Chapter 14
Future of Mobility:
Potential Challenges and Ethical Considerations

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ABSTRACT

Quantum Computers with its extraordinary computing power, have marked the beginning of a new era of computers. Their presence is not just revolutionising the scientific community, but also transforming the world. However, such a power in the hands of an adversary can be fatal. They will empower adversaries to have unauthorized access to user's data. Technologies based on lightweight cryptographic methods such as Vehicular Communication, will be adversely affected. Thus, there is a need to develop mechanisms that are lightweight and at the same time uncompromisable by Quantum-Powered Adversaries (QPA) before powerful Quantum Computers are developed. In this chapter, we first focus on the current scenario of secure communication and how QPA can exploit it. Later, we focus on how Quantum-Safe Cryptography and Artificial Intelligence can contribute in the development of defensive mechanisms against QPA. Finally, we conclude the chapter by highlighting the challenges in making the solutions feasible for adoption.

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1. INTRODUCTION

Vehicular Communication have transformed transportation. Particularly, they have enhanced security, reliability and traceability of vehicles. This Vehicular Network when was further connected with Internet, a plethora of possibilities opened in Vehicular Communication. These opportunities revolutionized Vehicular Communication bringing them into the umbrella of Internet-of-Vehicles (IoV). IoV has connected Vehicular Communication with cutting-edge technologies such as Cloud Computing, Edge Computing, Artificial Intelligence to name a few (Partovi et al. 2023).

Figure 1 depicts the architecture of IoV (El-Rewini et al. 2020). Here, we can observe the multi-layered architecture which consists of the perception layer, network layer, and application layer. The perception layer includes sensors and devices embedded in vehicles and infrastructure to collect real-time data such as on road conditions, vehicle health, environmental factors etc. Technologies like LIDAR, radar, cameras, and GPS are integral to this layer. The network layer ensures seamless data transmission between vehicles and infrastructure using advanced communication protocols such as Dedicated Short-Range Communication (DSRC), Cellular V2X (C-V2X), and 5G. Cloud and edge computing systems are employed to manage and process the vast volumes of data that is generated. Finally, in the application layer critical processes such as traffic optimization, predictive maintenance, autonomous driving support, infotainment systems etc. (Taslimasa et al. 2023) are addressed. However, to improve the efficiency of these layers, effective management of Data Communication is of paramount importance (Bucaioni et al. 2020). Figure 2 depicts the communication framework that is used in an IoV Network. Here, we can observe the four types of communication namely, Trusted Authority to Infrastructure, Vehicle to Trusted Authority, Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I). When a vehicle is travelling in an IoV network, it can communicate with each other (V2V) through Dedicated Short-Range Communication (DSRC) such as Bluetooth, Lidar etc. (Azam et al. 2021). It can also communicate to the Road-Side Units (V2R) which are deployed besides the road. They provide the vehicle with necessary information using DSRC. Moreover, these RSU's also receive data through Internet from other infrastructural units such as Trusted Authority, other RSUs, etc. The vehicle can also receive

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