Chapter 3
Scope and Future Trends in 6G

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ABSTRACT

Imagine a cosmos where your devices communicate with each other at light speed, remote medical procedures take place effortlessly, and entire cities function seamlessly with interconnected, intelligent systems. Such is 6G, a preview of what the forthcoming wireless communication technology revolution will encompass. With 5G only just starting to be rolled out globally, researchers and technology leaders are already involved in a frantic race to create 6G, a network that will offer even faster speeds, nearly zero latency, and flawless integration for artificial intelligence (AI) and quantum computing. This chapter, Scope and Future Trends in 6G, will investigate thoroughly what distinguishes 6G from its predecessors, its fundamental technologies driving it, and its impacts in the real world. Looking ahead to the prospective future of this innovative technology, we will also consider how it can be utilized responsibly—how its advancement can be aligned with human progress with the least damage to our planet possible.

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INTRODUCTION

The history of wireless communications has been one of the greatest technology revolutions, reshaping the manner in which individuals communicate, interact, and connect with the world around them. From the first voice calls of first-generation (1G) networks in the 1980s to the fast, low-latency performance of fifth-generation (5G) networks, each new generation of wireless technology has brought new innovations that have reshaped daily life (Agrawal & Patel, 2021).

The 1G networks were analog-based and primarily supported voice calls, but with poor call quality and weak security systems (Rappaport et al., 2002). The 2G networks in the 1990s revolutionized mobile communication by adopting digital technology, which enabled Short Message Service (SMS) and basic mobile data services (Garg, 2010). This revolution marked the beginning of mobile devices becoming more than basic voice communication devices. The third-generation (3G) networks in the early 2000s revolutionized data speeds and enabled mobile internet browsing, video calls, and the introduction of smartphone applications (Dahlman et al., 2011). This revolution ushered society into a global digital connectivity world, where users were able to access information, entertainment, and services on the go. The introduction of fourth-generation (4G) networks in the 2010s revolutionized the digital world by offering speeds 100 times faster than 3G, enabling high-definition video streaming, mobile applications, and real-time cloud services (Shafi, 2020). With 4G, the "smartphone economy" was born, and this created innovations in mobile commerce, ride-hailing services, and mobile banking (Zheng et al., 2022).

The advent of 5G in the late 2010s and early 2020s pushed this revolution even further, with ultra-low latency, increased data rates, and massive device connectivity (Gupta & Jha, 2015). This new technology is a precursor to new fields like the Internet of Things (IoT), autonomous cars, and augmented reality (AR) (Dang et al., 2020). Consequently, the world already awaits the next wireless communication landmark: sixth-generation (6G) networks. Even before 5G is fully deployed around the world, researchers, companies, and governments have already started investing in research on 6G. Vowed to deliver data speeds 100 times faster than 5G, 6G will provide near-zero latency, ultra-reliable connections, and smooth integration with future technologies like artificial intelligence (AI), quantum computing, and sophisticated IoT frameworks (Saad et al., 2020). With these features, 6G is likely to support totally new use cases in various sectors.

In medical care, 6G could revolutionize remote surgery by enabling precise real-time operations thousands of miles away, enhancing access to quality care in remote areas (Latva-Aho & Leppänen, 2019). In transportation, 6G could support fully autonomous vehicles by enabling immediate communication between vehicles, infrastructure, and traffic systems, enhancing road safety, reducing congestion, and