DISSEMINATION OF EMERGENCY MESSAGES USING BEACONLESS APPROACH IN INTERNET OF VEHICLES

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Candidate of **Master of Science in Computer Science (MSCS)** at the National University of Modern Languages do hereby declare that the thesis **Dissemination of Emergency Messages using Beaconless Approach in Internet of Vehicles** submitted by me in partial fulfillment of MSCS degree, is my original work, and has not been submitted or published earlier. I also solemnly declare that it shall not, in future, be submitted by me for obtaining any other degree from this or any other university or institution. I also understand that if evidence of plagiarism is found in my thesis/dissertation at any stage, even after the award of a degree, the work may be cancelled and the degree revoked.

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ABSTRACT

Title: Dissemination of Emergency Messages using Beaconless Approach in Internet of Vehicles

The future transportation system demands an intelligent traffic system which aims to create a network of vehicles named Internet of Vehicle (IOV), achieved by connecting groups of vehicles to internet of things (IOT). The abilities of IOV must be utilized efficiently and effectively in order to meet the requirement of current traffic situations. It is mandatory to monitor, manage, and track the connected vehicles in IOV network. During accidental and alarming situation, accurate information delivered in timely manner is considered first priority. For this context, Vehicular Ad Hoc network (VANET) plays a vital role as an emerging technology plays a vital role as an emerging term that is deployed and implemented to reduce the risk of road accidents as well as to improve passenger comfort. In such context, exchange of emergency message through vehicle communication plays an important role for safety related applications. However, dissemination of Emergency Messages (EM) is a major concern. Since it gives rise to several issues such as broadcast storm, unwanted duplication that cause packet loss and poor system's throughput. For this purpose, BEMD is proposed in which fuzzy logic decision making tool is design that evaluate the rebroadcast probability of a packet for Vehicle to Vehicle communication (V2V). A feedback mechanism is added by utilizing the current available resources in a network in order get acknowledge to make sure the emergency packet is received by the vehicles. BBEMD is compared with past schemes under simulators NS-2.3 and MOVE and BEMD well performs in term of traffic reachability, saved rebroadcast and average service delay.

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LIST OF ABBREVIATIONS

ACM	Adaptive Control Messages
AFCS	Adaptive Forwarding Messages & Cooperative Safe Driving
AOI	area of interest of the packet
BT	rebroadcast time of the packet
CMP	Congestion Mitigation Process
CC	Control Channel
CV	current vehicle
DSRC	Dedicated short range communication
EM	Emergency Message
FBBPA	Fuzzy-based beaconless Probabilistic Broadcasting Algorithm
ITS	Intelligent Transport System
IOV	Internet of Vehicles
MAC	Medium Access Control
MANET	Mobile Ad-hoc Network
OBU	Onboard Unit
PV	previous vehicle
PRt	Priority of the packet at any time t
P2P	Peer to Peer
RSU	Road side Unit
SV	source vehicle
tR	time at which the packet p is received
VANET	Vehicular Ad-hoc Network
V2V	Vehicle to Vehicle
V2I	Vehicle to Infrastructure
V2X	Vehicle to Everyone
V2R	Vehicle to Road Side Unit

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CHAPTER 1

INTRODUCTION

1.1 Overview

First chapter comprises of research area, research enthusiasm, problematic scenario, research goals and the contributions are reported briefly. Vehicular Ad-hoc network is deliberated together with its strengths and utilization. Problem encloses the current concerns in Vehicular Ad-hoc network. Offered scheme and its influences defined concisely. Finally, the arrangement of chapters is taking into consideration.

1.2 Vehicular Ad-hoc Networks (VANETs)

VANETs is a core technology, which is implemented among smart moving vehicles in order to promote the vision of ITS. This technology is based on communication among vehicle to vehicle (V2V) and vehicle to RSU, named Road Side Units (V2R). Vehicular Ad-hoc network upkeep countless applications associated with vehicles, driver, passengers and traffic management everything from infotainment to traffic safety services [1]. VANETs technology is used for improvement, development and implementation of systems that are rapidly develop and enhance to support Intelligent Transportation, since it plays a significant role in elevating traffic management, automatic driving and traffic coincidences. The essential required distinct services be contingent on well-organized broadcast of numerous kind of beacons with essential Quality of Service. Well-organized and well-timed spreads of data among vehicles are important factors, affect the communication performance capabilities. In particular, safety related applications are deployed by transmitting 2 major categories of messages beacons known as intervallic one-hop protection beacons and warning messages. Periodic single-hop safety messages support awareness applications to maintain safe driving environment for vehicles, while warning beacons produce event-focused warnings to all vehicles inside a specific area. In both categories, the information is spread in the form of proactive data diffusion technique. Dissemination is highly recommended as compared to unicast and multicast as traffic related information that is exchange among group of crowds rather than a single entity.

In this epoch, many researchers are considering VANETs as interesting area, due to their important appealing topographies including dynamic topology, no centralized organization, dynamic connectivity and self-organizing [2]. Vehicular ad-hoc network considerably promoted conveyance organizations and reduces various unwelcome situations producing unrepairable accidents on highways. It allow vehicles to create a grid devoid of need of any sort of central server, make it possible for vehicles to exchange information on highways or in parking lots. It changes each an automobile into a router or moving node and allow nodes to connect in a communication range of up to 100 to 300 meters around each other, consequences a net with an extensive range. When vehicles moves from signal communication range and remove from the network and new vehicles comes in that range in order create a mobile internet [1].

All sort of communication occurring within vehicles are named as Vehicle to Vehicle (V2V) communication whereas, exchanging data among vehicles and infrastructure is known as vehicle to infrastructure (V2I) communication while exchanging data regularity utilized for sharing information within VANETs is from 5.85 GHz and 5.92 GHz. Facility based station and Control Channels (CC) usually utilized for sharing safety beacons concerning misfortunes, as well as various further dangerous actions, moreover, usual beacons as compared to safety beacons [3]. VANETs architecture along with communication process is shown in Figure 1.1. It can be seen that two types of communication is performed V2V and V2I communication. In V2I, communication among vehicle and infrastructure is performed on the basis of infrastructure. V2I communication uses one of the two approaches for data broadcasting i-e push bass approach and pull based approach. Push based approach is best fitted for public interest data i-e emergency warning messages in which road side infrastructure transfer packets containing info to all vehicles in Area of Interest (AOI). The pull-based approach is suitable for utilizing infotainment and comfort applications. In V2V, communication among vehicles is completely based on ad-hoc. It does not involve any infrastructure for support. Protocols use for V2V communication use one of two approaches for broadcasting i-e flooding approach and relaying approach. For promoting flooding approach in the mechanism leads to a problem called broadcast storm problem in a dense network. But it has better reachability. Relaying approach, forwarding vehicle broadcasts the packets to nearby vehicle and then again next forwarding vehicle is selected and loop repeats on behalf of selected criteria. Here relying upon approach is scalable and reliable but gives least reachability.

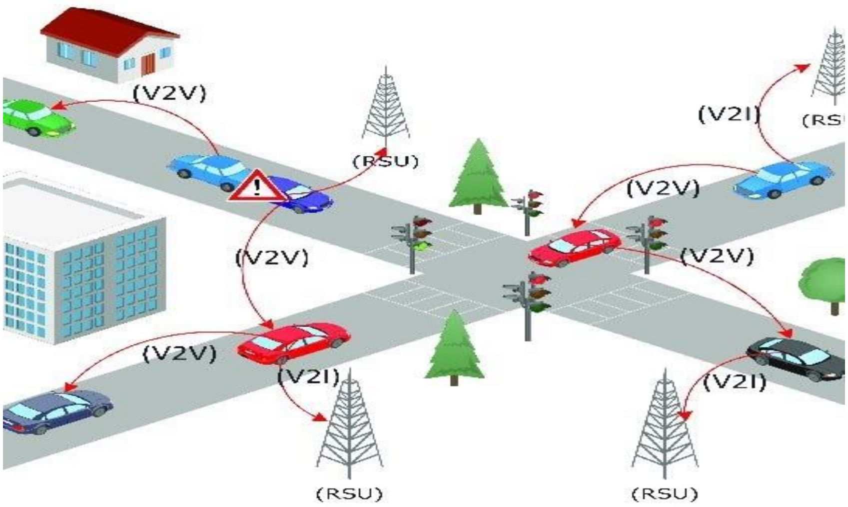

Figure 1.1: VANET Architecture and Communication

Keeping in mind about smart transport concept, IoV is making progress in development and research from vehicular ad hoc networks (VANETs) [4][5]. Internet of Vehicles fabricate a net of vehicles to implement Intelligent Transportation Systems (ITS) by integrating information. it is combination of threesome connection that consists of inter-vehicular network and vehicular mobile internet for sharing information among vehicles. The domain majorly consists of 6 foundations named vehicle, pedestrian, device, infrastructure, and detecting instruments. The communication between these components develops a various level swapping of data: vehicle to vehicle, vehicle to device, along with device with device as well as pedestrian to vehicle, and person with device [6].The functional utilization of travelling time to intensify traffic safety, efficiency, and commercial infotainment is also one of the key equitable of IoV [4][7].

It is a multiplex organization that is presented in Figure 1.2, consists of three layers such as sensor layer, data process layer and communication layer. Sensor layer comprises of onboard components (OBU) and various tools to check the surroundings nearby the vehicle. It examines the vehicle as a large mobile sensor node and get traffic information, the vehicle position, speed and route. Vehicles consists of OBU, an electrical component, having ability to sense, communicate, and enumerate [6].

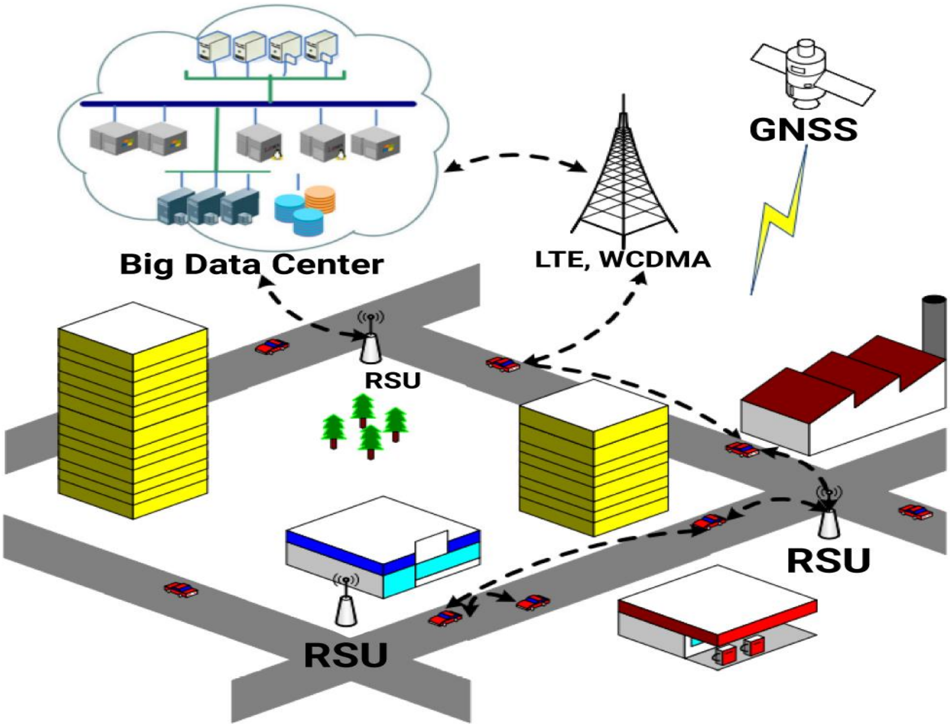

Figure1.2 The layers of Internet of Vehicle

The communication layer is usually a mixture net comprises of VANETs, Cellular network most probably 5G and net. It usually cover Vehicle to Vehicle communiqué and Vehicle and Infrastructure, also it could be positioned in dynamic safety uses, by way of illustrating vehicles accident cautionary or prevention schemes. The cellular based system and internet give access of data by a data or presentation based server assisted by large data expertise [8]. The data layer contains of a storing and analysis sub-layers. Data storing sub-layer needs an appropriate storage mechanism for large vehicle info, traffic information and some other information required. For internet of vehicles, analysis sub-layer is essential because it provides services including location finding facilities and vehicles tracking facilities. In IoV, the devices have connectivity to the network, enabling them for proficiently broadcasting information between vehicles in the happening of any sort of dangers and create communicating atmosphere [7].

Emergency message (EM) dissemination is considered a very critical ITS application. Literature has proposed a variety of Media Access Control (MAC) and other routing schemes to facilitate EM distribution in VANET [9] [10] [11] [12]. In situations involving accidents or a certain road Point of Interest, vehicles nearby areas urgently require specific information in order to react properly (e.g., slowing down or changing lanes), as soon as possible because they are only a short distance away from the POI. Additionally, such kind of information is likely at varying levels of detail, must also be disseminated at different distances to allow following vehicles to make appropriate location-aware decisions (reroute or detour if feasible) [13].

Every vehicle in a VANETs, have capability for transmitting intervallic and event based beacons. In intervallic beacons, the vehicle important information which consists of velocity and path with any supplement information a safety layer is needed. The foremost far-reaching measures for vehicular Ad-hoc network is DSRC or WAVE is created over the IEEE set organization. In it, vehicles can pass beacons in 2 stations: the service-based channel and the control-based channel. The SCH is mainly aimed at applications, whereas the CCH is cast-off to exchange beacons. These messages beacons are consists of data relevant to a vehicle's location, velocity and track. After getting many beacons, a vehicle can construct nodes network in its surrounding area. It is cleared that system will change frequently due to frequently changing routes of vehicles.

A vehicle need to send important information with high communication range so that vehicles in surrounding get information timely. As vehicles required to exchange latest information with neighboring vehicles so beacons transmit frequently exchange, as a result channel congestion occurs which is an important concern within VANETs. In congested traffic, higher the probability of channel congestion, the reason behind it is that bandwidth limited. Typically, usually in cities traffic bottlenecks is very common. It increases congestion rate, and messages Collison starts happening repeatedly, leading to a delivery delay and hindering safety applications. Because of the fast vehicles moving from a specific area and vanishing of vehicles, conventional congestion removing techniques becomes difficult to put on VANETs [14]. It is observed that about 57% of road accidents occurred because of people faults, including carelessness, no cooperation among people who are driving, and pathetic decisions [1]. The transmission of accident alarm information between vehicles or between vehicles and infrastructure can effectively avoid accidents if data is transmitted among vehicles timely and fast. In regard, it is vital to connect vehicles wirelessly before congestion and collisions occur.

When a vehicle or infotainment system detects an incident, beacons required to be transmit to surrounding vehicles. The beacon imitative vehicle conveys the beacon merely by disseminating all vehicles that are close to initiator vehicle. Receiver Vehicles retransmit the same message to more vehicles. Such mechanism is well-named as flooding. By this way, beacon may be send to the required vehicle, but this process leads towards congested network situation; that's, a vehicle sending beacons to further vehicles even if they already received that particular message. This useless resending of message within the network overcome the latest packet distribution rate. Enhanced selection of flooding or flood-based data broadcast schemes are used [15]–[17]. With the calibration of the transmission agreement for the VANET are named as IEEE 802.11p which is utilized to transmit alert immediately in a case if collision occurred. Such warnings are relayed from one vehicle to another to ensure safety of the driver along plane traffic movement. Warnings are occasionally unnoticeable or not is in the range of people earshot. This proved much useful for drivers and this procedure can considerably upsurges the reply duration of very first responders with the help of suggesting the alternative path from the area in which accident occurred [3].

1.3 Motivation

Modern transport system are providing facilities which becomes an important part the managing and energy utilization in cities. ITS make IoV as remedy for providing better interaction between vehicles. This technique progresses traffic super vision applications and facilities to provide assurance about security on highways. It create a network of vehicle which incorporates facts and aid intelligent vehicles improve transportation through swapping of beacon packets. This exchange of information should be reliable and must have maximum throughput and reduced delay, since there is no compromise over traffic management and road safety in real time. (Congestion, delay, repeated messages with high priority, reliability are problems). Data dissemination is a critical challenge for VANETs, despite their many obstacles. Generally, usual beacons are not time based, whereas EM are time-based beacons must be communicated effectively as soon as possible. Although various techniques exist for disseminating Emergency Messages (EMs). On the basis of the ease that is provided to the vehicle, most of the EMs are designed to be effective in particular frameworks. Despite the fact that the expertise is yet in development that has not extended to much development yet, many improvements still need to be improved.

1.4 Architecture of Ad-hoc Networks

VANET is the pinnacle of ad-hoc networking, providing vehicle to vehicle (V2V) as well as vehicle to infrastructure (V2I) or road (infrastructure)-to-vehicle (I2V) communication. VANET represents an evolved version of MANET in terms of architecture, communication self-management, shared radio and self-origination. In VANET vehicles do communicate directly with other neighboring vehicles via V2V and communicate with reachable road side units that are fixed infrastructures retained by following the infrastructure of V2R framework. The main communication devices that support VANET networks are the Fixed Road Units (RSU), the On-Board Unit (OBU) and the Application Unit (AU) including in vehicle. These terms are the essential tools to ease the communication processes of the VANETs.

The RSU provides vehicles with special facilities such as information dissemination, Internet management with many other safety uses. The Onboard Unit is an important part of the vehicle to attain communication with different entities such as RSUs. The communication abilities let the Application Unit to be underpinned by facilities provided by the network [2]. Vehicles promote communication with each other between in a Peer-to-Peer (P2P) manner or by taking help as extension from available nearby RSUs. The P2P manner is in the category of vehicle-to-vehicle (V2V) communication, and the other scenario of taking support of RSU is the part of vehicle to infrastructure (V2I) communication. Vehicle to Vehicle and Vehicle to Infrastructure communication are achieved with the help of auspicious wireless standard which are called WAVE.

The whole setup of it comprises of three sectors: within vehicle along infrastructure domain. The vehicle consists of an OBU as well Application Units that connected through wire or wireless way. The onboard unit and AU are considered as relevant to network fixed in unsystematically. Moreover, the adhoc sector consists of a roadside unit (RSU) act like a stationary entity and vehicles that are in motion fortified with OBUs and AUs. The application is available for RSUs and OBUs and the entity that is arranging the application is known as the provider however the second one that is utilizing it is known as the user. Interaction is created within RSUs and vehicles as well as among two RSUs one-hop or by many-hop. In infrastructure, twp. major categories of access media are: RSUs and hotspots (HS). The RSUs can approach to the internet through gateway, the OBUs has capacity to transfer information among them by hotspot or through internet depends on availability [18].

The high developments in communication technology enable the altered usage for vehicles in villages and cities and roads to keep diverse levels of qos in different applications. The basic purpose of a vehicular ad-hoc network is to establish steady wireless connections among vehicles and Roadside unit [19][20]. The great headway in communication, smart vehicles and automotive manufacturing technologies, modern vehicles are fit out with special wireless communication components. The components support vehicles to communicate nearby vehicles openly with adjacent vehicles via a V2V style and with RSUs via a V2I or I2V style [21]. IEEE 802.11p is a technology that enables the Dedicated Short-Range Communication (DSRC) works on promoting communication between high-speed vehicles. DSRC permits OBUs to exchange information vehicle networks via V2V and/or V2I. Vehicle to Vehicle communication, vehicle to infrastructure communication and Hybrid architecture (Mixed V2V-V2I approach) communications are presented by VANET. Vehicle-to-Vehicle Communication eases an interaction procedure within vehicles, to amplify the street safety. This provides right set of circumstances to collect a thorough knowledge almost the congestion scenario. The vehicles are boosting to transmit alarming beacons about accidents and obstacles during going towards destination [22]. V2V enables communication with other adjoining vehicles directly without any on road fixed communication units. In V2V communication mode, a vehicles communication group is created between close vehicles. Each node will act as a router or communication entity that is built among nearest neighboring nodes up to100 to 300 meters setting up a widespread range network. Safety related information requires high sending rat with low delay rate to avoid accidental scenarios whereas other applications claim to expand traffic proficiency while keeps travelers and drivers luxury ratio [23][24].

In a Vehicle to Infrastructure Communication, vehicle swaps date to a nearest road side unit. RSU provides different services to OBU infrastructures. Communication between a

Vehicle and the existing infrastructures is built by V2I and V2V way. The RSU play an important role by gathering the essential information in order to ensure various actions for the local domain vehicles.

In hybrid communication scheme, vehicle can interact with ranging nodes by V2V as well as with the exterior devices by V2I (or I2V) in one hope or many- hope. The technique is a mixture of V2V and V2I. Federal Communications Commission names FCC, has a well-known wireless etiquette named as DSRC. It operates by full-bandwidth operation of ITS in the 5.9 GHz and 75 MHz frequency bands. The utilized frequency band was split into a control channel (CCH) and six service channels (SCH). Welfare applications and messages for welfare are disseminated via the CCH while SCHs disseminates the other kinds of different service data [25]. The three available transmission modes for vehicular communication are unicast, multicast and broadcast. In unicast mode, the source vehicle can directly transmit a message to a certain designated vehicle using each of networking device naming single or multi-hop. In multicast, the source vehicle transfer messages and make communication possible to a group of vehicles. In broadcast mode, source vehicle make communication to the neighboring vehicles by sending messages with in a certain range. The nearest nodes will send the received beacons by a innovative broad casting. Assembling decreases the number of nodes used to spread beacons by using cluster head. Multi-hop wireless transmission uses location-based or topology-based routing techniques to forward information [26][27]. Much researches have largely focused its efforts on direct vehicle communication: intravehicular communication (IVC) rather than infrastructure communication. IVC can be achieved by revealing of significant event detection elements and distributing them to vehicles [28]. Communication types to which VANET supports are shown in Figure 1.3.

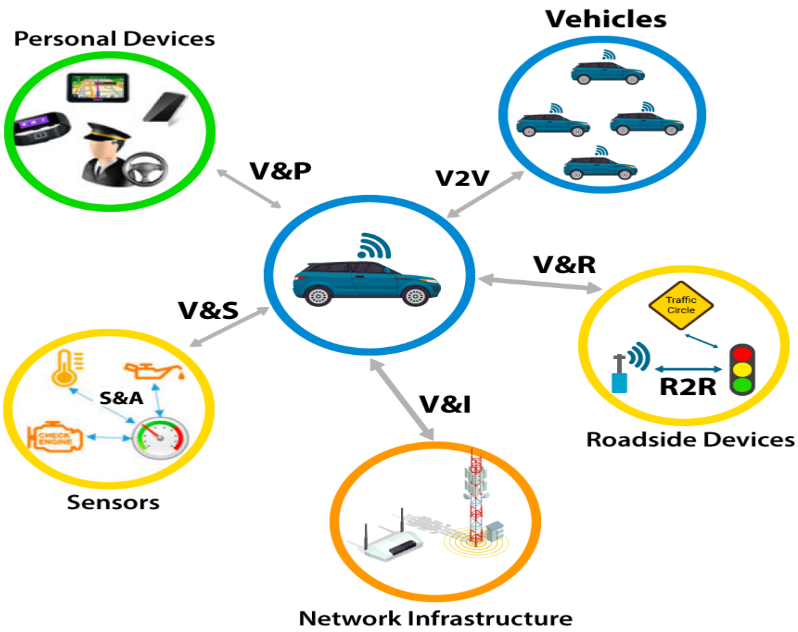

Figure 1.3: VANET communication types

Having efficient mechanisms to distribute info between vehicles depends on broadcasting protocols is important for the provision of safety and entertainment services. A disseminated message can originate at RSU nourished through any distant server, or resides at the On-Board Unit (OBU) that contains information of interest that might be useful to roaming users. This dissemination process entails the efficient use of vehicular communications networks by using intelligent and adaptive broadcasting algorithms, which prevents the broadcast storm issue [29]. Each node getting the same beacon send it further and the network become highly congested. Broadcasting protocols are grouped as probabilistic and interval based. Network coding algorithms consider a third type of scheme. Operational elements include the use of beacon messages (named "hello" messages). As a result of message depend broadcasting protocols, nodes are learned about appropriate information about neighborhood (containing the locations and velocity of neighboring nodes) through distributing beacon messages on a timely basis. In order to take a decision either or not to transmit a new beacon expected, this relevant facts are also used by a vehicles entity decide the target node. Beacon-less technique are ground on the employ of self-governing logic. On the entrance of a new beacon, a choice is taken either to onward send the beacon, depend exclusively on the entrenched procedure reason and to the beacons regulator information. Beaconless broadcasting procedures mechanism works on each timer depend algorithms. In this scenario the choice to onward send a beacon is inclined on the credit of a very accidental variable whose dissemination might be exaggerated by the situations of the sending and reception vehicles [29]. In timer-founded procedures, the chosen promoting vehicle is the one having the direct regulator amongst entirely of vehicles getting a disseminated beacon.

1.5 Applications of internet of vehicles

According to [5][6][11], VANETs have some applications that are classified as safety-related, traffic efficiency and management and infotainment related applications.

1.5.1 Safety-related applications

In VANET and IOV, the key objective is to prevent and lessen road mishaps since this includes the danger of survives. Applications that intense to provide safety services are delay sensitive [19][6]. The intention behind these applications is to offer the driver through earlier cautioning. This will ultimately reduce the accidents by happening at any scenario. Safety services are characterized as: intersection collision evasion, community safety related requests, vehicle upkeep, repairs, and facts by other vehicles. In Public based services, the main worries of ITS, deliver protection to drivers in situation of disaster. Vehicle maintenance warns the drivers about vehicles need repairing services as it is important for proper functioning of vehicles. These services of modern transport gather information equally from vehicle to infrastructure (V2I) communication architecture and vehicle to vehicle (V2V) communication architecture.

1.5.2 Management and efficiency of traffic

The aim of management and efficiency of traffic applications are to improve the overall efficiency of these systems by providing information related to traffic situations to drivers and operative teams of transportation systems. In order to accomplish this goal, the traffic information must be exchanged while implementing the framework provide by VANET. Nodes are instructed about traffic flow condition onward for numerous OBUs and RSUs consequently, nodes might alter their paths in case occur probability of congestion and keeps the time save. Traffic efficiency and management consist of sub applications Guidance for optimized speed at green lights, V2V merging assistance, and enhanced route guidance and navigation are some examples. Assistance is required for vehicles to manage the passage at connection proficiently. As nodes moves by intersections in urban areas, can be unsafe due to any unawareness can danger the existence.

1.5.3 Infotainment and comfort applications.

These services let the drivers to strengthen the traveling ease. Infotainment applications can bear beacon losses and few intervals. Unicast transmitting is the chief communiqué way for infotainment services. Comfort and infotainment applications are classified as non-safety applications by mean of providing entertainment via internet and on regular basis, provides information to drivers. Use cases include in this category are: Internet access in vehicle and point of interest notification. Internet Access in vehicle provides the drivers and passenger the access to internet via VANET where notifications on the basis of user’s interest provides the agents and advertisement companies to advertise the business promotions, they offer to nearby vehicles.

1.6 Constraints of internet of vehicles

The purpose of this section is to discuss the challenges and the issues related to open research that are having thought about carefully for developing efficient and a cost-effective convention and utilizing applications for VANETs. In VANET, the main factors are price, act, the complication of employ, and time. The most significant challenge is enhancing Quality of Service (QoS) factors in internet of vehicle applications [6]. Followings are the constraints from which the research was conducted from [2][6][30][31].

1.6.1 Data management

Data should be exchange according to significance in infrastructure to effect choice production as different types of data are using in the system. Data managing shows serious part in various plan stages. As fragment of the IoV, merely the important data should be kept in the databases to shelter a huge capacity and diversity of data by focusing attention on the data received for analysis. Issue arises here is the poor management of data leads to performance degradedness.

1.6.2 Dissemination of Data in VANETS

Disseminating data is a widely discussed topic in vehicular networks. Timely and proper dissemination of data is prime objective of VANET. The main challenge is to inform vehicles about periodic and event-driven messages in order to take necessary measurements while avoiding the broadcast storm problem.

1.6.3 Bandwidth limitations

- VANETs are distress from the lack of a centralized controller that operates with restricted bandwidth and content.
- An additional challenging issue that VANETs face when deployed in a densely populated region is congestion in the channels.
- The crucial aim in designing efficient vehicular communication protocols for VANET is ensuring tolerable time delay. VANET must follow strict time strategies.
- Vehicular communication requires necessary tradeoff between accountability and privacy. Each of the node need to acceptance the source of the received data besides must be able to protect the driver’s privacy.
- In VANETs, the communication range (effective diameter) is usually short, leading to weak connectivity between vehicles. As a result, VANET routing protocols may suffer numerous difficulties as each vehicle cannot maintain the entire topology of VANET.

- As VANETs are open environment networks, so it can be threatened by enormous total of occurrences. As the focal security trials in VANET is need to determine the diverse attacks associated to vehicles interaction, and charge the routing protocols protect opposed to the spasms.

1.7 Problem Background

For dissemination emergency between vehicles, different factors for proper dissemination are considered to reduce. Buffer capacity is considered as one of crucial factor, for approximating the beacon forwarding postponement. Queue leads to higher delay time for such beacons that has great need. A vehicle receives data beacons from various vehicles from that are available in queue as per their broadcast time (Bt). Current researches added that a it is not essential to retransmit the similar warning beacons after getting it by other than four times.

The constant defined as, earlier getting the occurrence position, the higher numbers of nodes that have at present transmit the received beacon. So, if that beacon is received higher than 4 times, at that point it is better to drop that beacon before the delay clock for that beacon got expired. In FBBPA, the performance becomes slow to some extent at high traffic areas. As the accidental beacons are send firstly on the basis of their respective priorities, therefore, a few advertisement packets are getting lost due to their limited lifetime.

1.8 Problem Statement

As part of improving the alert dissemination process, various schemes are represented to improve beacon dissemination but repeated beacons in network leads to severe performance degradations. In Fuzzy-based beaconless Probabilistic Broadcasting Algorithm (FBBPA) [38], Performance degrades slightly at higher densities, and packets get lost due to their limited lifetime in the network. The retransmission of a beacon by various vehicles nearby leads to a severe performance-deprived scenario. In a dense scenario, due to high packet exchange, will lead to redundant rebroadcasts, contention, and collision. This problem will ultimately reduce the efficiency of the network.

1.9 Research Questions

The prominent questions regarding emergency message dissemination handling procedure and related works, is as follows:

- How can communication cost be reduced?
- How many types of parameters are included to determine the priority of messages that are to be shared between vehicles?
- How the impact of buffer capacity is scaled to reduce delays?

1.10 Aim of the Research

This research seeks to promote the concept of Intelligent Transportation System (ITS) in which the aim of research is to draw a better approach that will enable efficient and effective communication between vehicles in emergency situations.

1.11 Research Objectives

Some of the related research objectives followed by research questions are as followed:

- To reduce communication cost problem by controlling beacons redundancy.
- To keep sufficient set of parameters to determine the priority of messages those are to be shared between vehicles.
- Reduced delay by implementing fuzzy logic with modified rebroadcast probability.

1.12 Thesis Organization

Thesis is prepared according; Chapter 2 set out a literature review along with contextual knowledge in detail to talk about the positive points and limitations of existing schemes. A comprehensive contrast of existing techniques is in view of a table. Chapter 3 contributes to a methodology while chapter 4 presents protocol information, chapter 5 highlights the results and chapter 6 concludes summary and future work.

CHAPTER 2

LITERATURE REVIEW

2.1 Overview

In this segment, background of internet of vehicles (IOV) is discussed with main problems in context of message dissemination among vehicles. Then, previous studies in order to manage by the transmission storm issue with various successful schemes are described, which are characterized into two extensive groups. Then, differences between both categories along with respective schemes are converse about. Following this, a comparison of past techniques is examined with some merits and demerits. Research gaps are highlighted as well. Finally, conclusion of whole chapter is concluded in couple of lines.

2.2 Internet of Vehicles (IoV)

The idea behind a wide range network framework includes available heterogeneous networks, because wide range network strongly experienced many circumstances due to increase in topology structure such as moving vehicles on road, smart phones and other enabled device sensors in our daily life. A combination of terms involved in a wide range of network is a future internet termed as Internet of Things (IoT). Intelligent interfaces are utilized smoothly and continuously with integration of heterogeneous networks in IoT. The efficient use of data heterogeneous devices is one of the major aims of IoT. IoT has proven most of capability to send and receive data via a network without requiring human interaction at any level.Over the past few years, an unsophisticated interrelated concept came in the frame, which is termed as Internet of Vehicles (IoV). IoV is transfiguring the transportation system into a globally diverse network. As presented in Figure 2.1, the IoV is a combination of 3 networks: inter-vehicle network, an intra-vehicle network, and the vehicular mobile Internet [32]. Inter and Intra vehicle communications provide detail on the current state of the art in wireless communication technology. Intra-vehicle systems monitor the vehicle's internal performance through On-Board Units (OBUs). Vehicle to Human (V2H), Vehicle to Infrastructure (V2I) and Vehicle to Road V2R comes under its umbrella. V2H supports awareness for Vulnerable Road Users (VRUs) such as pedestrians and cyclists. V2I supports the wireless exchange of information between a vehicle and infrastructure. V2R supports the wireless exchange of information between vehicle and road side units. Vehicular mobile internet involves Vehicle to Cloud communication that allows the vehicle to access additional information from the internet through application program interfaces (APIs). Inter-vehicular supports V2V communication that is communication among vehicles by using On-Borad unit without any need to RSUs.

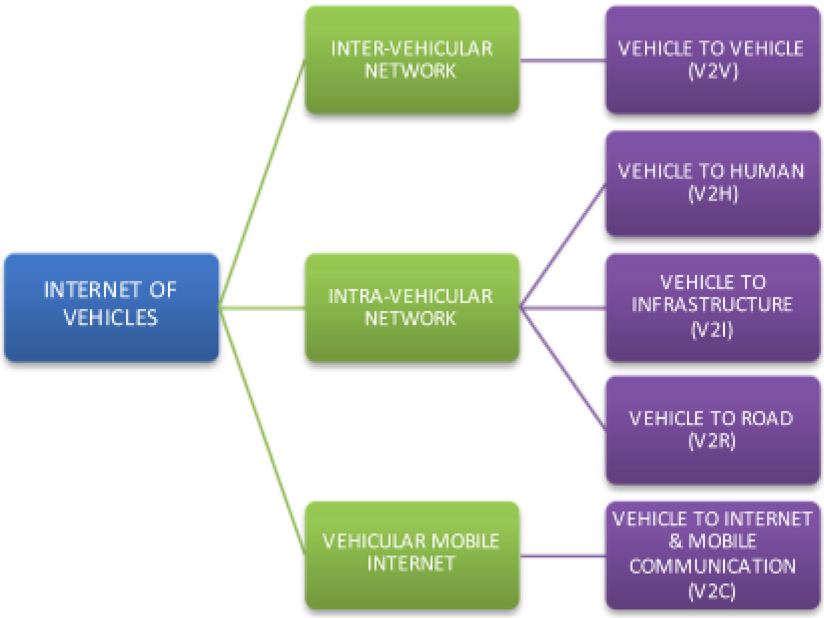

Figure 2.1 Components of IoV

The Internet of Things (IoV) technology likewise includes the incorporation of Artificial Intelligence (AI) for integration of administration delivery and activities, influencing Quality of Service (QoS) and assurance management, accessibility, while allowing more agility, versatility, and faster customization [5]. Nonetheless, the Internet of Things is considered as the significant component of a Smart City concept and has plenty of opportunities for enabling intelligent transportation systems. However, a variety of factors including network efficiency, cost and energy efficiency, standardization, big data handling, and privacy and security still have to be addressed to make the Internet of Things practical.

Nevertheless, extensive data analyses must be required to determine the factors that influence and affect IoV, and repeatedly conducting experiments and simulations to test the data, and this analyzed this data to provide sustainable and reliable information to other dependent sources. The simulations and experiments conducted by many more need arduous improvement and advancement. The prime objective of IoV is the effective and efficient utilization of travelling time. On the basis of smart transportation, it is a developing idea in field of modern transportation field to magnify the present proficiency of vehicular network by incorporating by the Internet of Things (IoT) [7], [33].

Vehicular Ad-hoc network (VANET) supports digital communication between groups of moving vehicles that are connected wirelessly such as vehicle to vehicle (V2V) with vehicle to infrastructure (V2I) communication network system, to indorse the image of Intelligent Transport System (ITS). The foremost far-reaching measures aimed at vehicular network are DSRC or WAVE that is depend on the IEEE 802.11p protocols. Vehicular Ad-hoc network (VANET) architecture comprises of three main constituents: an On Board Unit (OBU), an Application Unit (AU), and a Roadside Unit (RSU) [34]. An on-board unit (OBU) is piece of hardware that is installed in every vehicle. OBUs are typically mounted on vehicles to exchange information with RSUs or with other OBUs. An AU is a vehicle-mounted device used with the application provided by the provider to communicate with the OBU. Roadside Units (RSUs) are typically installed on the road side or in specific locations such as near intersections and parking lots. In addition to provide the user with safety information, the device is connected to the Internet and therefore, can be used to prevent accidents. Only an authenticated user may access the information. There are a lot of services offered by VANET, but the most important of all is the road safety services to reduce road accidents by exchanging data over the Internet [35].

It is aim of ITS is to ensure road security and traffic effectiveness while offering other favorable facilities. Various researches have been supervised that era to progress the traffic safety and ease services by strengthen the modern Transportation System [2]. ITS supply consistent choices for people and provide security to both drivers and passengers. A huge number of traffic based data is nowadays present that can switch to a noteworthy progress of ITS by revolving around a data-based modern transport system. VANETs is now convert to very valuable and famous because of its enormous applications exactly for safety goals [36].

Traffic accidents cause thousands of people die each year, 57% of that can be reduced if drivers were provided by a cautionary alarm mostly up to some seconds before an accident [1]. With the purpose of dropping vehicles accidents, Smart Transportation Systems services including emergency based beacon interaction protocols, have been established to significantly overcome the postponement it takes emergency bacons to spread [37]. Important to the provision of security and entertainment services is the accessibility of procedure to efficiently distribute information between vehicles based on broadcast protocols. In some cases, a disseminated message flow can originate from either an RSU, served from a server, or from an onboard unit, confined under a vehicle that might consists of suitable evidence of attention to many other users [29]. Message broadcasting on vehicular network is a general practice to send information and assets between vehicles by communication through V2V, V2I, and V2X. Though, because to the vibrant mode of VANET, dissemination of beacons may switch to some trials [36]. The advent of emerging technology has led to the suggestion that three elementary data broadcast schemes can be utilized by the background of VANET, named as unicast, multicast, and transmission, and transmission, whose usage is depending upon application necessities [38]. However, dissemination is better than a modest unicast procedure. Frequent dissemination approaches have been planned for VANET in literature, with flooding being the most conventional method that shows excellent reachability. In flooding, when the nodes gets a beacon directly, it is retransmitted through network. Despite this, in a thick traffic situation, a huge number of data beacons swapping will outcome in duplicate rebroadcasts, contentions, and then collisions due to a limited number of available wireless resources [39]. Cooperatively, this condition is named as “broadcast storm problem,” wherever the nonappearance of RTS/CTS beacons and crash acknowledgement will generate an endless loss of data packets.

One of main problem is the transmission storm difficult. Due to this issue, same messages are broadcast again and again, which slows communication and degrading the system. There are instances when some nodes fail to receive the broadcasted messages since then did not become under the communication kind or station. It is important as consider these problems in mind while setting up a message dissemination mechanism for VANET [36] [40].

2.2.1 Timely Distribution of safety beacons

The appropriate distribution of safety beacons is highest priority in vehicular network. Because of the conflict in the system, the beacons experience intervals in broadcast. Severe situations for the nearby nodes arise, if the timely transfer of safety beacons experience delays. The likelihood of broadcast interval surges as the network dimension rises.

2.2.2 Network Congestion

The information is spread by broadcasting the messages across throughout network. Sometimes, because of the hidden node or due to dissemination storm issues, the one beacon is transmitted many times. Therefore, the frequent broadcast of a beacon leads to the congestion. In network Congestion in VANETs considerably impact the execution of services which are penetrating to delays.

2.2.3 Delayed emergency message

A delayed message may cause a terrible traffic accident for real-time safety related applications. Thus, the latency of the emergency message should be reduced. However, in urban VANETs, multi-hop emergency message transmissions are crucial due to the limited range of wireless communication range, and quickly selecting a remote forwarding node to relay emergency messages is a non-trivial task.

2.2.4 Uncontrolled rebroadcast mechanism

Even though neighboring nodes receive warning information by one broadcast message, an uncontrolled rebroadcast mechanism typically pilots to the broadcast storm problem, which causes: severe message redundancy, medium contention, and packet collisions. Thus, significantly wastes the limited channel resources for VANETs significantly.

2.2.5 Message reliability

Message reliability is another challenging issue, as the loss of an emergency message leads to terrible fatality. Nonetheless, in urban VANETs without Point Coordinators (PCs) to control vehicles media access, distributed media access is certainly adopted at the Medium Access Control (MAC) layer.

2.3 Reported broadcast mitigation schemes

Generally, the possibility for vehicle driver to react is higher when quicker the alert beacons are established by the threatened nodes. So, it is vital to attain a huge distribution rate and little latency in sending alert beacons. Therefore, alert beacons might not be properly sent appropriately at a timely manner because of data crashes and the unpredictability of the wireless channel in dense traffic situations [13]. To manage by the transmission storm issue, scientists introduced various suppression schemes. Few of them considered as latest schemes are divided as: beacon-less strategies as opposed to beacon-based approaches. beaconless approach depends on immediate information on vehicles position at most. Whereas the beacon-oriented approach utilizes its long time period knowledge and it is kept via exchange of beacon packets [41]. An important component includes usage of BSM (occasionally named as “hello” beacons).

Broadcasting conventions utilizing beacons suppose that nodes are learnt by timely delivery of beacon messages of the significant location of its nearby (as an example, the position and velocity of nearby node). This important data is likewise utilized by a vehicle network to take a decision either or not to send a new message it got, while decide the directed destiny nodes. Beacon-less conventions are primarily depended at the service of independent reason. Choices as to either or not to transmit a beacon are under taken at the arrival of all latest beacons, primarily depend upon exclusively on the fixed procedure judgement and on regulator evidence which is controlled with the beacon itself [29]. In view of the importance of VANETs, numerous articles in the literature containing many works that illustrate techniques for reducing Emergency Message (EM) dissemination delay and along with a method for handling the broadcast storm problem in vehicular networks.

In Distributed Priority-Based Rebroadcasting Protocol (DHBP) [42], this technique generates fewer rebroadcasts in order to optimize reachability and rebroadcast efficiency. It saves more rebroadcast than using simple flooding technique and other related algorithms for rebroadcasting. It evaluates the adaptive approach to data dissemination by controlling collision of packets and contention occurred in network promoting the aim to increase reachability and decrease the average delay. This approach considered environmental factors variety of dissemination occurred and interval to the event location, outperforms on reachability, number of rebroadcasts and delay in congested areas. Message sharing is evaluated on function names as decision-making function (DMF) which considers two parameters including interval between the incident and receiver node and the number of accepted messages from source. Nodes dynamically make decisions without using ‘’hello’’ messages. The DMF is calculated according to Equation 1.

$$DMF = \begin{cases} Pr\,V\,i^{(t)} & c = 1 \& d_i < D \\ Pr\,V\,i^{(t)} * \left(1 - \frac{d_i}{D}\right) * \left(1 - \frac{c}{C}\right) & 2 \leq c \leq C \& d_i < D \\ 0 & c > C \& d_i > D \end{cases} \quad (1)$$

In calculation, di is the interval between the receiver side vehicle and the location of incident where c is the used as counter that counts the accepted messages by receiver from source as number during the transmission. D and C are threshold values for interval between receiver and source and the number of counts for accepted messages by setting their values D=600m and C=6. Simulation scenario of vehicle is considered 800*800m2, by assuming vehicles exceeding than the threshold value fixed by defined interval and counter are not considered in message transmission. Adjusting counter C=6 means that only some of the rebroadcast messages are kept save in infrequent network. Making time to zero by decreasing the priority value assigned at available time t PrVi(t), which means that management has overcome the critical situation. When t≥T, the security authorities adjust the initial value of Pr0 depending upon the incident severity as given in Equation 2.

$$P_{rv_i}{}^{(t)} = \begin{cases} P_{r0}.\,(1 - tanh(\dfrac{t - t_0}{0.5T})) & t_0 \leq t < T \\ 0 & t \geq T \end{cases} \qquad (2)$$

Therefore, when priority of vehicle becomes zero, the interval between the incident location exceeds the threshold value and the counter of accepted rebroadcasts packets exceed the threshold value, vehicle ultimately stops the rebroadcasting safety messages about the situation. Receiving node includes incident record of the time of occurrence of a particular event t0, the incident location (X0, Y0), an initial priority Pr0 and the time required by the security authorities to mitigate the critical situation. These parameters are attached with the header of message. The message having highest priority is rebroadcasted and other messages with average or least priorities are queued or discarded. The receiver node should react appropriately according to the parameters defined in a message.

In DAPIF [43], existing nearby concentration is considered while beacon is got according to forwarding probability and probability is set based on the time distance from sender. For estimating near traffic, native thickness estimate technique is planned deprived of maintaining information in nearby table. Instead, different regulators are make used to prevent excessive dissemination by defining defer timer and retry timers. Content-Centric Network (CCN) models have newly emerged as an appropriate resolution in order to eliminate the need for maintaining end to end connection in VANETs. In DAPIF [43], the forwarding probability of a node is inversely proportional to the unit of neighboring vehicles. There is need to share geo location of vehicles with neighbors, no additional parameters are added in CCN model. This protocol achieves better reachability and reduces the network load.

Reliable broadcast mechanism (RBM) [44] uses implicit acknowledgment technique to determine whether the safety data is disseminated to various nodes or not. In urban roads, safety services regarding VANET are consider important. In this mechanism, network assets and transmission storm issues are minimized by taking the retransmission beacon of the subsequent forwarder by means of implied acknowledgement. There are three parameters I-e forecast space, density and comparative velocity that considered to be included for prioritized forwarders for rebroadcasting. For start/stop the back off timer, various methods are described to determine position of vehicle near intersection area. The proposed scheme estimates the obstacles. In the actual urban scenario near the intersection such as buildings. The vehicle that is closest to the center of intersection area is considered for broadcasting the message to other vehicles. If there is no vehicle is no vehicle center to the intersection point, then the vehicle that arrives first is considered for broadcasting emergency messages to all the roads adjacent to the intersection point. When some of the vehicles have emergency messages to broadcast, they forward the message sto different directions using multihops to notify all the vehicles in the specific area. Neighbors' position and velocity is maitianed in a table to predict the latest position. Vehicle of intersection abandons broadcast rebroadcast when it receives implicit ACK from all directions linked to intersection area during a certain amount of waiting time, else rebroadcast until its life time expires. For this regard, rebroadcast waiting time (RWT) is calculated and its value is updated in the Rebroadcast Waiting Timer field of schedule table as given in Equation.3. Where WTmax is the maximum waiting time and Tpd is the maximum propgation delay of the broadcasted message. This approach relies on reducing message distribution delays in terms of reliability.

$$RWT = WT * pdmax \qquad (3)$$

In [45], Message delay and reliable communication are the significant factors in case of emergency-based communication. This approach broadcast emergency messages from source end to defined target efficiently and reliably. It includes both message delivery time derivation model and bi-directional evaluation model for moving vehicles. This protocol selects optimal intermediates and reduced complexities in order to deliver message in less time. The sending node sends requirements to the neighbor vehicles. Receive vehicle location is confirmed by make use of vector based cataloguing classic and correctly identified node sends message to requestor node. Optimal intermediate is selected on the behalf of least delay in message delivery. EE-FMDRP [45] is comprises of five phases: adaptive beaconing (AB) initialization, vector-angle oriented classification model, vehicle direction (VD) based authorization, message delivery time (MDT) based confirmation and energy efficient framework. After the approval from these five phases, the delivery time for message dissemination is estimated for providing confirmation. There is a confirmation list, having number of vehicles considered for selecting optimal intermediate. This proposed model uses Road Side Units (RSU) upon receiving emergency messages from VANET. Optimal intermediates are connected to frame a route used for forwarding the emergency messages. This protocol achieves minimum transmission delay and energy consumption with maximum throughput.

Fuzzy-based beaconless probabilistic broadcasting [38] notifies nodes around an occasion in fewer dissemination. This is a receiver-based transmission scheme wherever the forwarding likelihood of a beacon at vehicle container is determined and depend at various factors including space, angular location, stirring velocity and container data delay. There is a mechanism able to be make use as resultant probability used for broadcast rescheduling. This approach goals to provide huge reachability while having low traffic mobbing by controlling storm problem. It deals with reducing the delay of data packets that are used for different purpose such as providing emergency alert and advertising applications. (FBBPA) is planned in order inform nodes regarding any incident in low dissemination. The effort intentions to provide huge access while low traffic mobbing in lowest time in case of emergency scenarios and also for marketing services. The suggested FBBPA compacts to beacons helping various determinations so the alert beacons broadcast while minimum service interval. The idea of fuzzy logic is used to discovery the retransmission likelihood, while space, angle based direction, drive and container weight delay are provide as an input to the fuzzy model. In this research, distance, angle direction, drive and container of vehicle load at receiver end are full into deliberation.

The road accidents are reduced using a protocol proposed by considering DP-EMB [46] depend on the location for transmitting emergency beacons in VANETs that aids to prevent unimportant retransmission of emergency beacons and disperse accurate warning messages to surrounding vehicles to avoid the effective zone in case of some accident encountered to a vehicle. These types of Distributed Position-Based Protocol are could be used on highways as well as in urban places, as they have power to broadcast messages in surrounding areas with small postponement and huge distribution dormancy with no extra re-transmissions for the accuracy of emergency message broadcasts.

The DV-CAST [47] which is consistent, proficient and accessible is considered to tackle disseminated beacons under Vehicular Ad-Hoc Network. This gets data by GPS and is perfectly used on various many traffic conditions: high or low traffic systems. The protocol is best within one-hop nearest vehicles and powerfully works in various traffic circumstances by developing routing convention that able to look after for Transmission Storm issue as well as the Detached Network issue. It provides ingredients like Perceiving the nearest, transmission conquest and supply-carryforward appliance. It benefits within reliability, efficiency, robustness under strong traffic situations but face problems in certain design parameters and every parameter required properly active to deal best exaction by through GPS correctness that shouldn't unsuccessful.

Trinary Partitioned Black-Burst-Based Broad cast Protocol (3P3B) [48] presented a many-hop beacon transmission technique for time-based alarming facilities in VANETs. The procedure presented in this technique contains two main procedures. As part of primary method, Ems are provided high importance in communication channels for time-based broadcasting when associated to further beacons, utilizing a context known as mini dispersed inter edge (DIFS) present on the MAC layer. In the other portion of procedure, the interaction range is divided into minor subdivisions by emerging a trinary separating technique. With this approach, the initiator vehicle that is much far from communication sort will be able for transmitting EM quickly, thus increasing the rapidity of beacon broadcasting, which in turn reduce the number of hops to the target. Additionally, the proposed protocol makes the contention period stable, it pointedly decreases the jitter time in the conflict space in any case of the traffic density.

In [49], nodes are categorized according to their track, speed, and relation site. In the common interest for cluster formation is determined by transmitting the beacon packets periodically. Emergency messages are transmitted by using cluster or nodes that have improved location and track; precisely, vehicles coming from opposed path are chosen. However, high mobility in vehicular networks may cause frequent changes in network topology, which makes the network unstable. Ultimately, emergency messages fail to reach the target vehicles. Therefore, vehicles are dynamically clustered to mitigate the broadcast storm problem, and a position-based technique is proposed to overcome the communication delays, propagates the timely dissemination of emergency messages.

In Simple and effective adoptable data distribution scheme (SEAD) [50], a beaconless technique for compactness consciousness is proposed. The nodes indirectly learnt regarding to their nearby concentration with the accessible "redundancy ratio". The SEAD algorithm incorporate postponement and likelihood broadcasting, where promoting likelihood is calculated by distance, compactness and broadcast track.

In Volunteer's dilemma game for VANET broadcast (VDGVB) [51], the timer value of a relay node, depends on the previous transmission, forwarding probability and density of nearby nodes. It is a receiver-based technique where the attitude of possible forwarders be determined by on game theory. The chosen forwarder nodes try to utilize of fuzzy logic to control the scope of contention window depends at preceding broadcast, accelerating possibility and close compactness. Using fuzzy logic, the chosen forwarder vehicle determines volume of the contention window based on prior transmissions, transmitting probabilities, and close compactness. A player is a vehicle that receives a broadcast message in this game. It is crucial to expect that at least one player will pay a cost and will volunteer to rebroadcast the message, since this would benefit all. By combining fuzzy logic techniques with information from the network layer about the probability and density of local transmissions, the contention window size can be adjusted at the MAC layer. Fuzzy logic techniques and data from the network layer about local density and probability of transmission will be used to determine the contention window size at the MAC layer.

In Multi-hop broadcast mechanism for emergency messages dissemination (MBM-EMD) [26], to prevent broadcast storm, in one-hop broadcast, permits broadcast messages for vehicles in a candidate set that are obtained by designed strategy. consists of two sub parts, in first part, selection of optimal relays is based on vehicles' density, motion, direction and channel quality by including nearby vehicles to reach till destination; in second part, broadcasting of messages identified optimal relay and initialize a rebroadcast on next best available relay. In selecting optimal relays, not only vehicle density and relative vehicle movement are considered, but also by signal fading, channel contention, broadcast interference, and packet queuing delays. To determine next forwarders, all these parameters are grouped into a new metric, ETGPH (expected transmission gain per hop).

In STNC [52], time slots are carved up for transmission to improve delay by proposing a data dissemination approach from a scheduling perspective. Each vehicle should update the RSU periodically with its velocity and position, to capture the real-time changing topology. It consists of three phases, relay selection phase, relay transmission phase and feedback phase. STNC [52] designed a practical relay selection strategy based on the knowledge of velocity, position, and decoding ranks. As compared to a sparse network, STNC [52] nodes in a dense network can be selected more appropriate for data relaying.

2.4 Comparison of Reported broadcast mitigation schemes

In former section, present schemes were deliberated on basis of emergency dissemination mechanism. Emergency message dissemination process among vehicles is characterized into two sub categories. These two sub categories are beacon oriented and beaconless, preferred on basis of real time scenarios of traffic. Protocols that are related are discussed as in scenario; the sub category will be implemented. In this part, a precise summary of past schemes is described having basic idea, procedure with strengths and weaknesses. Summary of previous studied schemes related to emergency message dissemination is shown in Table 2.1.

Table 2.1: Summary of schemes

Scheme	**Basic Idea**	**Mechanism**	**Advantages**	**Limitations**
DHBP [42]	• To overcome Broadcast storm for accident packets	• based on the distance among sending and receiving node.	• It decreases average delay. • more suitable for applications that can afford delay	•Needs to further optimize the protocol

DAPIF [43]	• To cope Transmission storm issue for contented based vehicles network	• surrounding density, time-dependent space among sender and receiver. •Waiting time is arbitrarily assumed	• no need for vehicles to get aware of Neighbor's location	• Required to add RSU to create networks chunks • Lack of proper data from available nodes
RBM [44]	• Network resource consumption, Broadcast overhead	•Effective communication distance	• protect assets and controls the transmission storm issue • concept of implicit acknowledgement is used	• Not considered the mode of selection and problem in resource allocation in V2X networks affects the throughput
EE-FMDRP [45]	• Reduce message distribution delay, minimum overhead	• Distance, direction, message delivery time	• Minimum transmission delay, maximum throughput and minimum energy consumption	• Security issues on message broadcast-ting
FBBPA [38]	• To overcome broadcast storm problem and resource consumption issue	• based on distance among the sending and receiving, node angle direction ,movement buffer load constraints	• It notifies nodes as an occasion in low dissemination	• Advertisement beacons facades additional delay • Unwanted duplication leads to congestion • Low performance

(DP-EMB) [46]	• prevent extra retransmission of EM	• This scheme is completely distributed. • received messages schedule each vehicle	• Lessens additional re-broadcasting preventing the collision of EM transmission.	• Low performance
DV-CAST [47]	• To handle messages disseminated in a Vehicles Network to devise a routing protocol	• Usages info by GPS and works on roads in several traffic situations	• Consistent, effective, strong beside severe traffic circumstances and strong to network interruptions	• Low accurateness
3P3B [48]	• To rise the speed of beacons broadcasting by reducing the amount of hops	• Small dispersed interface space at MAC stage gives high priority to Ems in communication channel	• Upsurge the speed of beacons broadcasting by reducing the number of hops to the target	• Extra delay occurs in it.
EMDS [49]	• Broadcast storm	• Cluster-based	• Reduces delays in communication, resultant in timely dissemination	• poor in efficient transmission between speedy vehicles
SEAD [50]	• Broadcast storm	• Distance, density and message propagation direction	• integrates delay	• connectivity problem between communicating vehicles
VDGVB [51]	• Broadcast storm, collision	• Delay-based	• high reachability highway and urban environments	• lower reachability performance in sparse networks high bandwidth consumption

MBM-EMD[26]	• To overcome congestion, delay and bandwidth	• Identifies relay towards destination, rebroadcasting based on optimal relays, involve channel quality, direction and density and motion	• Improvement in packet delivery ratio, availability of alternate short paths.	• Resource consumption, communication up for rebroadcasting
STNC [52]	• avoid collision	• Perform scheduling and made transmission frames	• To safely disseminate messages • Avoid collision	• Lack of interaction • Performance declines in sparse environment

DHBP [35] and EE-FMDRP [26] technique provides reliability and reduces delay that is an important factor in intelligent transport system, reduces energy consumption and controls collision that is much important element for gaining best services from ITS, both techniques are useful in case of delay sensitive scenario, but DHBP [42] requires further focus in order to utilize properly and keep a keen eye on environmental factors that may disturb its utility. DAPIF [43] can work well even if not aware of its neighbors position but this scheme currently do not involve Road side till now if RSU added it can easily retrieve data from network nodes and enhances efficiency however it will make this scheme costly to implement, RBM [44] and DV-CAST [28] are ideal during traffic condition because they can resolve collision storm problem and provide best service and also resolve network congestion issues. RBM [37] is an ideal technique for effective communication and blamed resource allocation also keeps broadcast storm too low, in case of V2X communication further research is needed. EE-FMDRP [45] provides minimum energy consumption at maximum achieved through put but it has not much strong and sufficient security for message broadcast that is weak point of this technique.

DAPIF [24] scheme do not need to pay attention towards its neighboring vehicles they focus on their own mechanism. (DP-EMB) [27] Eliminates the need of unnecessary transmission and avoid storm of data collusion that can cause emergency messages to delay.

3P3B [29] increases the speed of message transmission by reducing number of hops and make sure to decrease jitter by making the contention window constant. In case of limitations DHBP [23] needs more protocol to enhance performance if this scheme. RBM [25] and FBBPA [13] did not consider resource allocation mode that make it is, as low performance scheme. FBBPA [13] and 3P3B [29] faces some extra delay. EMDS [49]helps in timely transmission of beacons which helps vehicles to take important decision on time but when vehicles are in high speed effective communication is bit disturbed. SEAD [50] is another technique that ensures low delay however like EMDS [49] this scheme also suffers from communication during high speed. VDGVB [51] is not fruitful in case of sparse environment. MBM-EMD[26] has high communication overhead that makes this scheme costly to implement and use while it sends packet with high probability of successful packet delivery ratio and try to find short paths for better and strong communication. STNC [52] also shares same limitation like VDGVB [51] of not much efficient in case of sparse environment.

Each scheme has its own pros and cons, keeping in mind the scenarios and priorities a scheme which is considered more relevant can be selected and implemented. It is suggested that because of high reliable delivery probability, DHBP [42] is considered as better approach to implement since it has decrease in average service delay, but there is need to consider environmental factors. SEAD [50] integrates delay issue as compared to FBBPA [28], DV-CAST [47], and 3P3B [48]. SEAD [50] has limitation regarding network connectivity among vehicles. Due to security weakness in EE-FMDRP [26] it is not recommended to use when alternative options are available. MBM-EMD [26] and STNC [52] has shown improvement in dissemination but resource consumption issue arises with least interaction among vehicles appears as limitation.

2.5 Research Gap and Directions

Adding information about nearby vehicles in the transmission range improves performance because routing range improves performance because routing decision can be made easily from sender to receiver by suing this information. Increase in density leads to overhead count which will deteriorates the throughput of network in terms of bandwidth wastage, loss of packets and make the network congested [53]. It can be observed with assumption that in range of 300m, channel can be loaded 80% when a vehicle transmits a beacons of 200 bytes for each 100ms [53]. In past literature, sender node is selected to send the beacons to receivers, but sometimes receiving node might not receive beacons successfully due to some issues i-e signal fading, obstacles in the paths and packet collision. On the other hand, beaconless approach which is receiver-oriented approach, receiver node has decision-making ability either to become participant in routing process or not. Packets is received only by vehicles in vicinity of current forwarder that's why beaconless approach is more convenient to use. Limitation occurs here is delay constraints as vehicles do not maintain neighbor table. Recent studied schemes in literature do not well scale the impact of buffer load. Monitoring and stabilizing the effect of buffer load plays vital role in reducing the delay. Here the main gap is careful handling of both types of packets. Many researches are performed to improve the process of disseminating messages, but quiet it is an open challenge. Two types of messages are communicated between vehicles i-e Accident packets and advertisement packets. Advertisement packets are given higher priorities and are delivered first, rather than scheduling advertisement packets along with accident packets, only scheduling of accidents packets are preferred [38]. Timeline defined for advertisement packets are limited and packets get lost, this leads the performance degraded at higher densities. As throughput is an important factor in vehicle communication by overcoming end-to-end delay and traffic reachability. Following are the major problem that degrades the system performance and efficiency of VANETs.

2.5.1 Broadcast storm problem

In pure flooding, after successful receiving of message from source vehicle, the receiving vehicle is responsible for retransmission of received message. Nonetheless, the broadcast productivity of flooding broadcasting scheme is very stubby. All this situation moves towards extra retransmission of same beacon, causing a delay in interaction and down the network's efficiency [36]. To effectively manage the broadcast storm problem is critical issue that cannot be refuse to take notice of or acknowledge.

2.5.2 Hidden node problem

Through the dissemination of the beacons, few of the nodes are unable to get the beacon as they are not lie in the range of network defined for communication. For creating packet broadcasting procedure reliable for VANET, it needs to take into account of these problems in mind [36].

2.5.3 Packet Collision

The safety beacons and the many hop alarming beacons both are spread on the switch medium of the dedicated range for vehicles interaction. It may move to severe intrusion among two types of beacons [23].

2.6 Summary

For the vision of smart ITS to be realized, efficient information distribution of data packets, is essential. VANETs are dynamic in nature, and disseminating messages across the network is extremely challenging. As far as challenges are concerned, the broadcast storms, hidden nodes, and packet collisions are all major problems. In an ad hoc network (VANET), a number of researches have accompanied in order develop an actual and consistent technique for broadcast emergency beacons efficiently. Still improvements are required to made properly for avoiding broadcast storm efficiently.

CHAPTER 3

METHODOLOGY

3.1 Overview

This chapter is all about methodology that is used for design and develops proposed protocol. .The Selection of area, literature study problem as well Simulators are discussed there. Main concern of this research is to efficiently send emergency message to avoid any unusual incident. We observed average service delay which is much minimum than existing schemes.

3.2 Operational Framework

Safety and traffic efficiency are the most important contributions of ITS. As ITS is an innovative term that provides safety and reduce congestion at road traffic circumstances. The Internet of Vehicle (IOV) has expanded services for mankind since many comforts have been added the pattern of life has been changed. Despite reducing road accidents fatalities and road death rate. Communication between two mobile nodes is based on single hope or multi-hope strategy. For multi-hope communication the routing protocol determines the rout from the source to the destination.

Low latency and reliable end to end data delivery are the two major characteristics for balancing efficient routing protocols. Multi-hop broadcasting in VANET is the main working chunk for promoting comfortable experience as its maintenance beacon broadcast between travelers in real-time on large scale. Though, a system occupied with equally beacons and swapping of packets give rise to broadcast storm problem that causes in-efficient utilization of available resources. Instead of maintaining 1-hop neighbor tables as suggested by forwarding decision making strategy, a receiver-oriented decision-making strategy should be followed owing to lessen collision od packets and dropping rate.

As a result of this effect, performance degrades slightly at higher densities, and packets get lost due to their limited time stamp in the network. Multiple close vehicles in the area of interest broadcasts messages which lead performance degradation. This issue gives rise to redundant rebroadcasts, contention, and collision. Although, huge literature range is contributed and most of mitigation protocols are presented timely to avoid broadcast storm problem and its impact on real time traffic scenarios, due to limitation of each presented schemes, the requirement for studying efficiency and reliability of IoV and further research in this domain.

The pictorial representation of research map is shown in Figure 3.1. It comprises of following main phases. Initially the analysis phase begins with a literature review. A literature review is considered in the context of emergency message dissemination. Different parameters like bandwidth, delay time, broadcast ratio as well as traffic reachability are noticed thoroughly. In the middle, firstly, design and development phases come. To avoid high utilization of bandwidth and beacon delay, fuzzy-based mechanism is introduced. Secondly, Data is prioritized on the basis of assigned AOI. In the third phase, performance evaluation phase comes, for checking effectiveness of proposed protocol, NS-2 is used. A combination of C++ and OTCL coding is used for evaluation. Vital parameters are considered including traffic reachability, rebroadcast ratio, and average service delay.

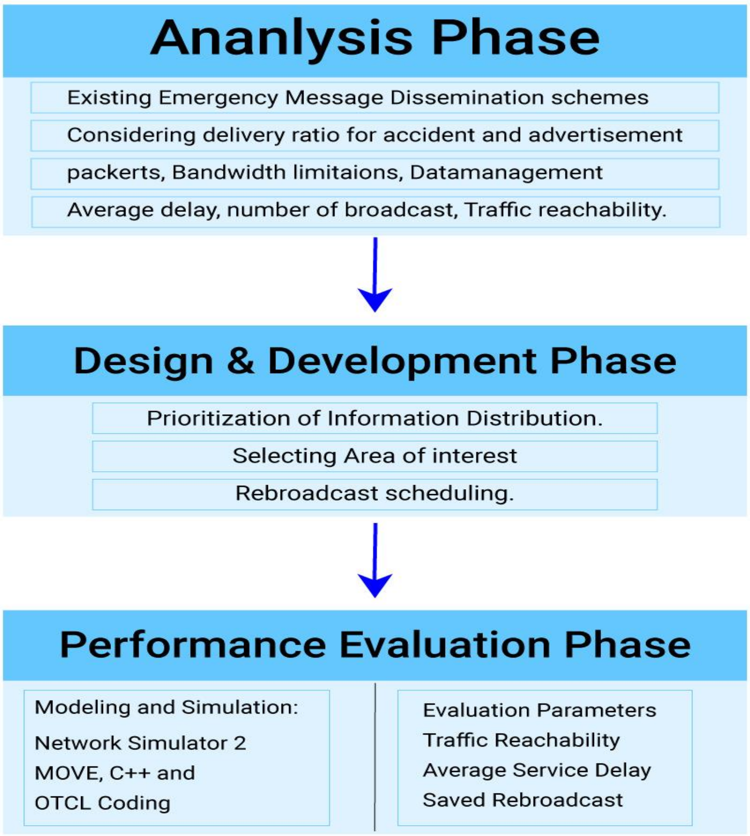

Figure 3.1: Operational Framework

3.2.1 Review of literature

To get deep understanding and Concept, about 45 research papers on beaconless approaches are studied. Survey Paper, Journal papers and Conference papers are considered for studying After this, literature on beaconless approach and analyzing bad effects, Problem is identified.

As literature is concerned, up to date and good impact factor papers are studied out and most relevant are chosen to complete literature review write-up. A detailed Comparison of beaconless approaches to transmit data is also mentioned to clarify the differences, main advantage along with limitations.

3.2.2 Problem identification

In VANETS, for transmitting packets among vehicles in a transmission region, multi_hop relaying mechanism simply named as flooding is used since density is not a constant unit. It fluctuates in a network. When the density of vehicle increases, the retransmission of same packets also increases. This increase in no of retransmission will overload the buffer of vehicle. That will consume the limited bandwidth and leads to delay. In this way flooding leads to serious packet collision name broadcast storm problem.

After studying FBBPA [38] scheme, there is a problem recognized and is plotted. Use of pure flooding mechanism in FBBPA [38] ultimately leads to packet redundancy at high rate in dense network, this would create congestion in wireless channel and results will cause collision of packets and failures in delivery of data packets. The side effects of identified problem comprises of broadcast storm which eventually downgrades the performance and also adds delay and loss of advertisement packets. This problem motivates to study the issues of this problem and provide efficient solution to eliminate it.

3.3 Proposed Solution

In existing FBBPA, the rebroadcast probability calculating parameter is not a sufficient parameter. As the received packets resides in vehicle buffer and waits for their rebroadcast until their timer expires. The counter that determines rebroadcasting priority as assigned greater in number that will cause packet redundancy. Number of times a packet receives and rebroadcast are also taken in consideration. Also, the handling of accident and advertisement packets along with respective priorities must be handle with in the life of each packet that is ready to rebroadcast so that the major issue that will cause broadcast storm problem must be handles in efficient manner. Fuzzy logic decision-making tool is utilized to evaluate rebroadcast probability for the aim of reducing broadcast storm problem by controlling duplicate messages. By getting acknowledgement only after the highest priority packet has been generated.

3.4 Selection of Simulation tool

For checking proficiency of proposed Solution Simulation method is used. The simulation for proposed algorithm is performed using network simulation along with two tools having version ns 2.35 that incorporates 8.2.11 adjustments and Nakagami broadcast framework. Initially the factors linked with movement and traffic conditions are considered and compared with existing protocols on the basis of performance. Ad-hoc network require accurate simulations of node mobility which is assumed as one of the most important parameters. A practical mobility-based model is necessary that accurately simulate VANET production in the real world. For conducting evaluation, accurate mobility is designed on a network using Mobility Model Generator for Vehicular Network (MOVE). It quickly generates practical mobility models for VANET simulation. The realistic mobility output is used by popular network simulators including NSN-2 and QualNet. For simulating, network simulator (NS 2.3) is used. The basic purpose of using the Simulator is that it provides good and flexible interface to observe emergency message dissemination and results.

A network simulator (NS) is a type of simulator used to simulate networks such as VANET and MANETs. It provides simulations for routing and multicast protocols for both wired and wireless network scenarios.

3.4.1 Evaluation Parameters

For checking proficiency of our proposed solution some existing schemes are considered under different important parameters which comprises of traffic reachability, same rebroadcast and average service delay. On the basis of these metrics, proposed protocol is analyzed and compared to existing mechanisms proposed by existing schemes in order to check the efficiency and effectiveness. In comparison along with graphs, our proposed solution with some previous schemes result showed that proposed protocol provides fat better results than existing schemes.

3.5 Summary

The whole procedure that is followed to complete research work discussed in this chapter. From literature review to results analysis, all main details are provided here. The proposed schemes preformed much better than existing schemes that shows our proposed scheme is more effective than previous ones.

CHAPTER 4

BEACONLESS- EMERGENCY MESSAGE DISSEMINATIION

4.1 Overview

In this portion proposed solution is presented to efficiently disseminate emergency message at fast delivery rate. This section includes proposed protocol explanation with its system model. For better understanding, detailed flow chart and algorithm is elaborated also. Lastly, complete chapter is summarized.

4.2 Beaconless- Emergency Message Dissemination (B-EMD)

There are many dissemination protocols have been put forward for vehicular network in which information transmission is done between nodes as per Vehicle-to-Vehicle broadcasting way. The data has to be spread either flooding or relaying. Flooding shows excellent reachability and is the most conventional network-wide broadcasting approach. The basic aim is to spread the data packets to all the nodes in a system at all by blindly flooding the beacon over the system. As a result, at flooding, when a node gets a beacon for first time, that is retransmitted in the system and discards already received data packets. Though, in a thick situation, because of the availability of restricted wireless assets, a huge number of beacons are swapped that eventually consequence in three distinct problems; duplicate rebroadcasts, congestion, and accident. Cooperatively, these problems are known as transmission storm issue, wherever the non-presence of RTS/CTS data and inaccessibility of collision acknowledgment procedure is built to an extent loss of beacons.

communicate over common wireless channel. As the duplication ratio of the beacons gets on every vehicle is, relative to the system compactness. Therefore, if the beacon is sent with higher duplication ratio, then transmission storm issue may happen else if duplication ration is less then here is probability that the beacons would not reach to all vehicles in that region. The elementary key of reducing broadcast storm issue and sending beacons along a particular delay of time is to retransmit the data packet for a constant time with wait for ACK response by clutch of receiving nodes surrounded by initiating nodes.

4.2.1 Rebroadcast probability evaluation metrics

For this purpose, angular orientation movement and buffer load delay from the receiver are taken into account.

4.2.1.1 Distance

Distance is calculated by using the current location of vehicle and the receiving vehicle. In Equation 4, $\boldsymbol{xc}$ and $\boldsymbol{yc}$ is the previous vehicle location which broadcast the packets. $\boldsymbol{xi}$ And $\boldsymbol{yi}$ is the location of current receiving vehicle.

$$D=\sqrt{(xc-xi)^2+(yc-yi)^2} \tag{4}$$

Membership function for distance can be mathematically be derived as expressed in Equation 5 and 6. Distance value is categorized into less and large value. In which value between 0 to 155m is considered as less distance and value ranges from 145m to 300m is considered as large distance.

$$\mu_{LD}(D) = \begin{cases} 1 & 0 < D < 145 \\ \frac{155-D}{10} & 145 < D < 155 \end{cases} \tag{5}$$

$$\mu_{MD}(D) = \begin{cases} \frac{D-145}{10} & 145 < D < 155 \\ 1 & 155 < D < 300 \end{cases} \quad (6)$$

Here the vehicle that comes under the area of interest (AOI) is prioritize in terms of distance from source side vehicle found at farthest range is consider more suitable for covering uncover services areas.

4.2.1.2 Angular orientation

There may be more than one neighbor intersection for a available route. Angular orientation is determined for a vehicle with respect to all neighbor intersections. If angle that is formed between x-axis and the line that connects the current vehicle to source hop is less (+-45°) then that orientation is preferred for rebroadcasting.

Membership function for angular orientation can be mathematically be derived as expressed in Equation 7 and Equation 8. Angular orientation is categorized into less and large degree value. In which angle between 0 to 50° is considered as small angle and large angle from 145° to 300° is considered as large angle. Here the least angle formed by vehicle is given priority.

$$\mu_{S\theta}(\theta) = \begin{cases} 1 & 0 < |\theta| < 40 \\ \frac{50-\theta}{10} & 40 < |\theta| < 50 \end{cases} \quad (7)$$

$$\mu_{l\theta}(\theta) = \begin{cases} \frac{\theta-40}{10} & 40 < |\theta| < 50 \\ 1 & 50 < |\theta| < 180 \end{cases} \quad (8)$$

4.2.1.3 Movement

When a vehicle received a packet, it will identify the future movement of packet by determining the current and source location. Every vehicle in the network keeps the record of source location. Movement of source location is updated after 1 second. For determining the movement of vehicle, distance of current vehicle and estimated future predicted location from neighbor intersection is used.

$$\mu_{AM}(\mathrm{M}) = \begin{cases} 1 & 0 < M < 0.9 \\ \frac{1.1-M}{0.2} & 0.9 < M < 1.1 \end{cases} \quad (9)$$

$$\mu_{TM}(\mathrm{M}) = \begin{cases} \frac{M-0.9}{10} & 0.9 < M < 1.1 \\ 1 & M > 1.1 \end{cases} \quad (10)$$

Membership function for movement can mathematically be expressed in Equation 9 and 10. Movement is categorized into two terms naming away and towards. Here movement greater than 0.9 is considered towards and less than 1.1 is considered away.

4.2.1.4 Buffer Load Delay

Buffer load is assumed to be important factor of determining delay required for forwarding packet. Queuing can cause higher end-to-end delay, especially for the packets that have high priority. Delay assigned to packets residing in buffer of vehicle will be less than 10 µs. The objective behind the evaluation of delay is to scale the effect of buffer load for the fast delivery of packet. Membership function for buffer load delay can mathematically be expressed in Equation 11, 12 and 13.

$$\text{Buffer load delay } (T) = \begin{cases} 0 & PR_0^{Received} > PR_0^{Buffer} \\ B_T^{Highest} - t_R & PR_0^{Received} > PR_0^{Buffer} \end{cases} \quad (11)$$

Where PRo received is the initial priority of the packet that is in the buffer of vehicle. PRo buffer is the priority of all packets in the buffer. BT highest is the highest of all broadcast time value for the packet that have high priority.

$$\mu_{LT}(\mathrm{T}) = \begin{cases} 1 & 0 < T < 5 \\ \frac{15-T}{10} & 5 < T < 15 \end{cases} \tag{12}$$

$$\mu_{MT}(\mathrm{T}) = \begin{cases} \frac{T-5}{10} & 15 < T < 15 \\ 1 & 15 < T < 25 \\ \frac{35-T}{10} & 25 < T < 35 \end{cases} \tag{13}$$

Buffer load delay is categorized into low, medium, and high delay. It is considered low when vale ranges between 0ms to 15ms, medium for 5ms to 35ms and high for greater than 25ms.

4.3 System Model

In proposed work, road scenario consisting several vehicles equipped with Onboard Unit, are considered. Vehicles able to communicate with other vehicles (V2V communication) for road information, tackling emergency situations and receiving other data packets. It is assumed by a vehicle that the requester and producers of data are driving via road whereas rest of the vehicles act as forwarder, their job is to forward the received packets. An illustration of system model is presented in Figure 4.1.

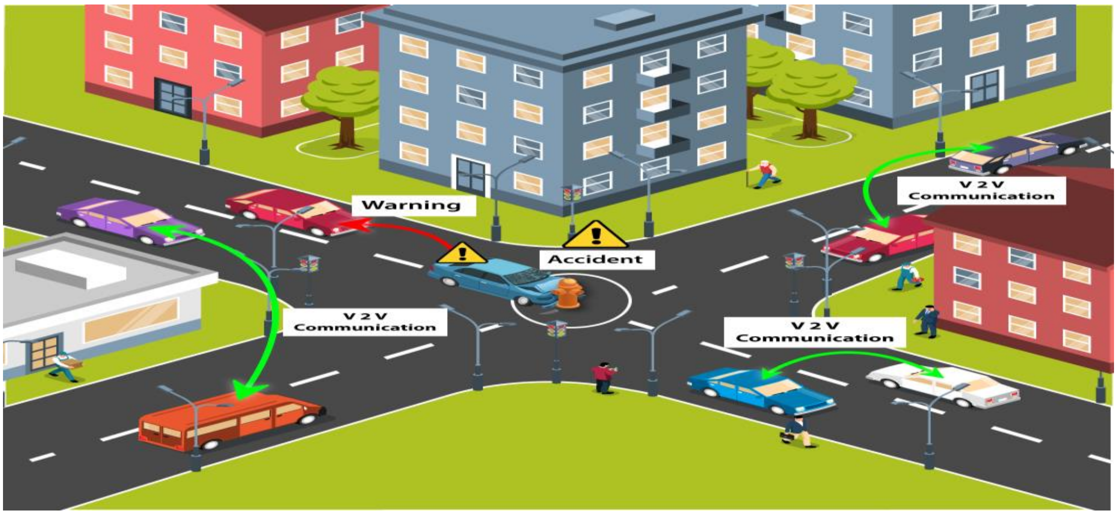

Figure 4.1: System Model

4.4 Proposed Algorithm

In step 1 to 3, A vehicle broadcast/ rebroadcast a data packet. This data packet incorporate the information in header of the packet as in figure 4.2 Information in the header of packet includes, primary preference value as per to the rigorousness of mishap , event time, Id, x coordinate, y coordinate of sender and existing vehicle (Time To Live) of beacon and area of attention border.

In step 4 and step 5, every beacon “P” got by current node (CV), space among occurrence area and current beacon getting vehicle is calculated using formula. In step 6, preference of beacon at time t is calculated using equation 1. In step 7 to step 14, At first it is checked if the calculated Distance (dsc) is less than area of interest (AOI) of packet and priority of packet PRt at that time is not equal to 0 then continue step 8, wherever at all the beacons lie, in container of current node CV, calculate the preference of all container beacons at its retransmission time through equation 1 in step 9. In step 10 to 14, check if preference of P is greater than estimate T = 0ms, otherwise move to step 13 in order to estimate T = PhBt – Phtr. Where PhBt is the greatest of transmission interval unit for beacons comprises of a huge preference.

In step 15, input value for Distance parameter is calculated using distance formula by taking distance values among former node and present node. Vehicle found farthest in range is considered more suitable for covering uncovered services. In step 16, input value for Angle direction parameter is calculated by neighbor intersection of previous and current vehicle. In step 17, input values for movement parameter is calculated. In step 18, Fuzzy logic function is called and all of the four calculated parameter values are assigned as input to a fuzzy system. Here fuzzy rules for designed system are described. The next step defines the type of inference engine and defuzzificarion method. Afterwards, accessing and turning of the system comes, where cross checking of input and output ranges for fuzzy sets are revised. Step 18 implements the fuzzy logic-based waiting time evaluation procedure. In step 19, waiting time wt and rebroadcast time of packet p is calculated using equation 4 and 5. In step 20, simple the loop that is used in step 8 to calculate the rebroadcast probability for each packet is completed. In step 21, it is checked if timer expires and rebroadcast count for packet p is < 3 then broadcast the packet otherwise discard of drop the packet.

1: **for** data beacon 'p' disseminated/ re-disseminated by the node **do**
2: Integrate/update the information in beacons
3: **end for**
4: **for** data packets 'dp' got by the node Cv **do**
5: Compute Dsc=√*dp→SVX−CV→x)2+(dp→SVY−Cv→y)2*
6: Discover dp→PRt by Equation 1,
7: **if** ((Dsc < dp→AOI) && (dp→PR_t != 0)) then
8: **for** all beacons available in node of CV **do**
9: calculate probability of p through retransmission time by Equation. 3;
10: **if** preference dp greater then
11: calculate buffer load interval (T) = 0 ms;
12: **else**
13: calculate buffer load interval (T) = ph→B_T - dp→tR;
14: **end if**
15: Distance parameter D =√*(dp→PVX−CV→x)2+(dp→PVY−Cv→Y)2;)*
16: angle direction (Θ) θ = tan− 1 (Yn − dp→Pv Y Xn − dp→Pv x) − tan− 1 (Cv Y – p→Pv Y Cv xd − p→Pv x)
17: Movement = √*(CvX−Xn)2+(CvY−Yn)2)* ÷ √*(CvX,future−Xn)2+(Cvy,future−Yn)2)*
18: Calculate the parameter values using fuzzy membership function as input (D,M,T,Θ); by using equation 4, 5,6,7
19: To compute dp→WT and dp→BT

```
        end for
         if (time expires) && (Cv→Cp< 3), then
        set flag == false in AOI
        Broadcast p;
         else if
        set flag==true
        discard p
        Broadcast p;
         end if
    end if
end for
```

Figure 4.2: Algorithm for Beaconless-Emergency Message Dissemination

To avoid message duplication, flowchart of proposed protocol is presented in Figure 4.3. At the start packet p is received. When packet is received by a vehicle, distance is calculated among occurrence site and current beacon carrying node. In the next step, priority of packet Pr(p) at that instant is calculated. If D is greater or equal to AOI and Priority (p) =0 then discard the packet and stop the process. Otherwise find the priority of packet in vehicle buffer. Check if Pr(p) of the packet is not highest, then estimate delay and if highest then estimate delay=0. After estimating delay, evaluate Distance (D1) between itself and previous vehicle, Angle direction and Movement. All the four calculated values used as input to fuzzy set. After this, fuzzy inference is processed in which fuzzy inference table is maintained and apply Min-Max method. In the next step, Defuzzification process is performed where last of minima defuzzification method is applied. Packet p is scheduled and it is checked either timer for packet p is expired or not. If not expired then again check the timer value, If yes then check is the packet receives more than 3 times with in this time or not. If yes then drop the packet p. If no then update p’s header, broadcast this packet p, and terminate this process.

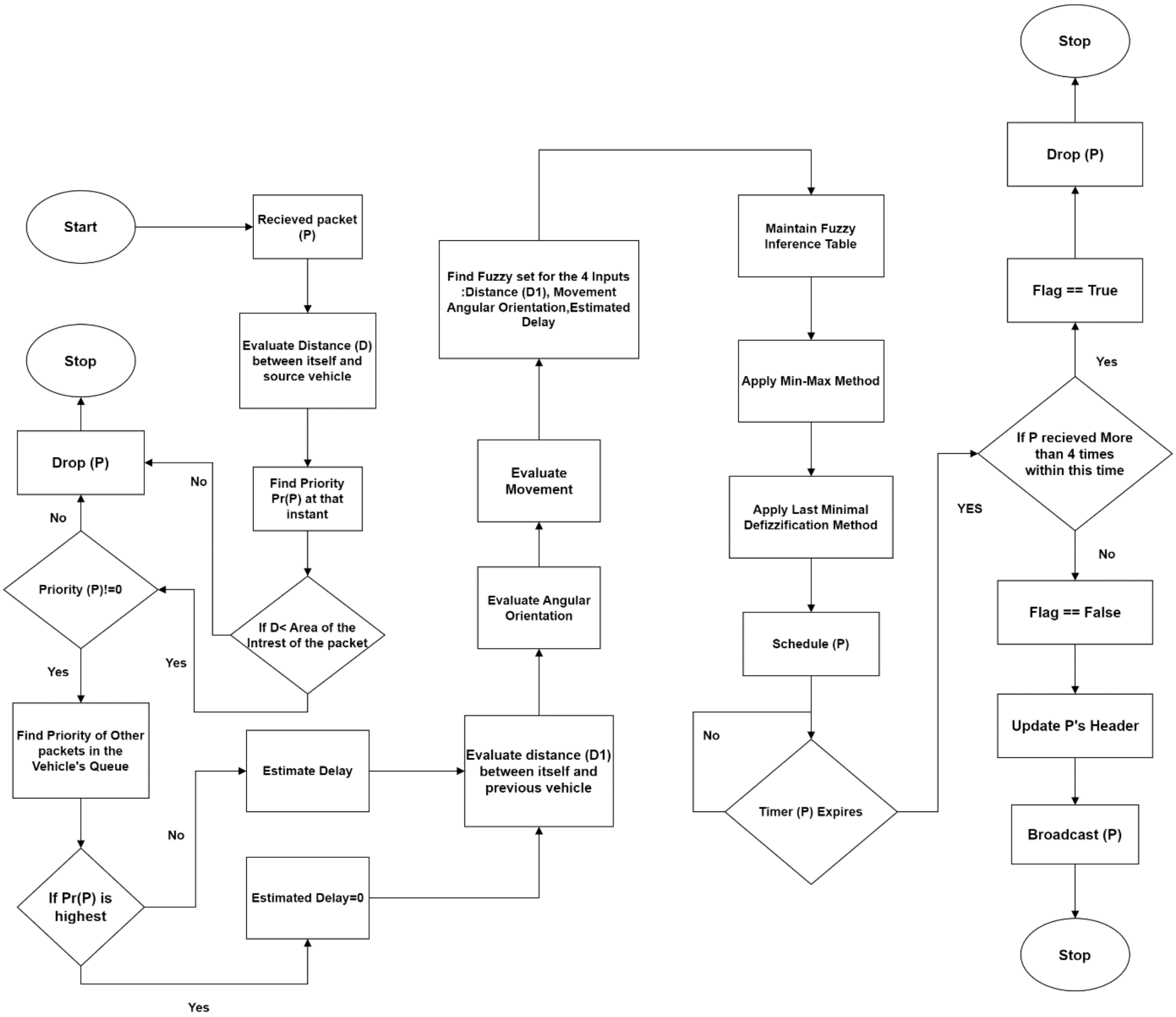

Figure 4.3: Flowchart of Emergency Messaging

4.5 Summary

This chapter contains detailed explanation of proposed scheme B-EMD. The system model designed for proposed shame is discussed with interactive figure and details to provide concrete concept of B-EMD. Finally flow chart and algorithm of our proposed work is described with detail of each step.

CHAPTER 5

RESULT AND ANALYSIS

5.1 Overview

The chapter contains a contrast of previous techniques by our proposed scheme. Analysis and results are put in place by using simulation. Evaluation is performed by considering different metrics which are considered more important. Comprehensive information on simulation software is discussed with specified parameter values.

5.2 Simulation tools and Environment

For simulating the performance of the proposed protocol B-EMD, NS tools have version ns-2.35 that integrates 802.11p modification and Nakagami broadcast framework. Accurate mobility is built by a network topology using MOVE in order to conduct the test. In essence, MOVE is consisting of two main units: the highway chart editor and the nodes measure editor. The very first unit specifies the main roles of the topology, like infrastructures, intersections, traffic lights, road side units and many more. The other part is able to adjust the node values, its directions, and speed. Furthermore, it is capable of modifying the possibility of moving and taking turns to right side and to left side and many things like that. Topology is restricted to rectangular space of 5000 length and 5000 meter width, along this seventy five junctures and one hundred and forty both-direction roads. About 10-100 nodes per lane are travelling randomly, and they are travelling at speeds range 10 -15 meters per second. Upon arrival at an intersection, the probability of vehicles is 0.5 continuing in the same direction, while the likelihood of them taking right-hand and left side tries is 0.35

extension .tr file that is imported in NS-2. Messages are distributed randomly, broadcasting one beacon at a second. Running duration for simulation is up to 500 seconds that is more than sufficient to observe the performance under different various densities with speeds. It enables the nodes to send data beacons at a rate of 6Mbps with communication range of 300m. Simulation values which are used for measuring the reliability of proposed protocol are mentioned in table 5.2.

Table 5.2: Simulation parameters with values

Simulation Parameters	**Values**
Simulator	Network simulator 2.35, MOVE
Grid in Size	5000 meter x 5000 meter
Broadcasting area	350
vehicles	20-200 vehicles per lane
Sending rate	6 (Mbps)
Data Case Size	512
Vehicles speed (m/s)	10-30 meter per second
Simulation duration (s)	500 seconds
Broadcast Founts	15
Broadcast Standard	Nakagami standard
MAC and Physical layer	IEEE 802.11p
Message Type	Accident and advertisement packets
Radius for advertisement packets	1500 meters
Radius for accident packets	1000 meters

5.3 Traffic Reachability

Information Coverage or Traffic Reachability is concerned with the emergence of an emergency at the event of road accident or car crash in the midst of bustling crowd. The protocol must ensure that the packet containing the incident's information is transmitted straight to the neighboring vehicle instantly within milliseconds so the communicated beacons covers many nodes on the road. Formula for Traffic Reachability is given in Equation 14 [38]. Here, parameters represent the set of knowledgeable and attentive nodes correspondingly.

$$(TR) = \frac{IFv}{Iv} \quad (14)$$

5.4 Saved Rebroadcast (SR)

Saved Rebroadcast is referred as ratio of every vehicle which has received the transmitted messages but has not broadcasted the emergency packet transmissions to adjacent vehicles in that specific area of interest. If few vehicles transmit the data packets successfully then those vehicles will be eliminated from the count and this way the other vehicles will have to discard the rebroadcasting process after receiving the data packet. Saved rebroadcast is calculated as **$((fR - fT)/FT)$*100** in which **Vehicular count= f_R and f_T** .Where f_R represents the number of vehicles that accepts the service messages as well f_T represents the number of vehicles that further rebroadcast the service message respectively.

5.4 Average Service delay

Average Service delay is simply the total time at which the broadcast message is being taken to transmit the beacon inside the zone of attention. The Average Service Delay is shown in Equation 15 [38].

$$\text{Average Service Delay} = \frac{\sum_{i=0}^{Iv} tr(i) - ts}{Iv} \quad (15)$$

Where I_v is the count of vehicles in interested region. t_r (i) is the time when a vehicle (i) receives a message. t_s is the time for recorded for event occurred by the emergency situation.

5.5 Effect of velocity and density variations on network's performance

The variation in the network topology is difficult to handle because it significantly affects the performance of the system. In V2V, the transmission process of data is affected by one of the factors named density. As network includes number of vehicles in its range, high number of vehicles in the network make the transmission medium congested which cause the packet collision at high rate which will ultimately decrease the throughput of vehicular network.

5.5.1 Traffic Reachability (TR) / Information performance

When in the surge of nodes, the fragmentation issue is mitigated, which leads to a development in the conversant proportion. All six protocols are compared against different densities to evaluate the traffic reachability, illustrated in Figure 5.1 and 5.2. In the primary phase it could be seen that the reachability is less at all of the occurrences. The reason is, in low density environment, a proper direction to send the packet is not available rather than all of the time. Therefore, increase in density is directly proportional to increase the possibility of nodes to interact to each other. It guarantees instance of improving the reachability. Nonetheless, traffic reachability begins to decline while the compactness boundary surpasses a specific value. Latest researches shows that while dissemination greater than a starting point value, leads to lower the packet reception rate and the issue of the transmission storms will become very severe. By this way, a huge amount of nodes tries their best to approach the station simultaneously; resulting, the beacons start colliding and twitch starting to drop. Only difference between the 6 conventions is performance based on controlled broadcast.

In most of the cases, when timer wait expires then the nodes rebroadcast the message receiver from forwarder. In AID, the regulator value is adjusted at random and inside that time based period it is checked if the arrival period among messages got within time slot is high, the vehicle resend it under assumption that the system is thin otherwise, discard that beacon. However, the vehicle is moving with huge density and while the clock value exceeds the network affected by out-of-date data and output in to incorrect rebroadcast decision making. In simple way, when a vehicle that notices small density, might be able to broadcast region because of the higher clock value after reaching a high density. DHBP provides much satisfactory results as compared to AID by allowing control over redundant rebroadcasts. In DHBP, vehicle velocity is monitored and the assessment time depends this velocity. Here, to estimate the local density, promoting possibility be determined by the number of beacons got by the nearest nodes. Besides this, redundant rebroadcasting can be measured through sending the beacons in the region of attention where preference value is never equivalent to 0 (beacons preference reduces with passage of time). Like as the DHBP, the DAPIF determines whether to rebroadcasts according to the number of neighbors. Even though the native compactness scheme accepted in DAPIF as additional precise for native compactness estimation, a development its execution has not been observed. It suffers due to three reasons, firstly the selected parameters are not effective, as all the vehicles simultaneously receives the messages in the communication range. Secondly, DAPIF keeps record of neighbor through previously received packets by maintaining an interest table. When a decision for retransferring of packet is made, the Defer clock gets prepared and the beacon is rebroadcasted when the times for clock expires, this process keeps the vehicle endures its estimate procedure and the system is chance apart from the out-of-date facts. The execution of scheme decreases when the density increases, due to response beacon.

Additionally, evaluated consequence indicates that, amongst beaconless and beacon-based strategies, the performance of beaconless strategy as AID, DHBP, DPAIF, FBBPA and proposed B-EMD is better than beacon-based schemes as RBM and EE-FMDRP. As the use of bsm generates the extra cost of data through the system, that causes channel becomes jammed. In RBM, constraints used for conveying load standards are space, relative velocity, and transportation density, these are almost common parameters that put no additional advantage over the performance. In EE-FMDPR, there are tons of further packets are put to use beforehand sending the real data packets. At initial, the initiator vehicle gets responsible for transferring a send appeal to the close vehicle. In response, when a neighbor receives this request and finds stirring near the objective site, it replies through appeal authorization to the source; otherwise, they send call_request_rejection. Therefore, 4 extra packets including beacons, appeal authorization are transmitted first before sending a single data packet to the forwarder. This leads the network get highly congested and due to limited lifetime, the real packets one or the other experience conflict or finish.

As part of the procedure, reachability is preserved in fewer transmission in the subsequent way: (i) the region of concern fluctuates depending on the sort of communication

(ii) dropping preference over period (iii) diverse weight values for nodes to reduce conflict/accident (iv) if a node receives more than one in its wait time surpasses further than the onset, the packet is fallen (v) use of beaconless technique. In all cases, reachability declines with velocity as the message amongst nodes occur at a small passé of time. Figure 5.1, signifies the readings of reachability form of percentage (%) at diverse densities and speeds for in cooperation mishap and ad packets. In contrast, reachability of the relevant schemes are effectively the equal for accident and ad packets.

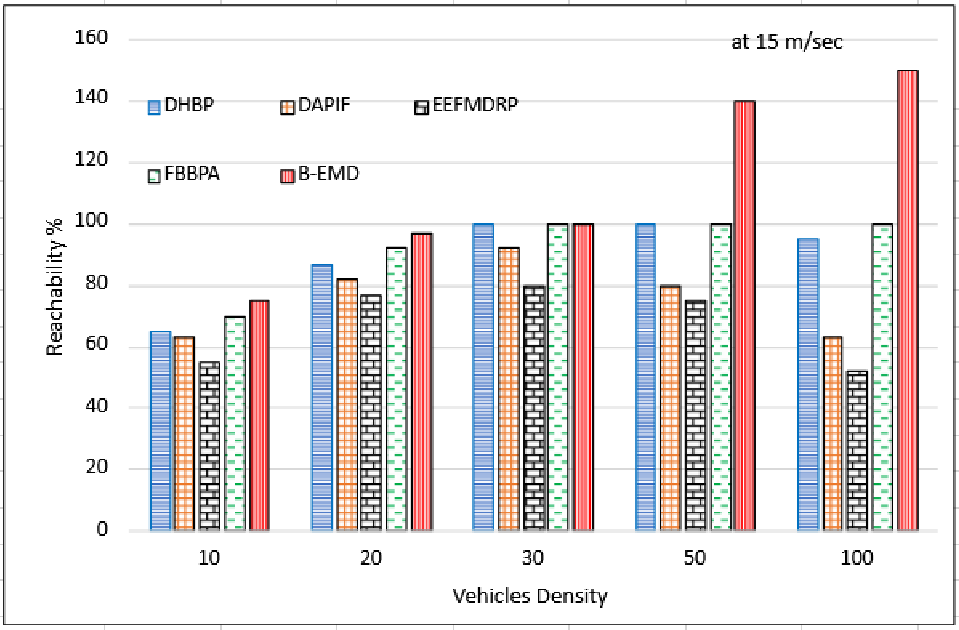

Figure 5.1: Traffic Reachability for Accident Packets

Figure 5.2 illustrates that reachability is low among the listed schemes at initial stage. Since there might be least chance of complete routing path in dense environment. Reachability increases when density increases. But when density exceeds the specific limit, there is a decline in reachability. The performance of EEFMDPR is low as compared to other protocols.

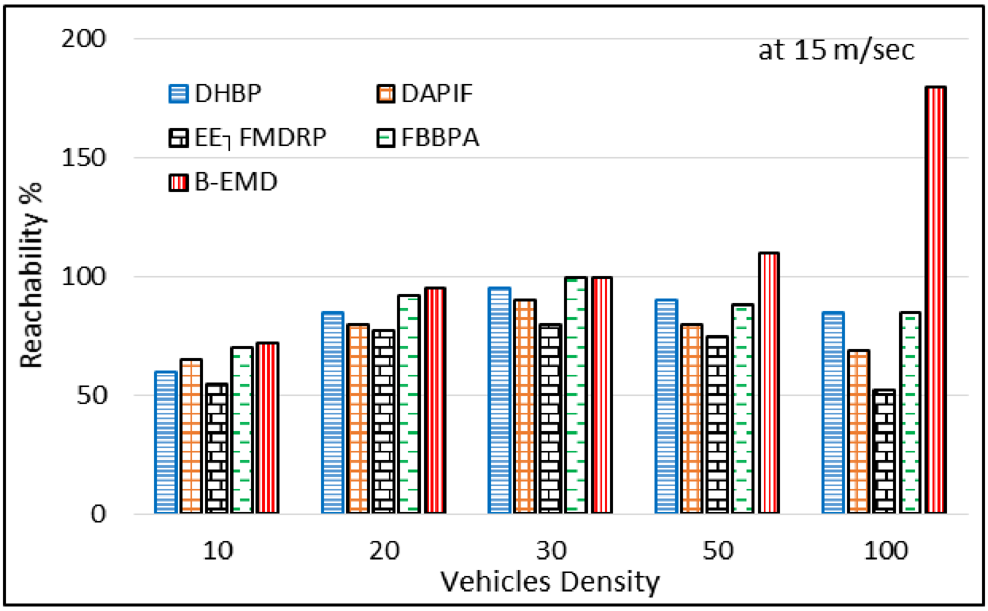

Figure 5.2: Traffic Reachability for Advertisement Packets

5.5.2 Average service delay

Figure 5.3 illustrates the delay presented by various forwarding schemes in sending two forms of messages. The digit of nodes start increasing, delay lessening at entire speeds shows that the dissemination procedure ideal additional for dense area. It occurs due to various possible forwarders are present for retransmitting the data in the system. It causes to reduce delay while the density starts rising the amount of forwarders to contact content also increases. So, afterward a firm boundary, performance gets degraded when the density increases at entire scenarios.

The dual features the influenced mediocre delay are, more higher the waiting time, the higher is the day, and queue delay as the container capacity rises by the data traffic. In DHBP, the queue delay is low and performance is better than AID because of controlled broadcast. Nonetheless, while DHBP is associated to DAPIF, in this case the DHBP is not much operational. Conferring to DAPIF, the broadcast probabilities for huge number of nodes are generally greater in fewer nodes region, which is why the set timer is (deferral timer) are quite short. Where in DHBP, the valuation period is straight proportional to the speed and direction of nodes at a greater speed in sparse regions. Therefore, growing the data of valuation period in light density areas having the speed of 10 to 15 m/sec drops the enactment of DHBP regarding delay factor. Nevertheless, as density increases, the delay difference between both protocols gradually decreases, it is not constant. This occurs, for the two reasons that: At first, the broadcast likelihood of nodes is much small in DAPIF for high velocity. Therefore, for listening the medium more frequently, vehicle initiate the retry timer as an alternative of accept period. The value of repeat period ranges between defers timer and assessment timer. Secondly, result of delay in DAPIF is greater at higher velocity due to the response data. Thus, the period needed to communicate the packet needs high time however quiet it is found better in performance. In further analysis it is demonstrates, the performance is poorer that the queuing delay due to the use of beacons. In EE-FMDRP, the distant nodes having low delivery time to spread messages is favored above others, but it still face delays since the further data have additional power upon the networks execution. It is mentioned above d, for every single data byte, 4 extra data messages are sent all over the system in EE-FMDRP. Due to this contention, these packets compete for the same channel, which adds delays.

In Figure 5.5 Comparing the protocols for saved broadcast A message is not rebroadcasted if it is received over a certain time with predefined threshold. It is assumed if a vehicle has received multiple copies of the same message, then there is chance that it’s near vehicle also have those copies. On this behalf further rebroadcast is discard. EEFMDR have slightly performance degrade since it is beacon oriented. It uses three additional packets. DHBP is better in performance than DAPIR.FBBPA has better performance than rest of the previous compared protocols. Because of priority assign to a message.

In our recommended solution, the fuzzy method allots a diverse variety of likelihood to every packet, wherever the greatest data owner allowing to its native bounds is highlighted for retransmitting foremost. The top forwarder keeps the ability to shield a widespread variety of vehicles, approaching in the direction of the foundation position, in fewer time. The vehicle, has given a minimum wait time, that is anticipated to change near the adjacent connection in adjoining prospect. The packet with highest priority is scheduled first however allocating various wait time to the vehicle. As the early importance of accidental data is utmost, therefore, the accident messages are arranged initial and the delay for these messages is kept low. Figure

5.4, demonstrate the data readings of delay for altered densities and speeds in case for accident and advertisement messages.

Among all additional compared protocols, the data are preserved equally, therefore, delay for both types of data packets are exactly same. Nonetheless, delay for commercial data packets is high, as additional time is required to refuge the region of concern which is Rth=2500m for marketing data packets and 800m for misfortune data.

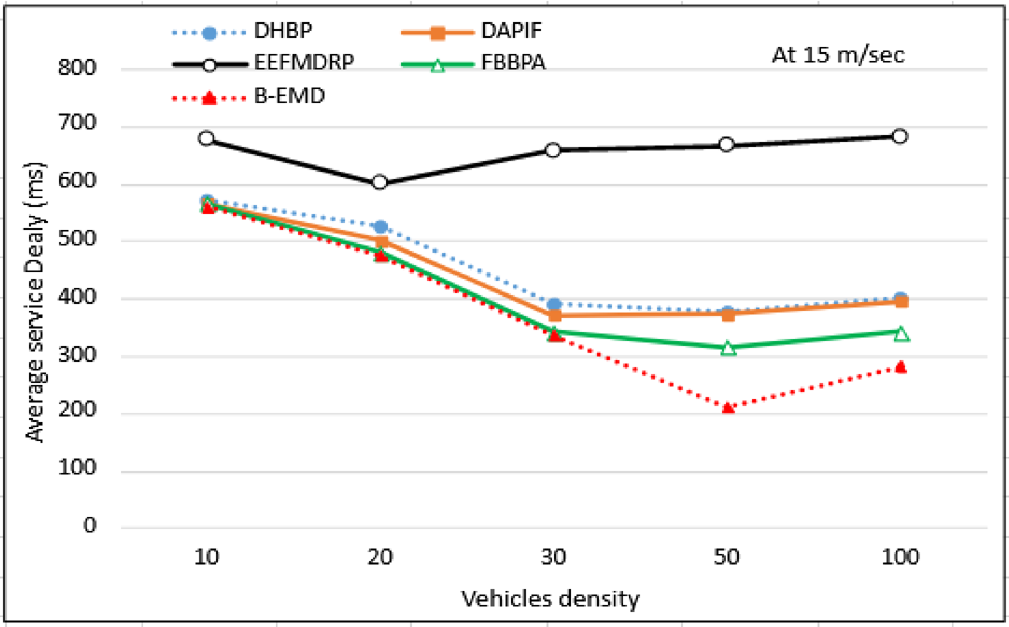

Figure 5.3: Average Service Delay for Accident Packets

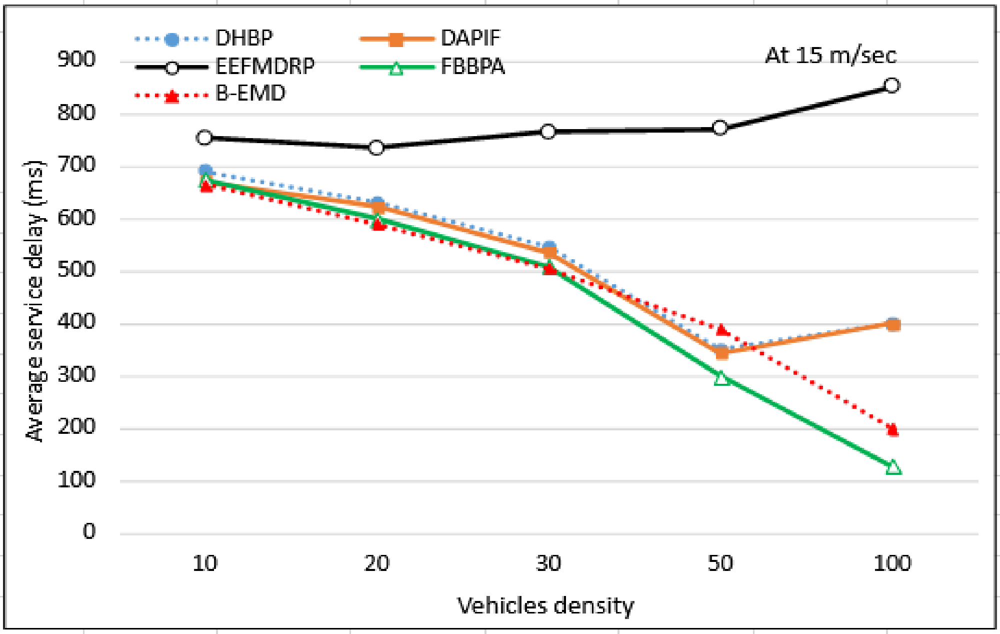

Figure 5.4: Average Service Delay for Accident Packets

5.5.3 Saved rebroadcast

It is expected that an efficient broadcast protocol will distribute advisory messages to entirely carters by prominent an equilibrium between latency and reachability. There exists a balance among saved rebroadcast and reachability. To conserve system resources increases chance that beacons will not spread totally preferred nodes. The major goal is to overpower the retransmitted data and thus increase its getting possibility. Retransmission count increases with vehicle density; thus, vehicles within communication range of each other are highly probable to be acknowledged more frequently, and excessive transmissions are not required for this case. Similarly, nodes do not catch the data at consistent pause at sparse network, therefore it is mandatory to retransmit the most of the accepted messages by vehicles. For the purpose of decreasing the saved rebroadcasts and increasing reachability of packets, transmission likelihood need to be keep low for thick area and keep greater for sparse area. Additionally, the data packet get by an already defined constant with in its clock will never retransmitted for all the compared protocol. After several reproductions of the exact data packet have been got by a node, highly expected that neighbors' vehicles have received the message already. Subsequent rebroadcasts of message are halted, since the saved rebroadcast upsurges by the compactness. Associated by AID, the execution of DHBP is much improved since, fewer extra parameters, including as space by the occurrence and preference of messages are deliberated to reduce duplicate retransmits. Compared with AID. DHBP has done much fair as compared to DAPIF in terms of various densities. Though, with low density, delays factor varies low, and all this rises very progressively because to the use of response packets. Due to the fact that EE-FMDRP and RBP are beacon-based schemes, the rebroadcasts that are saved indicate lower performance. In proposed protocol B-EMD, beacons are not considered however estimating saved rebroadcast, therefore, there are deceptions of execution of RBM among DAPIF and DHBP. It is described prior, the EE-FMDRP work makes utilize three types of extra packets, it makes its performance bad as compared to other schemes.

Proposed scheme perform well in context of saved rebroadcast since rebroadcasting algorithm is more specific to AOI. And vehicle stops broadcasting when the same packet is received more than 3 times. It is more suitable for controlling packet redundancy. As the additional note, in both cases of accident packets and advertisement packets, the saved rebroadcast execution of the compared schemes is approximately the identical. In our work, accidental data packets are decided to transmit at primary level and rebroadcast is kept at greater concentrations due to the inadequate life duration (TTL) of packets. For accidents packets and advertisement packets, Figure. 5.5 illustrates variations saved by rebroadcasting by flexible concentrations and speeds for accident packets, respectively. Figure. 5.6 illustrates variations saved by rebroadcasting by adjustable concentrations and speeds for advertisement data packets, as well.

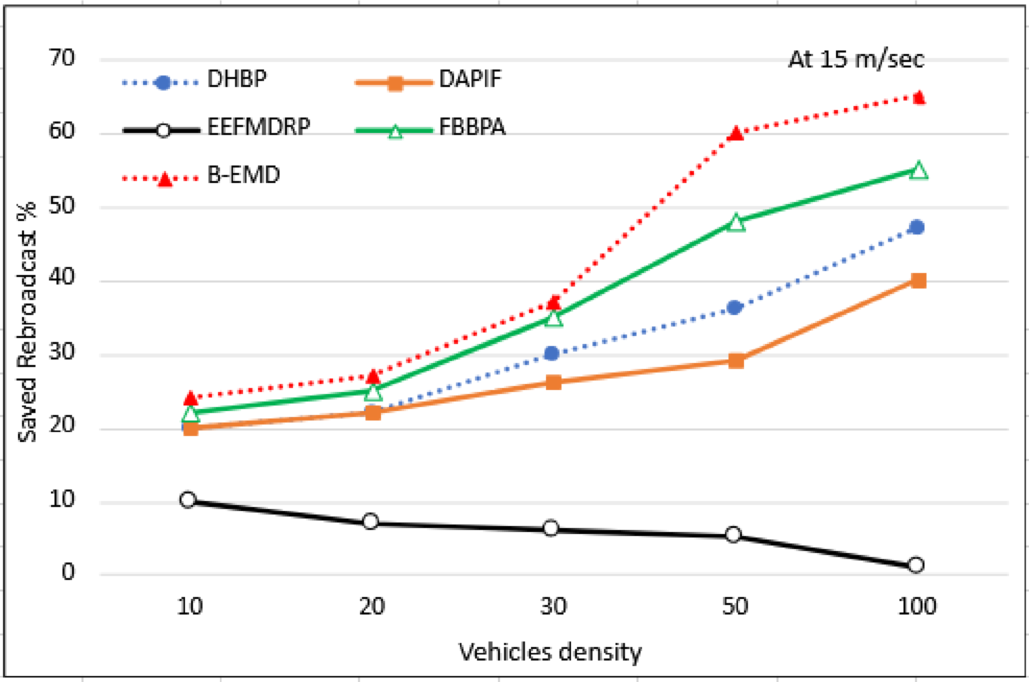

Figure 5.5: Saved Rebroadcast for Accident Packets

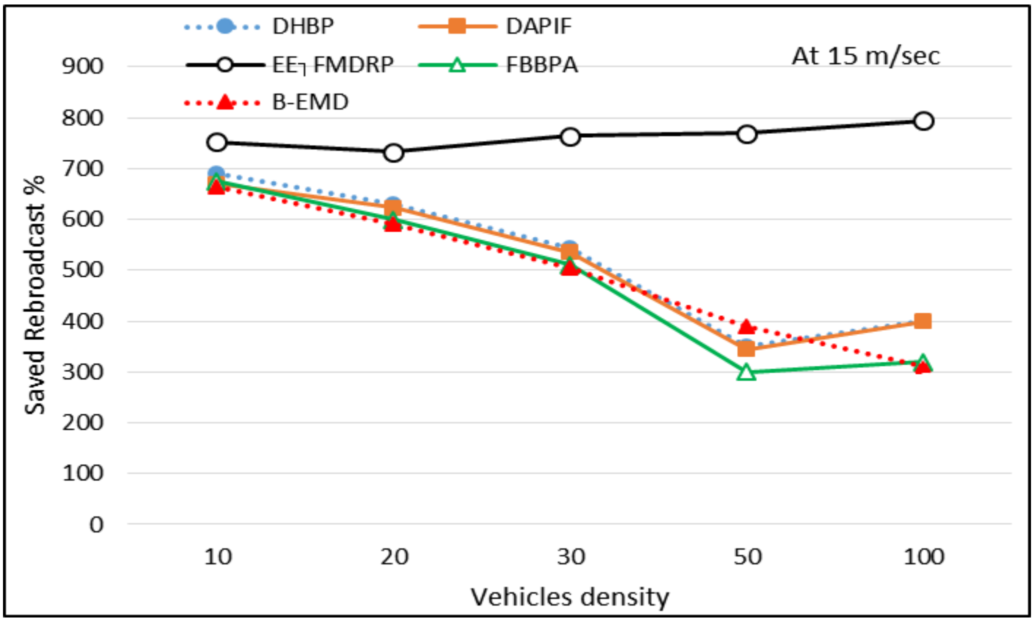

Figure 5.6: Saved Rebroadcast for Advertisement Packet

In Figure 5.6, protocols are compared against saved rebroadcast for advertisement packets. In which the performance degrades for EEFMDRP since three additional parameters are required for calculation. The rest of the compared schemes have identical performance. DHBP is better than DAPIF since there is rise and fall in densities. The proposed protocols are effective in monitoring the redundancy but it has a low delay when density is low. And delay gradually increases due to the addition of a feedback mechanism. Therefore, there is average performance of the proposed schemed for saved rebroadcast for advertisement packets.

5.6 Summary

This chapter is about contrast of our presented protocol along with some previous schemes that are more relevant. Different evaluation parameters are considered to check our proposed schemes efficacy.

CHAPTER 6

CONCLUSION AND FUTURE WORK

6.1 Overview

The chapter consists of a summary, of the major achievements of our proposed scheme. There are some points that are still left open, which we will do in the future. The basic aim of our proposed scheme is to give priority to emergency messages to avoid any bad incidents. We have evaluated our proposed work by simulation. For simulation purposes, NS-2 and MOVE are considered. The results of the proposed technique are compared with other schemes. The graphs are elaborate that we have provided a better solution.

6.2 Summary of Research work

IoV is the latest mechanism that is adopted by various counties. Though it provides enormous benefits to its users, there are still some areas in which much work needs to be done. Vehicles during their journey receive many messages that are related to safety and advertisements these messages are important for users who are traveling but getting a lot of messages can create storm and congestion problems. Different schemes of art are presented in this area but these schemes don't provide many efficient solutions. Vehicles having limited buffer, duplication of messages leads to delay and packet loss problems. To avoid this issue, in our proposed work we have used fuzzy logic decision-making tool to calculate rebroadcast probability in order to avoid broadcast storm problems by controlling duplicate messages. By getting acknowledgment only after the highest priority packet has been generated. For checking the performance of our scheme

Simulation is done using network simulator NS 2.3. Lately, the proposed scheme is compared with previous techniques under different evaluation metrics that show our proposed solution is more efficient in handling message redundancy.

6.3 Future Work

In the future, it is planned to improve and extend the content retrieval mechanism in content-centric vehicular networks, by including Road Side Units (RSU), Data packets transmission and caching policies in our design. Also, the consumption of different membership functions along with the impact of their parameters on the scheme proficiency will be checked as the addition within the present scheme B-EMD.

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