest possible level of modulation and detection efficiency. The EAT, which is capable of operating in the 60 GHz band, may be employed in a radio-over-fiber testbed in order to minimise the complexity of a base station's design to simply the EAT. This will allow the testbed to more accurately simulate real-world conditions. Experiments conducted on the radio-on-fiber testbed at 59.6 GHz and 60 GHz, respectively, reveal that it is possible to transmit 156 Mb/s of data in both the downlink and the uplink. [15]. T's research mostly centred on developing methods to improve millimeter-wave fibre radio links. Kurniawan et al. in 2006. In this piece, we take a look at a number of high-performance fibre radio distribution systems for millimeter-wave radio services and evaluate both their positive and negative aspects. In the downlink, a constant wavelength is sent without the use of optical amplification; nevertheless, the noise and nonlinear features of the Tx-Rx pair as well as the analogue optical connection must be taken into consideration. When compared to systems that make use of coaxial cable for transport, they make the discovery that RF-over-fiber systems have the potential to boost performance by 3 dB. [16]. According to the research carried out by Jianxin Ma et al. (2008), it is possible to create and transmit double-sideband optical mm-wave signals by utilising an all-optical carrier. In this article, we discuss a unique approach for creating DSB optical mm-wave signals using only an optical carrier, and we investigate how well this method transmits data. Additionally, we outline this method's potential applications. The results of this investigation ought to contribute to the advancement of scientific knowledge. This is true regardless of whether the fading nodes are actually available or not. The conclusions from our theoretical analysis and numerical simulation are consistent with one another [17]. T.Wang et al. (2009) gave a presentation in which they employed the FWM effect of SOA to create mm-wave frequencies as part of a downlink transmission system for RoF. They suggest using a radio-over-fiber method to provide downlink service at wavelengths of millimetres. This system would make use of the phenomenon known as four-wave mixing, which takes place when an optical amplifier that contains semiconductors is used to create millimetre waves. This phenomenon takes place when an optical amplifier is used to generate millimetre waves. The microwave frequency that was utilised in the command and control room was 5.4 gigahertz. A semiconductor optical amplifier and a modulation technique that suppresses optical carriers are utilised in the generation of an optical millimetre wave operating at 32.4 GHz. At the base station, a high-speed photodiode was used to recover the downstream signal, and an electrical mixer was used to recover the upstream signal. Both of these procedures took place simultaneously. Both theoretical analysis and practical observations have demonstrated that it is possible to successfully send downlink data at a rate of 2.5 Gb/s across a distance of 20 kilometres using a single mode fibre, with a power penalty of less than 0.15 decibels. [18] This can be accomplished using a single mode fibre.

J. According to Yin et al.'s (2009) findings, "in this paper, we offer a unique approach to generating multi-band millimetre wave signals for use in a full duplex 40 GHz ROF system." Based on the findings of this inquiry, it appears that a unique approach for producing frequency-diverse BPSK signals might potentially be included into a RoF system. It was a choice that merited investigation since the RoF system has the potential to increase both the capacity and mobility of future-proof content delivery while maintaining service to clients on both fixed and mobile connections. The authors of this study suggest a system that employs a single OPM and a single MZM in a centralised site to produce 20 GHz and 40 GHz mm-wave signals concurrently at a data rate of 1.25 Gbit/s. This system would be used in a centralised location. This approach is included into their methodology; further discussion on that topic is forthcoming. It is possible to complete duplex transmission at the home base with the installation of just one MZM, which will allow for data flow in both directions. Due to the fact that the data are phase modulated at the receiver end, optical signal may be utilised to load the transmitter's data without the need for an LD at the base station. Because the information is phase-modified at the end that is receiving it, this is indeed possible. Demodulating the BPSK signal may also be accomplished by generating the electrical carrier at 20 GHz, which is an other approach that may be employed. Everything that is described in the proposal has the potential to be implemented in a duplex RoF network in the near or far future [19]. Y. An innovative approach for producing microwave signals has been devised by W. Shen and colleagues (2009). This method makes use of a Brillouin fibre ring laser that operates at many frequencies. In this paper, the authors suggest and experimentally demonstrate an original Brillouin fiber-ring laser that is capable of operating at a variety of frequencies. This laser serves as the foundation for a proposed and partially achieved technique for the production of a high FM signal. The process was suggested by. The experiment is successful in producing a microwave signal at 11 GHz, which demonstrates that the technology may be used. [20]

III. Challenges

Benefits of radio communication have been compared to those of wireless communication in a number of studies. In contrast, previous research was narrower since it paid less attention to performance and attenuation. It is also important to consider the factors that may affect performance. Wireless communication optimization required running simulations that factored in potential influences. This is why we need further research on the effects of attenuation, bandwidth, and loss percentage while transmitting data of wireless network.

IV. Need of research work

In the planned research activity, consideration will be given to earlier work on topics such as attenuation and wireless transmission. Previous studies have been criticised for having insufficient data because of the limited scope of their samples. It is vital to develop a model that can predict the optimal configuration for a wireless network in order to cut down on signal loss that is caused by attenuation. When conducting simulation studies, it is important to take into consideration factors such as distance and wireless transmission media. There is an urgent need to do research in the field of wireless networks and attenuation, as well as an investigation into the elements that influence attenuation in wireless networks, such as the distance between nodes and the kind of wireless transmission medium used. More study has to be done so that an optimised model can be proposed. This model need to be capable of obtaining the best wireless network configuration possible, with optimal attenuation. When conducting an evaluation of attenuation, it is important to take into consideration the impacts of any potentially relevant configuration factors for wireless networks.

V. Future Scope of research

Over the course of the next several years, it is anticipated that the number of networks constructed employing wireless network would see a great increase. Developing nations are making the decision to invest in their wireless network infrastructure rather than the development of their transit systems because they are aware of how essential it is to the growth of their economies to have access to a reliable and speedy internet connection. Attenuation coefficients are frequently expressed in terms of values measured in dB per km within the context of the area of wireless communication.

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