


Chapter 11


Enhancing Electric Vehicle Performance Through 5G and Cloud Computing Integration

Ramya Srikanteswara

 <https://orcid.org/0000-0002-3609-2133>

Department of Computer Science and Engineering, Nitte Meenakshi Institute of Technology, Bangalore, India

Jagadevi N. Kalshetty

 <https://orcid.org/0000-0001-6466-4197>

Department of Computer Science and Engineering, Nitte Meenakshi Institute of Technology, Bangalore, India

Nagamani Molakatala


School of Computer and Information Sciences, University of Hyderabad, India

Saurabh Chandra

 <https://orcid.org/0000-0003-4172-9968>

School of Law, Bennett University, Greater Noida, India

Athira Manoj

 <https://orcid.org/0009-0009-4897-801X>

Department of Electronics and Communication Engineering, PSNA College of Engineering and Technology, Dindigul, India

ABSTRACT

This chapter explores the transformative potential of integrating 5G and cloud computing technologies to enhance the performance and efficiency of electric vehicles (EVs). By leveraging the ultra-low latency and high bandwidth of 5G, EVs can achieve real-time communication with cloud-based platforms, enabling advanced data processing, predictive analytics, and AI-driven optimizations. This integration facilitates more efficient energy management, improved battery life, and enhanced autonomous driving capabilities. Additionally, the chapter examines the challenges and opportunities of this convergence, including data security, network infrastructure, and the evolving landscape of smart transportation systems.

DOI: 10.4018/979-8-3693-7112-1.ch011

INTRODUCTION

The rapid advancement of technology in the automotive sector has driven significant improvements in electric vehicle (EV) performance, with 5G and cloud computing emerging as critical enablers of this evolution. As the world shifts towards cleaner and more sustainable modes of transportation, the integration of these technologies is not only enhancing the capabilities of EVs but also transforming the broader landscape of smart mobility. This integration offers a new paradigm where vehicles are no longer isolated systems but part of a connected and intelligent ecosystem that can adapt, learn, and optimize in real time (Donald & Brian, 2023).

5G technology, with its ultra-low latency, high bandwidth, and massive connectivity capabilities, is poised to revolutionize the way EVs operate. Unlike previous generations of mobile networks, 5G provides the necessary infrastructure for real-time communication between vehicles, infrastructure, and cloud-based systems. This enables instantaneous data exchange, which is crucial for various EV applications such as autonomous driving, vehicle-to-everything (V2X) communication, and advanced driver assistance systems (ADAS). For instance, a 5G-enabled EV can communicate with traffic signals, other vehicles, and cloud servers to dynamically adjust its speed, route, and driving behavior in response to real-time traffic conditions. This not only enhances safety but also optimizes energy consumption by avoiding unnecessary stops and starts (Tao et al., 2017).

In parallel, cloud computing plays a vital role in processing and analyzing the vast amounts of data generated by EVs. The cloud offers virtually unlimited computational resources, allowing for the implementation of complex algorithms that can analyze driving patterns, predict maintenance needs, and optimize battery management. By offloading these tasks to the cloud, EVs can operate more efficiently, as the onboard systems are freed from the burden of heavy computation. Additionally, cloud computing enables continuous software updates and improvements, ensuring that EVs remain at the cutting edge of technology without the need for frequent hardware upgrades (Yang & Hua, 2019).

One of the most significant advantages of integrating 5G and cloud computing in EVs is the potential for enhanced autonomous driving capabilities. Autonomous vehicles require the ability to process and respond to massive amounts of data from their surroundings in real-time. 5G facilitates this by providing the necessary bandwidth and low latency for real-time data transmission between the vehicle and the cloud. Meanwhile, cloud computing provides the computational power needed to run advanced machine learning algorithms that can interpret this data and make split-second decisions. This combination enables safer and more reliable autonomous driving, bringing us closer to the widespread adoption of self-driving cars (ElGhanam et al., 2021).

Battery life and energy management are critical aspects of EV performance, and the integration of 5G and cloud computing offers significant improvements in these areas. Cloud-based predictive analytics can monitor battery health, predict potential issues, and suggest optimal charging strategies. This proactive approach helps to extend battery life and improve overall energy efficiency. Moreover, 5G enables real-time communication between the vehicle and charging infrastructure, allowing for dynamic charging management that can balance the load on the grid and reduce charging times. These advancements are particularly important as the adoption of EVs increases, placing greater demands on existing energy infrastructure (Y. Cao et al., 2018).

However, the integration of 5G and cloud computing in EVs also presents challenges, particularly in terms of data security and privacy. The constant exchange of data between vehicles, infrastructure, and the cloud creates potential vulnerabilities that could be exploited by malicious actors. Ensuring the

24 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:
www.igi-global.com/chapter/enhancing-electric-vehicle-performance-through-5g-and-cloud-computing-integration/374512

Related Content

Collusion-Free Privacy Preserving Data Mining

M. Rajalakshmi, T. Purusothaman and S. Pratheeba (2010). *International Journal of Intelligent Information Technologies* (pp. 30-45).

www.irma-international.org/article/collusion-free-privacy-preserving-data/46962

Integrating AI in Higher Education: Applications, Strategies, Ethical Considerations

Salim Bakhit Al Daraai, Mallak Al Maqrashi, Mohammed Al Zakwani and Zahir Al Shaikh (2024). *Utilizing AI for Assessment, Grading, and Feedback in Higher Education* (pp. 189-211).

www.irma-international.org/chapter/integrating-ai-in-higher-education/346554

Robotic Process Automation (RPA) in HR Operations

Natalia Khazieva and Andrei Ternikov (2026). *Digital Transformation and Human Potential in the AI Era* (pp. 297-324).

www.irma-international.org/chapter/robotic-process-automation-rpa-in-hr-operations/397508

Accelerating Financial Inclusion in Developing Economies (India) Through Digital Financial Technology

Parul Garg, Tapsi Srivastava, Ankit Goel and Nancy Gupta (2024). *AI-Driven Decentralized Finance and the Future of Finance* (pp. 205-228).

www.irma-international.org/chapter/accelerating-financial-inclusion-in-developing-economies-india-through-digital-financial-technology/355308

Generation of Adversarial Mechanisms in Deep Neural Networks: A Survey of the State of the Art

Aruna Animish Pavate and Rajesh Bansode (2022). *International Journal of Ambient Computing and Intelligence* (pp. 1-18).

www.irma-international.org/article/generation-of-adversarial-mechanisms-in-deep-neural-networks/293111