

# PERFORMANCE ANALYSIS OF ADAPTIVE DATA DISSEMINATION IN VEHICULAR NETWORKS

A Thesis Submitted to the Atmiya University, For the Degree of

## **DOCTOR OF PHILOSOPHY**

in

## FACULTY OF ENGINEERING & TECHNOLOGY

by

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January, 2023

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I declare that the thesis entitled "*Performance Analysis of Adaptive Data Dissemination in Vehicular Networks*" is my own work conducted under the supervision of **Dr. Vishal. S. Vora** at Department of **Electronics & Communication Engineering**, Faculty of **Engineering & Technology**, Atmiya University, Rajkot, Gujarat, India and approved by the Director of Research.

I further declare that, to the best of my knowledge, the thesis does not contain any part of any work which has been submitted for award of any degree either in this University or any other University without proper citation.

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Name of Research Scholar: Mr. Mehul K. Vala

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This is to certify that work entitled "Performance Analysis of Adaptive Data Dissemination in Vehicular Networks" is a piece of research work done by Mr. Mehul K. Vala under my supervision for the degree of Doctor of Philosophy in Department of Electronics & Communication Engineering, Faculty of Engineering & Technology, Atmiya University, Rajkot, Gujarat, India. To the best of my knowledge and belief the research work and the thesis

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I declare that the submitted thesis entitled "Performance Analysis of Adaptive Data Dissemination in Vehicular Networks" incoporates

- 1. All the suggestions / directions / modifications / additions / deletions received from the supervisor and the external examiners through their thesis evaluation reports.
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#### Abstract

Recent advancements in mobile communications, embedded systems, and sensors lead to the design of intelligent vehicles. Such vehicles are able to establish wireless communication among themselves, and this is called vehicular ad hoc networks. A plethora of applications covering safety, efficiency, and infotainment are possible through the use of vehicular networks. Enhancing safety and efficiency is the main goal of an intelligent transportation system (ITS). That is why it is gaining much interest among the research community and automobile industries.

Safety-related messages need to propagate efficiently and reliably among moving vehicles to realize safety applications. Variable vehicle density and road topologies in vehicular networks raise many challenges for efficient message dissemination. Furthermore, vehicles must extend message awareness beyond the transmission range of the sending vehicles. The characteristics of vehicular networks, as well as the need to disseminate safety messages over a greater distance, necessitate efficient and reliable multi-hop communications.

The current thesis fits into this background and aims to investigate and propose novel and efficient data dissemination protocols, primarily addressing safety applications via vehicle-to-vehicle communication. First, it provides a detailed analysis of message dissemination protocols and their classifications. The thesis focuses on location-assisted message broadcasting for message dissemination tasks. Native broadcasting methods result in high redundancy and channel contention. Delay-based broadcasting techniques are efficient solutions to reduce excessive redundancy and channel congestion. This work provides a comparative analysis of different delay-based broadcast techniques.

Subsequently, an enhanced adaptive protocol design is presented that is robust against varying vehicle densities and road topologies. The proposed protocol is scalable to accommodate diverse application requirements. Additionally, the behaviour and effectiveness of the proposed protocol are carefully examined in a realistic environment.

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## List of Acronyms

- **DSRC:** Dedicated Short Range Communication
- **GPS:** Global Positioning System
- **ITS:** Intelligent Transportation System
- LOS: Light of Sight
- MANET: Mobile Ad-hoc Network
- **OBU:** On Board Unit
- **RSU:** Road Side Unit
- **RSSI** Received Signal Strength
- SCH: Service Channel
- **CCH:** Control Channel
- **V2V:** Vehicle to Vehicle
- V2I: Vehicle to Infrastructure
- **V2X:** Vehicle to X (Everything)
- VANET: Vehicular Ad-hoc Network
- **PHY:** Physical Layer
- **MAC:** Medium Access Control
- CSMA/CA: Carrier Sense Multiple Access/Collision Avoidance
- **IEEE:** Institute of Electrical and Electronics Engineers
- LLC: Logical Link Control
- WHO: World Health Organization