Performance Analysis of Dual-Band Millimetre Wave at 28 GHz and 73 GHz in 5G Heterogeneous Networks

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***Abstract*— The International Telecommunication Union (ITU) has selected millimeter-wave (mmWave) frequencies of 28 GHz, 38 GHz, and 73 GHz as suitable for fifth generation (5G) wireless communication. While earlier research has looked at both frequencies independently for prospective 5G systems, there is a gap in knowledge about the performance of dual-band mmWave systems operating at 28 GHz and 73 GHz. As a result, this article offers a thorough system model and performance analysis for dual-band mmWave use in 5G heterogeneous networks (HetNets). Our paper focuses on assessing the performance of dual-band mmWave HetNets in which mmWave small cells coexist with macro cells. We examined the effectiveness of leveraging the 28 GHz and 73 GHz mmWave bands in conjunction with the 3.8 GHz microwave frequency to improve the capabilities of 5G HetNets using simulations. The strategy used for resource allocation comprises the equal distribution of power and resources. The findings show that the proposed dual-band mmWave network at 28 GHz and 73 GHz model performs similarly to the single-band mmWave at 28 GHz in terms of throughput. In conclusion, this paper highlights the preliminary analysis of dual-band mmWave integration in improving the overall throughput of 5G heterogeneous networks.**

Keywords—Dual-band, millimetre wave, Heterogeneous Networks (HetNet), Resource Allocation

I. Introduction

In wireless communication using 5G technology, users are expected to achieve the highest peak data rate at 2 Gbps if they are on the move and reach 10 Gbps if they are static in a particular place [1][2]. To enable users to get the highest data rate, 5G uses mmWave technology, transmitting the communications channel using a higher frequency band. mmWave communications at frequencies ranging from 30 to 300 GHz, whose wavelengths vary from 1 ms to 10 ms, have several advantages. One of the primary benefits of mmWave communication is the large number of frequency band sources still underutilised in many applications. However, the mmWave communication frequency, easily blocked by solid objects, suffers from severe attenuation, significantly impacting the stability of mmWave communication [3].

Furthermore, because each mmWave frequency range has different atmospheric and molecular absorption rates, the communication differs significantly from one frequency range to another. For example, signals at 70-80 GHz have low atmospheric absorption and can establish long-distance communication by considering interference management. On the other hand, 28 GHz signals may achieve short-distance communication without being affected by significant interference [4]. With the wide range of spectrum in the mmWave, it is essential to fully use the available spectrum by utilising the lower and higher mmWave frequency bands. The Federal Communications Commission (FCC) has recommended the following frequency bands for 5G mmWave communications: 24-25 GHz, 32 GHz, 42 GHz, 48 GHz, 51 GHz for lower mmWave frequencies, and 70 GHz and 80 GHz for higher mmWave frequencies [5]. Therefore, there is a need to include a range of bands so that users can enjoy the highest data rate available.

This paper presented a performance analysis of a dual-band mmWave in a 5G heterogeneous network. The mmWave small base stations (SBS) operate at 28 GHz and 73 GHz, together with the conventional macro base station (MBS) at 3.8 GHz. We simulated the network and presented the data rate and spectral efficiency performance analysis. The rest of the paper is organised as follows: Section II explains the background studies and preliminary concepts. The proposed algorithm is given in Section III. In Section IV, the simulation parameters and results are presented, and the paper is concluded in Section V.

II. Background Studies

Recent developments in RRM have heightened the need to explore the techniques and technologies investigated recently to satisfy the increasing data demand by subscribers in 5G wireless networks. The key ideas and challenges are discussed in the following subsections.

A. 5G Heterogeneous Network

HetNets are designed to enhance several critical aspects of 5G networks, including coverage, capacity, energy efficiency, and quality of service. By embracing a diverse set of cell types, HetNets mitigate the challenges posed by signal attenuation, interference, and data congestion. Macro cells provide broad coverage, while smaller cells are deployed to improve data rates and reduce congestion in high-density scenarios. In 5G HetNet, the small cell can operate at mmWave frequencies.

However, due to the limitations of mmWave propagation, mmWave cellular systems cannot deliver constant high capacity across an extensive range of deployments. The traditional microwave is required for mmWave to provide more comprehensive coverage to the user. mmWave networks are different from one another; most likely, the distinction between cellular networks and local area networks is becoming less. However, adding mmWave cells to existing cellular networks will alter the networks in numerous ways beyond the size of the cells.