Chapter 7
AI Applications in Secure 6G-Enabled Smart City Infrastructure

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ABSTRACT

The development of secure 6G networks has the potential to transform smart city infrastructures, integrating artificial intelligence (AI) to manage urban systems with unprecedented efficiency. The integration of AI in 6G-enabled smart cities will enhance services such as public safety, transportation, and energy management, but also poses significant security risks due to the vast amounts of data being processed. This abstract explores AI's role in optimizing these systems while addressing the security challenges posed by real-time data transmission, cyber-attacks, and privacy concerns. By examining AI-driven solutions, such as anomaly detection systems and federated learning, this research offers insights into enhancing the safety and resilience of smart cities in the digital age.

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INTRODUCTION

Background and Context

The concept of smart cities has evolved significantly in recent years, driven by rapid advancements in communication technologies and the integration of artificial intelligence (AI). Smart city infrastructure is designed to enhance the quality of life for urban residents by improving services such as transportation, energy management, healthcare, public safety, and waste management (Li et al., 2021). The transition from 4G to 5G networks has played a pivotal role in accelerating the digitalization of urban spaces, providing higher data speeds, increased network capacity, and ultra-reliable low-latency communication (URLLC). However, the introduction of the next-generation 6G network promises to revolutionize smart city infrastructures even further by offering terahertz-level data transmission, near-instantaneous communication, and massive machine-type communications (mMTC) (Latif et al., 2021).

The evolution from 4G to 5G networks has already enabled cities to implement intelligent systems, such as real-time traffic monitoring, remote healthcare, and smart energy grids (Mukherjee et al., 2021). However, with the advent of 6G, cities will experience a significant leap in both connectivity and data processing capabilities. The 6G network is expected to provide ultra-high data rates of up to 1 terabit per second, minimal latency (in the order of microseconds), and the ability to support up to 100 billion connected devices globally (Gupta & Jha, 2020). These advancements are crucial for enabling the seamless integration of diverse services in smart cities, where data generated from various sources must be processed, analyzed, and acted upon in real-time. Moreover, the massive adoption of the Internet of Things (IoT) devices in smart cities necessitates reliable and scalable communication networks, a role that 6G is expected to fulfill.

Artificial Intelligence (AI) has emerged as a critical enabler in smart city ecosystems, providing the computational power and decision-making capabilities required to manage and optimize various urban functions (Khan et al., 2021). AI applications in smart cities span multiple domains, including autonomous transportation systems, energy management, healthcare, waste disposal, and public safety. For instance, AI-driven algorithms can analyze real-time traffic data to reduce congestion, optimize energy usage in buildings, and predict emergency response needs in case of disasters (Sundqvist et al., 2020). As the volume of data generated by smart cities continues to grow, AI becomes indispensable for deriving actionable insights and enhancing the efficiency of urban services.

However, the increasing reliance on AI and 6G networks for smart city operations introduces significant challenges related to data security and privacy. The vast amount of sensitive data collected and processed in smart cities, including

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