Chapter 6
Addressing B5G and 6G Network Connectivity Issues and Challenges in Rural Regions of India

M. Basuvaraj
https://orcid.org/0000-0002-2660-3331
University of Allahabad, India

Keshvi Rastogi
https://orcid.org/0009-0008-0954-6487
Christ University, India

S. Chitradevi
Global Institute of Business Studies, India

D. V. VidyaShree
Christ University, India

K. M. Anu
Christ University, India

ABSTRACT

The emerging technology of the fifth-generation broadband cellular network is already ruling the market with its efficiency, lower latency, higher connectivity, and many more features. In contrast, the sixth-generation broadband cellular network is yet in its research and development stage. These technologies cannot only revolutionize the world with their features, such as high speed and enhanced cybersecurity but also empower it to reach greater heights. To understand the network requirements of the rural and under-developed areas, it is important to understand all those challenges in the way ahead. . Launching such efficient and effective technologies in rural areas would benefit the country as well as its economic growth. The large markets of these cellular networks are at constant growth and are expected to be booming in the future of the Telecom Regulatory Authority of India. (2023, September 29)..

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INTRODUCTION

The deployment of 5G and emerging 6G technologies offers transformative potential for various sectors, but challenges such as infrastructure gaps, economic viability, and policy frameworks must be addressed to ensure equitable access. (Regulatory Authority of India, 2023). In today's world, the internet stands as the most vital tool and is the most potent engine, whether it be for communication, social, or economic growth. The Internet has not only acted as a catalyst for various operations worldwide but also as the medium for various developments in recent times. scaling up massive Internet-of-Things (IoT), energy harvesting and Simultaneous Wireless Information and Power Transfer (SWIPT) is foreseen to become important enablers when deploying a large amount of small, low-power radios (Gustavsson, U et al 2021). 5G, 6G, and Beyond (xG) aim at bringing new radical changes to shake the wireless communication networks where everything will be fully connected fulfilling the requirements of ubiquitous connectivity (Salahdine, F., Han, T., & Zhang, N2023). Real-time adaptive security, and novel data protection mechanisms such as distributed ledgers and differential privacy are the top promising techniques to mitigate the attack magnitude and personal data breaches substantially (Nguyen, V. L et al 2021). Integration of D2D communication with other prominent technologies and demonstrates the importance of integration with possible solutions in improving network performance (Gismalla, M. S et al 2022), Thus, the Internet needs to be open, accessible, trustworthy, and secure for everyone worldwide. Working, streaming, scrolling, and gaming are all extremely common reasons to use the internet. Out of the nearly 8 billion people in the world, 5.35 billion of them, or around 66% of the world's population, have access to the internet. As of April 2024, there were 5.44 billion internet users worldwide, which amounted to 67.1 percent of the global population. Of this total, 5.07 billion, or 62.6 percent of the world's population, were social media users. According to the data, Asia was home to the most significant online users i.e., over 2.93 billion users at the latest count. With around 750 million internet users. China, India, and the United States have ranked ahead of other countries worldwide in terms of the number of Internet users in these countries. As the capabilities of the internet continue to grow and change to keep up with life around us, the number of internet users is bound to increase and will do so at a rapid rate. In fact, in just five years, internet users are expected to increase 47% from 5.35 billion users in 2024 to 7.9 billion users in 2029. 6G technologies have the potential to bridge the digital divide by enabling cost-effective, energy-efficient, and flexible wireless connectivity in remote areas (Chaoub, et al. 2021). Bridging the digital divide through 6G requires overcoming infrastructure, cost, and energy challenges to provide affordable and sustainable connectivity in rural areas (Yaacoub, E., & Alouini, M. S. 2020). Thus, the Internet is taking on the world by a whirlwind. As global digital transformation accelerates, next-generation mobile networks such as 5G and the emerging 6G promise to revolutionize communication by enabling faster data speeds, ultra-low latency, and massive connectivity. These advancements are expected to fuel innovations in various sectors, including healthcare, agriculture, transportation, and smart cities. However, the deployment and effectiveness of these networks in rural areas face significant challenges, which risk exacerbating the existing digital divide between urban and rural regions.

This paper explores the connectivity issues associated with 5G and 6G networks in rural areas, examining the technological, economic, and social barriers and proposing potential solutions to ensure equitable access to advanced communication technologies. The 5G and 6G broadband cellular networks are the latest Information and Communication Technologies trends. The introduction of the 4G/LTE network helped people access the internet services better with smartphones, tablets, and PCs. Though it provided users with various advantages, the users still felt the need for high-speed Telecom Regulatory