# Chapter 11
# Traffic Management and Congestion Control in Vehicular Adhoc Networks

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## ABSTRACT

*Urban traffic congestion is a growing concern worldwide. Vehicular Adhoc Networks (VANETs) offer a glimpse into a future with smoother traffic flow and reduced congestion. These networks enable real-time communication between vehicles and infrastructure, creating a dynamic traffic management system. Imagine traffic signals that adjust based on real-time data, congestion being predicted and alleviated*

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*before it builds, and emergency services receiving faster response times. This is the potential of VANETs. Ensuring reliable communication and data integrity among constantly moving vehicles is crucial. Researchers are developing protocols and algorithms to address this, focusing on efficient routing, data dissemination, and network stability. The integration of emerging technologies like 5G, edge computing, and artificial intelligence holds promise for further enhancing network performance and robustness. While significant progress has been made, widespread adoption of VANETs faces hurdles. Scalability, security, privacy, and infrastructure development costs are significant concerns. T*

## INTRODUCTION

Urbanization and fast pace of vehicular traffic have exacerbated the problem of congestion in cities all around the world, causing great time loss, more fuel intake, and increased emissions of greenhouse gases. Conventional systems for traffic management fail to deal with the dynamic nature and complexity of modern urban traffic. The challenge has brought advanced technologies, including Vehicular Adhoc Networks (VANETs), to come forward as a viable answer. VANETs enable real-time communication between vehicles and infrastructures, thus providing an interconnected ecosystem for dynamic traffic management, predictive analytics, and efficient resource utilization.

Whereas the VANETs concept brings some excitement into its practice, it poses important problems like efficient data dissemination, dynamic routing, and robust stability in the network in highly mobile and volatile environments. Among such complex, dynamic optimization problems, reinforcement learning has really proven to be a suitable fit in dealing with them. With continuous interaction of systems with their environment through which they learn optimal actions, this enables a framework for adaptive, intelligent decision-making.

The main area in which reinforcement learning plays a revolutionary role for VANETs includes: Traffic Signal Optimization. Dynamic and real-time traffic signal scheduling may be carried out with RL-based agents, avoiding congested traffic conditions and smoothing out the traffic flow. Route Optimization. Vehicles carrying an onboard computer with an RL algorithm could optimize the route for travel on a self-driving basis, which saves more fuel consumption and time while trying to avoid bottlenecks and congested traffic areas.

Congestion Prediction and Management: RL models can predict traffic congestion and propose proactive actions that would be able to counter it.

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