Chapter 1
5G–6G:
Infrastructure and Industrial Applications

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ABSTRACT

Mobile networks play a crucial role in facilitating communication through the transmission and reception of radio wave signals. These networks are composed of interconnected cells provided by base stations, enabling wide geographic coverage. The evolution of mobile networks has progressed through several stages. It began with the analog-based first-generation systems that provided basic voice communication. The current phase is the fifth generation, which aims to deliver exceptional performance with faster speeds, low latency, and connectivity density. Ongoing research and development continue to shape the evolution of mobile networks, with technologies like 6G on the horizon, promising even faster speeds and transformative use cases. The network infrastructure for 5G and 6G plays a crucial role in enabling the capabilities and delivering the promised benefits of these advanced wireless communication technologies. The industry applications of 5G and the anticipated applications of 6G are diverse and have the potential to revolutionize various sectors.

DOI: 10.4018/979-8-3693-0819-6.ch001

1. INTRODUCTION

A wirelessly connected mobile network that covers a large section of the planet's land surface and is made up of transceivers at fixed locations known as base stations or cell sites. The base stations' network coverage facilitates the transmission of speech, data, and various types of information within each cell. To ensure high service quality and avoid interference, neighboring cells often utilize different frequency ranges. These cells are interconnected to provide comprehensive radio coverage across a large geographic area. This permits continuous communication between multiple portable transceivers (such as tablets, pagers, mobile phones, laptops, etc.) as well as fixed telephones and transceivers within the network through the use of base stations. This becomes specifically vital when some users are moving across multiple cells simultaneously while engaging in data transmission. The majority of populous regions on Earth have data and voice cellular networks installed by major telecommunications companies. Now, computers and mobile phones can connect to the public switched telephone network and the public Internet.

2. EVOLUTION OF MOBILE NETWORK (ARSHAD, 2019; DE VRIENDT, 2002)

- **1G:** In the 1980s, analog cell phone networks were released. In order to prevent economies of scale and limit usage to internal boundaries, each country at the time developed its own system. One can make voice-only calls over 1G. The 1G technology was analog and had inferior voice quality, battery life, and security in the phones that used it. They frequently dropped calls as well. The top speed of 1G technology is 2.4 Kbps. In the early to mid-1990s, 2G (second generation) cellular technologies took the role of 1G.
- **2G (**Stuckmann, 2002 & Halonen, 2004**):** It makes it possible to digitize and compress voice transmissions. As a result, they achieve more efficient utilization of the frequency spectrum compared to 1G. They introduced SMS text messaging-based data services for mobile devices. Both data and audio signals are digitally encrypted, leading to substantial enhancements in security against fraud and eavesdropping. Additionally, digital transmissions consume less battery power, further contributing to improved efficiency. Therefore, mobile sets use substantially less energy than their 1G equivalents.