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.

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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