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Radio-Over-Fiber (ROF) in Cellular Communication

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Abstract *- **The Radio over Fiber (ROF) communication technology combines the technical blessings of each fiber communication and wireless Cellular communication to unravel the issues of information measure, flexibility and magnetic attraction interference. Future generation of cellular Communication system should be capable of serving prime quality and broadband services even in extremely dense urban area.In this paper, the role of ROF technology in next generation of Cellular communication system is bestowed, then the conception is clearly taken.***

Keywords: RoF, Intermediate frequency, Remote Based Station,EAM,WDM.

1. Introduction

Radio over Fiber is that the future technology of Communication, owing to there's Associate in Nursing increasing demand for broadband services that ends up in ever-growing knowledge traffic volumes over these services. Communication base on cellular construct to extend the capability of mobile cellular system cell optimization are often accustomed cash in of frequency use theme. As a results of this theme, the quantity of base station will increase within the space. Increasing variety of base stations with current RF technology particularly in millimeter-wave band is incredibly pricey. And technically, exploitation millimeter wave band signal is inevitable as a result of the present RF spectrum is restricted. Base on these facts, radio-over-fiber (ROF) technology could be a best option to use in cellular system for cell optimization method since it will simply be utilized in millimeter wave band and additionally it will scale back the system overall price.

The traditional link between the radio base station (RBS) and also the antenna has incandescently been a copper coax. To use Associate in Nursing fiber cable instead, makes each style of latest sites, still because the physical preparation of the hardware, abundant
easier.

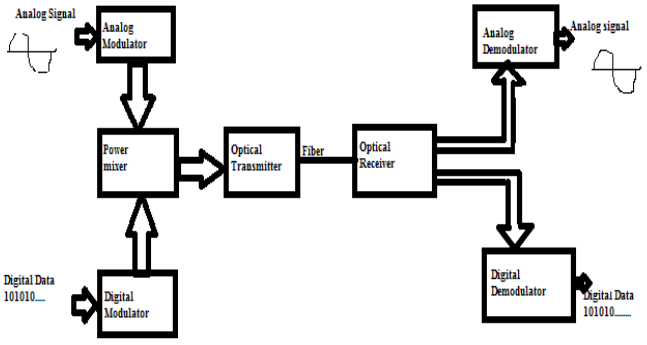

Figure 1. Basic Structure of Radio Over fiber Technology

2. Remote Base Stations antenna (RBS)

Figure-2 shows the available Equipments in RBS which can be listed as: one EAM (Electro-absorption modulator), one remote antenna, diplexer, high power amplifier, low noise amplifier and Power supply. However, the trend of ROF system is simplifying the RBS and changing it to passive unit.

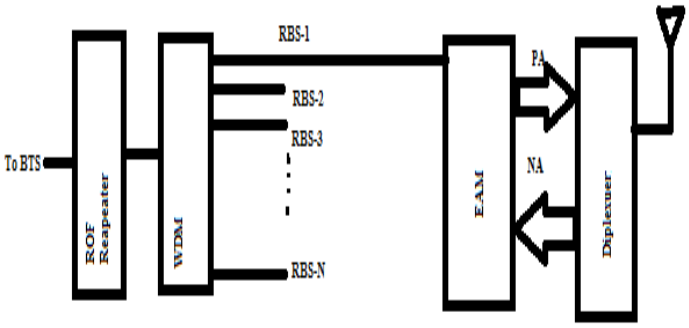

Figure 2 Radio Base Station

3.Radio signal transport schemes for RoF systems

We have several possible schemes to transporting radio signals over optical fiber in RoF systems, which is classified based on the kinds of frequency bands (RF bands, IF baseband (BB) transmitted over an optical fiber link. The three fundamental techniques as shown in Figure 3. RoF analog

photonic links are typically multichannel in nature and require high power compared to digital schemes because of the increased carrier to noise ratio (CNR) requirements. The performance, including CNR and capacity, of RoF systems employing analog optical links is limited by the noise of the various optical and electrical Components in the link as well as by device nonlinearities, which introduce intermodulation and distortion products that create interference with other radio channels.

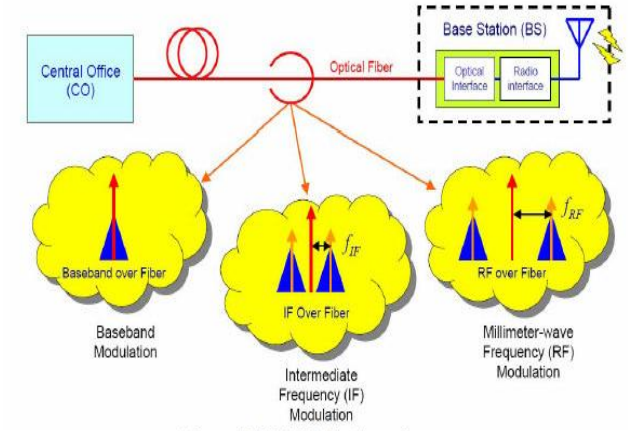

Figure 3 ROF Link Configuration

4. Development Trend of RoF

The resource of radio frequency in the world is facing increasing pressure along with a growing demand of bandwidth and mobility. The communication networks of 2G, 3G and 4G systems are hence constantly turning to new frequencies. However, low frequency bands with good coverage performance are used up and the occupied frequencies cannot be freed up.

The new generation mobile communication has to employ the new and wider frequency bands. The RoF technology has been born amidst this conflict of demand and supply.

4.1. 3G Cellular Communication

The third generation mobile communication relies on higher frequency than that of the second generation system, thus more repeaters and remote base stations are required to provide indoor coverage. The RoF mode will need much less cable in this case and thus less electromagnetic pollution.

4.2. 4G Cellular Communication

The fourth generation mobile communication employs even higher frequency than that of the third generation system and the bandwidth reaches up to 1 Gb/s. This requires the RoF mode to set up the networking with fiber-based distributed antennae and the mid-frequency remote unit to provide network coverage. The minimum bit rate that 4G would provide for broadband services is 20 Mb/s for indoor and 2 Mb/s for outdoor application even with high relative mobility. As candidate technologies for future systems, 4G-cellular and Intelligent Transport System (ITSs), have been attracting much interest in the mobile communication field. Both of these technologies take advantage of ROF technique. The concept in 4G cellular system is cell optimization. In ITS system, the key technology in road vehicle communication system is again ROF, in which many base stations are equipped along the trunk road in order to communicate with vehicles, and several control base stations manage these base stations.

4.3. Other Applications

(1) Military Application For security reasons, the broadband microwave or RF signals received by the radar are transmitted through the optical fiber in the mode of RoF communication to the remote end. This will cause fewer casualties in the event of radar strikes.

(2) High-Speed Sensing The RoF communication can be used for fast transfer of video monitoring signals on the high-speed trains and jumbo jets, as broadband transmission can be satisfied and also less electromagnetic pollution will be produced.

(3) Millimeter Fiber Transmission The millimeter wave at 60 GHz and higher generates fast attenuation and less electromagnetic interference thus is quite suitable for indoor coverage. Together with the RoF communication, the problems of electromagnetic interference and electromagnetic pollution will be addressed in a better way.

4.4 Advantages of Rof

The advantages and benefits of the RoF technology are:

Low Attenuation Loss, Large Bandwidth, Immunity to Radio Frequency Interference,

Easy Installation and Maintenance, Reduced Power Consumption, Multi-Operator and Multi-Service Operation Dynamic Resource Allocation.

5. ROF challenges for Cellular communication system and some proposed solutions

Modulation technique - Direct modulation is exist just for below mm-wave frequency. External modulation, optical heterodyne technique and EAM modulator can be solutions.

Chromatic dispersion-Single Sideband Modulation (SSB) modulation, photonic down conversion.

Phase distortion-1.Phase noise cancellation method 2.Side band injection locking 3.error correcting coding 4.Optical Phase Locked Loop (OPLL).

laser and optical fibre nonlinearity-Pre-distortion and post-distortion technique

Noise Characterization and Cancellation for combination of Optical and wireless noise-Characterize the optical-wireless noise by making relation between optical link property and optical devices with wireless noise.

multi-user detection in Non linear optical-wireless Estimation-Optical wireless detection using correlation property of PN code

RBS compactness and cost-Centralizing the signal processing at CBS , elimination of laser source and

electrical mixer in RBS, Elimination of power supply in RBS,

Expensive and complex uplink- Using photonic down conversion, electrical signal processing can be done in IF Frequency (reduce the cost)

6. Conclusion

In this paper, the application of ROF technology in Cellular communication is explained. Recent finding and issues in ROF cellular communication are discussed. The feature of future ROF technology in cellular communication is presented. Some of the Challenges are listed above.

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