Chapter 7

Millimetre-Wave Communication for 5G/B5G Applications

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ABSTRACT

Emerging millimeter wave (mm Wave) wireless communication systems reflect the culmination of more than a century of advancement in modern communications. Millimeter wave (mm Wave) communications have recently piqued the interest of researchers due to the enormous available bandwidth, which has the potential to result in rates of multiple Gbps (gigabit per second) per user. Though mm Wave can be easily used in stationary scenarios such as indoor hotspots or backhaul, it can be challenging to use in mobile networks because the transmitting/receiving nodes may be travelling, the channels may have a complex framework, and coordination among multiple nodes is difficult. In spite of this, mm wave is significantly important in implementation of 5G/B5G communication networks. The novelty in the chapter is to suggesting a modern antenna design for mm wave application and link budget analysis so as to achieve flaw less communication with reduced call drop rate. In this chapter we are focusing on introduction and background. The chapter further will focus on mm wave in cellular mobile communication along with the applications in 5G/B5G wireless communication networks. The chapter will also deal with system architecture of 5G communication employing mm wave and antenna in mm wave communication will be discussed. Also various challenges associated with deployment of mm wave technology in 5G networks are discussed. At the last advantages and disadvantages of mm wave will be discussed in brief.

1. INTRODUCTION

With the continued usage of wireless technology, wireless data traffic has been growing at a rate of over 50% annually per user, and this trend is anticipated to intensify over the next ten years. IoT (Internet of Things) growth and video (Gubbi, J., Buyya, R., Marusic, S., & Palaniswami, M. et al (2013) and Rappaport, T. S. et al (2016) The wireless sector is adapting to meet this demand by Fifth-generation (5G) cellular technology will be utilized. frequencies at millimeter wave (mm Wave) to provide unprec-

DOI: 10.4018/979-8-3693-8799-3.ch007

edented multi-Gigabit-per-second (Gbps) data rates and spectrum to a portable gadget (Rappaport et al., 2013). Cell phones and other portable electronics are commonly known as user equipment (UE). a quick evaluation demonstrated the potential for 1 GHz wide channels at 28 or 73 GHz. with a small phased array, provide UE with many Gbps of data rate. antennas on a mobile device(Rangan et al., 2014). Wireless channel bandwidths for 5G mm Wave will be greater than ten times more than the 20 MHz cellular channels used by 4G Long-Term Evolution (LTE) today. Due of the wavelengths' amplification, order of magnitude at mm Wave against current 4G microwave frequencies, material penetration, and diffraction will experience more attenuation, increasing the significance of propagation, reflection, and scattering of line-of-sight (LOS) signals. When designing novel systems, accurate propagation models are essential. protocols for mm Wave signaling, such as air interfaces. more than In recent years, data and models for a wide range of numerous businesses and have presented by many research groups (Rappaport et al., 2017)

The most recent paradigm-shifting advancement in wireless networks is communication at mm Wave operating frequencies. Consumers will continue to demand faster data rates for the consumption of media while demanding lower latency and consistent connectivity on wireless devices as mmWave gains traction. When compared to cellular and WLAN microwave systems that operate at frequencies below 10 GHz, the accessible spectrum at mmWaves is unmatched. The unlicensed spectrum at 60 GHz in particular provides 10 to 100 times more spectrum than is typically available for traditional unlicensed wireless local area networks in the Industrial, Scientific, and Medical (ISM) bands (such as at 900 MHz, 2.4 GHz, or 5 GHz) or for users of WiFi and 4G (or older) cellular systems that are not 5 GHz-capable. (Rappaport et al., 2014) In order to share network resources between local D2D communications and worldwide device-to-device (D2D) communications, it is possible to take advantage of the properties of mm Wave propagation and the usage of directional antennas.

In this chapter in the subsequent sections, we are summarizing different generations of wireless communication, mm wave propagation for device to device (D2D) communication, mm wave 5G system architecture, spectrum allocations in mm wave application and also the applications of mm wave are discussed along with the advantages disadvantages of mm wave.

Table 1. Wireless Generations

Wireless Generations	Features	Applications
1G	Analog Technology Deployed in 1980	Only Voice communication
2G	GSM, CDMA, deployed in 1990	SMS. Voice and low-rate data
3G	WIMAX & CDMA	Trans reception of video signals.
4G	Long term evolution (LTE)	Voice, video and data on high data rates (MBPS)

2. MM WAVE PROPAGATION FOR D2D COMMUNICATION

There are numerous basic principles in Mm Wave communication (with wavelength on the order of millimeters), in the aspects of propagation (Geng et al., 2009). First off, the propagation loss at 60 GHz is 28 dB more than it is at 2.4 GHz, making it significantly worse than the microwave bandh) because the propagation loss in empty space is proportional to the carrier frequency squared. It is preferred to