An Efficient Data Dissemination Technique in Vehicular Ad Hoc Networks

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Approval

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Abstract

Vehicular Adhoc Networks (VANETs) and smart cities is an emerging area of research. Therefore, the applications based on VANET are increasing day by day. There are a number of applications that can utilize the VANETs architecture to benefit the end-users. However, there are challenges that are coupled with VANETs. One of them is data dissemination in ad hoc vehicular networks. Typically, clustering algorithms are used for data dissemination among the nodes in the cluster of VANETs particularly moving in the same direction. In this approach, the cluster member (CM) upon receiving any packet forwards it to its respective cluster head (CH) which can only disseminate the data to other members. Such schemes can add additional delay and failed to perform in emergency situations. In this thesis, our objective is to propose an efficient data dissemination mechanism while controlling the amount of messages to the least.

Our proposed solution is based on the supernode concept, in case of emergency, any node can elevate its role to disseminate the data event to other vehicles for their timely action. Moreover, to avoid unnecessary rebroadcast which can cause broadcast storm problem, the Time-barrier approach is used to handle this problem. Therefore, only the furthest vehicle rebroadcasts the message and thus message propagate very quickly. The proposed scheme and traditional cluster based scheme will be implemented using OMNeT++, SUMO, and VEINS.

Dedication

To my parents,teachers and friends
Without whom this success would not be possible.

Certificate of Originality

I hereby declare that this submission is my own work and to the best of my knowledge it contains no materials previously published or written by another person, nor material which to a substantial extent has been accepted for the award of any degree or diploma at NUST SEECS or at any other educational institute, except where due acknowledgement has been made in the thesis. Any contribution made to the research by others, with whom I have worked at NUST SEECS or elsewhere, is explicitly acknowledged in the thesis.

I also declare that the intellectual content of this thesis is the product of my own work, except for the assistance from others in the project's design and conception or in style, presentation and linguistics which has been acknowledged.

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Acknowledgment

I am using this moment to show my appreciation to everyone who aided me out through entirety of my research. I am very grateful for such valuable assistance and friendly advices . I am wholeheartedly thankful to my Supervisor and Dept. of Computing Seecs for providing such an environment.

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Abbreviations

V2V	vehicle to vehicle
V2I	vehicle to insfrastructure
RSU	road side unit
OBU	on board unit
CH	cluster head
CM	cluster member
UN	unregistered vehicle
CAR	Cluster Association Request

Chapter 1

Introduction

1.1 Motivation

Vehicular Adhoc Networks (VANETs) and smart urban communities is a developing territory of research. In this way, the applications dependent on VANET are expanding step by step. There are various applications that can use the VANETs architecture to profit the end-clients. Be that as it may, there are challenges that are combined with VANETs. One of them is information dispersal in vehicular adhoc networks. Regularly, clustering calculations are utilized for information spread among the hubs in the cluster of VANETs especially moving a similar way. In this approach, the cluster part (CM) after accepting any bundle advances it to its separate cluster head (CH) which can just scatter the information to different individuals. Such schemes can add extra delay and neglected to perform in crisis circumstances. In this paper, our goal is to propose an effective information dispersal mechanism while keeping the quantity of messages as low as would be prudent.

1.2 Problem Definition

The IEEE institutionalized the correspondence convention for the vehicular ad-hoc scenario which is known as IEEE 802.11p. With the assistance of VANETs, alot of disasters can be stayed away from e.g. vehicle's impact cautioning is communicated to the drivers when the crash is identified. Vehicle mishaps/crashes cautions are passed down from vehicle to vehicle safeguarding the security of the drivers and the activity stream. Such alarms are some of the time not discernible or are a long ways past the human fringe or hearing reach, which could be enormous help to the drivers that are path behind the light of sight of the mishap, crash or breakdown of the vehicle. Such component can enormously build the response time of police or ambulances by giving the quickest course conceivable to the predetermined goal. Our point is to limit the extra postponement while keeping the messages check low.

1.3 Objectives and Research Goals

Our proposed arrangement is based on super node idea, in the event of crisis, any vehicle can hoist its job to spread the information occasion to different vehicles for their auspicious activity. Also, to maintain a strategic distance from superfluous rebroadcast, delay-based communicate procedure is utilized. We will likely limit the extra delay while keeping the messages tally low. Enhance packet delivery ratio and improve coverage area for information.

1.4 Thesis Organization

The work has been organized as follows. Chapter 2 covers the basic background information about the Vehicular Ad-hoc Networks. Chapter 3 covers the literature review and limitations. Chapter 4 explains the methodology used in the proposed mechanism. Chapter 5 unveils the evaluation of the results. Chapter 6 discusses the conclusion and future work.

Chapter 2

Background Information

VANETs have significantly enhanced the transportation frameworks and helped decreased numerous undesirable situations that reason irreversible accidents that occur on the roads. VANETs make it workable for the vehicles to speak with one another whether on the road or in stopping territories. Vehicles can shape their very own system without the assistance of a unified or appropriated framework. The correspondence which happens between the vehicles themselves is known as Vehicle-to-Vehicle (V2V) interchanges and the trading of data between a vehicle and a stationary unit besides the road which is called Road-Side-Unit (RSU) is called Vehicle-to-Infrastructure (V2I) correspondence.

The frequency that is utilized for vehicular data trade in VANETs is somewhere in the range of 5.85 and 5.925 GHz [1]. Service Channels and Control Channel are utilized for transmitting the wellbeing messages with respect to the mishaps, crashes and different risky occasions and ordinary information messages which incorporate messages other than security.

VANETs is coupled with many challenges which are unavoidable for the said scenario. One of the many challenges is the successful data dissemination of safety and normal messages [2]. While ordinary messages aren't time sensitive, the wellbeing/crisis messages are time sensitive and required to be effectively transmitted as quickly as time permits [3], [4], because after some time these time critical messages may become useless. Numerous procedures have been proposed for the transmitting of such messages. While each proposed procedure handle their very own concern , there is still space for much enhancements as this innovation is as yet creating and hasn't achieved its development yet.

At the point when an occasion is recognized by a vehicle or some infotainment messages need to conveyed to different vehicles out and about, the vehicle that needs to convey the message will broadcast the message in its

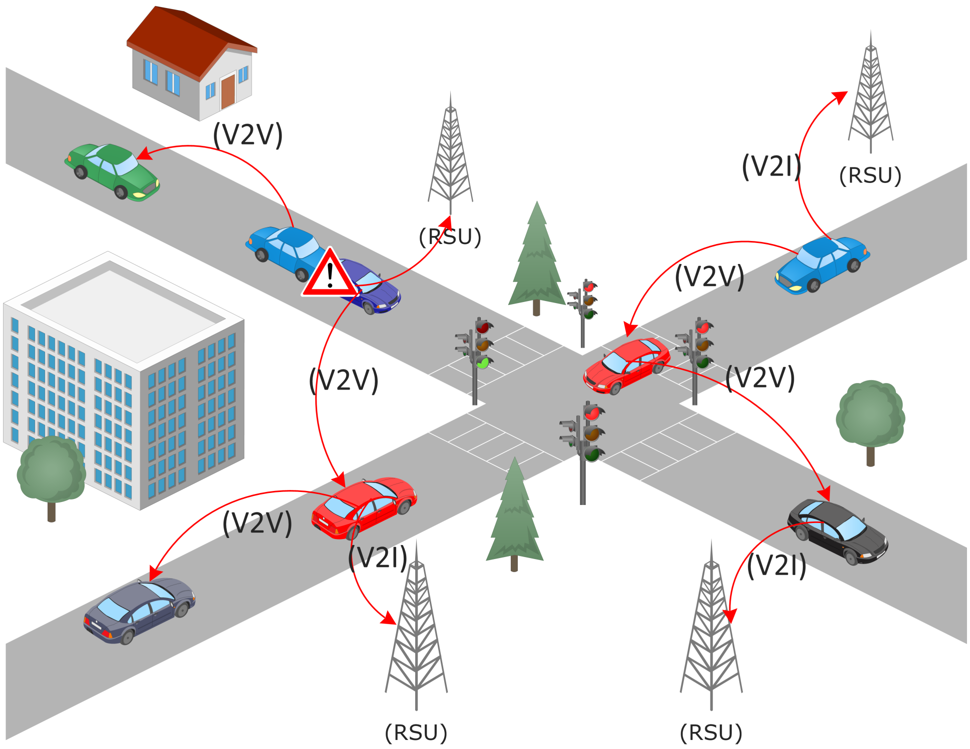

Figure 2.1: VANET's architecture

transmission run, the vehicles on the less than desirable end will rebroadcast a similar message with the end goal to exchange/transfer the data to different vehicles. The marvel in which each vehicle broadcasts a similar message when it is gotten is known as *flooding*. This method may convey the message to the proposed beneficiary however it likewise causes the system clog since hub may broadcast a similar message to different vehicles which might be now gotten by them. Such superfluous rebroadcast in system diminishes the packet delivery ratio in the said situation. Albeit specific flooding or flooding-based component are additionally utilized for the information scattering [5].

The IEEE organized the correspondence tradition for the vehicular adhoc situation which is known as IEEE 802.11p [6], [7]. With the assistance of VANETs, alot of disasters can be maintained a strategic distance from e.g. vehicle's impact cautioning is broadcasted to the drivers when the crash is recognized. Vehicle mishaps/crashes cautions are passed down from vehicle to vehicle guaranteeing the security of the drivers and the movement stream.

Such cautions are here and there not noticeable or are a long ways past the human fringe or hearing reach, which could be huge help to the drivers that are path behind the light of sight of the mischance, crash or breakdown of the vehicle. Such system can incredibly build the response time of police or ambulances by giving the quickest course conceivable to the predefined goal.

There can arise some issues relating to the security of broadcasting such messages. As in, someone falsely broadcast a car accident or violating the privacy of the driver's information. The autonomous cars e.g. Google's Car could fall victim to such malicious invasion [8]. One of the numerous reasons clustering mechanisms are utilized is information security nearby information scattering and numerous others. The vehicles shape a gathering known as a cluster based on a few highlights which is comparative in each one of those vehicles which mean to frame the cluster. A administrator is chosen for the cluster which is known as Cluster head (CH) which has managerial benefits of that predefined cluster. The determination or decision of the CH can differ starting with one calculation then onto the next. The various vehicles other than CH are known as Cluster members (CM). One of the numerous favorable circumstances of utilizing such technique can recognize the interloper who is dishonestly broadcasting the alarms. Another fundamental favorable position of clustering mechanism is that it addresses the issue which emerges from broadcast storm problem [9], in which each vehicle who gets a similar message rebroadcasts its causing a noteworthy network congestion. The clustering algorithm should be used so that it should tackle the major issues that arises in a VANET's scenario. The clustering mechanism is likewise used to draw out the network lifetime of the vehicles voyaging together on a similar road. The vehicular network could be either simply ad-hoc in nature in which vehicles just associate with different vehicles (V2V) or vehicles interfacing with the road-side-units (RSU) called as Vehicle-to-Infrastructure (V2I) or it could be cross breed which utilizes both [10].

The proposed techniques addresses the challenges that are encountered in an urban vehicular environment. The aim of the proposed technique is to minimize the transmission delay that is faced by the transmitted packet. Achieving this, while improving the packet delivery ratio and increasing information coverage area.

Chapter 3

Literature Review

VANETs acts an improvement job in the improvement of Intelligent Transportation Systems (ITS). In [11], the authors presented a cross-breed technique known as VMaSC-LTE which utilizes the pair of IEEE 802.11p Protocol and the 4G cell framework to build the packet delivery ratio and furthermore to limit the delay in effective transmission of packets. In [12], the authors presented a clustering plan "Cluster-On-Demand (COD)" which makes clusters based on Quality of Service (QoS) between alternate clusters utilizing the Minimum Spanning Tree technique. In [13], authors characterized the vehicles into various classifications dependent on their computation and capacity abilities. Each energy zone has a Cluster Head (CH) chosen for that explicit territory of the network and the information scattering is made conceivable through hubs which have more prominent computational power. This technique fathoms the issue of broadcast storm problem that makes the network soak in and be wrecked.

In [14], the authors presented a clustering mechanism known as OLSR-C. The position and velocity of the vehicle assumes an indispensable job, the arrangement of the clusters. The vehicle creates cluster with those specific vehicles which has low relative velocity and position which thus results in better packet conveyance proportion and low message transmission delay. In [15], the authors presented mixed-breed framework known as CC-HVNA which utilized VANETs and LTE for clustering technique. Efficient V2V and V2I communication is established and an improvement is seen for the dissemination of the safety messages.

In [16], the authors presented a plan to resolve the broadcast storm problem, disconnecting conduct of the network and the hoisted expense of communication in the uttered situation. An engineering scheme is presented which is built up on IEEE 802.11p for clustering mechanism. Packet delivery ratio is enhanced and transmission delay of messages is decreased while the usage of cell network is kept in as low. In [17], Authors proposed a scheme of location aware clustering scheme without the involved of advanced GPS architecture and Online maps. Broadcast storm problem is handled and superfluous messages transmissions are stifled enhancing the packet delivery ratio and limiting the normal transmission delay. The proposed scheme is a generic model which can be applied to any VANET scenario except for emergency data dissemination. In [18], authors proposed a technique called HBEB. Utilizing this clustering plan, a few vehicles are picked as spines of the network which are appointed with the duty of information dispersal. It is demonstrated that this clustering plan enhances the information scattering in the urban condition.

In [19], the authors targets the highway scenario which is concerned with the safety messages e.g. in situation of car accidents, dangerous situations etc. , since in these scenario vehicles should be alerted about the situation at earliest , the authors stresses upon minimizing CH election and quicker CM formation. The authors also presented a mechanism for electing a successor for CH in event of vehicle in-charge of specific cluster chooses to leave, this limits the repetitive CH selection and drag out the network length of the framed clusters. In [20], the authors presented a mechanism for clustering technique that depends on the direction of the vehicles. This technique additionally utilizes the density of vehicles in a given territory with the end goal of spreading information. For instance, the messages are just transferred to different vehicles if the direction of the transmitter and receiving vehicle is same, correlation somewhere in the range of 802.11p and 802.11b is done, reproductions demonstrates that the WAVE convention outflank than the TCP/IP convention with reference to execution in VANETs.

In [21], authors presented a clustering mechanism in which the Cluster head (CH) is selected on factors like direction and distance. CH expect the job for steering and conveyance of the messages that are generated in the cluster network. This mechanism is administrated utilizing NCTUns simulator. In [22], a mechanism is used by the authors in which they used an opportunistic approach for auto adaptive data dissemination for vehicular adhoc networks. The direction of the mobile vehicles is considered for this method. The messages check is progressively adjusted to best fit the network requirements with the end goal to stay away from network blockage.

In [23], the authors presented CODE mechanism for productive information dispersal utilizing clustering procedure. The proposed component utilizes relative speed of the vehicles to choose a cluster head for the cluster development. The objective is to keep up a more extended network lifetime of the clusters for enhancing the packet delivery ratio and bringing down transmission delay. In [24], authors presented a mechanism called C-DRIVE,

which makes direction of vehicles into move while development the clusters and cluster head election, the said mechanism inflicts fewer broadcasts and enables the transmission capacity of the network to be utilized ideally for spread of the information. In [25], medium access control method is utilized for the distinguishing the hidden node problem that rests in the network and may give rise to packet collision which in-turn results packet loss. Cluster heads are chosen utilizing the said instrument and are approved to dispense explicit network data transfer capacity to every individual from the cluster. In [26], authors endeavor to build an essential system to see whether it is important to utilize MANETs routing mechanisms for the examination of information scattering in VANETs situation. In [27], authors expresses that the proposed routing based component with the end goal of information spread shows enhancement in packet delivery ratio and limits the packet misfortune in VANETs situation. Results demonstrate that it performs well in high density zone where vehicles are a lot nearer to one another and creates much lower packets when contrasted with basic flooding procedures utilized for information scattering. In [28], authors presented the method called AODV convention, which organizes packets with the end goal of information dispersal and planning procedure is utilized close by it. The outcomes exhibits enhancement in throughput,delay and packet delivery ratio.
In [29], authors review the current strategies to make sense of the defects of the said systems. Two procedures are proposed i.e. unidirectional flooding and selective flooding with the end goal to handle the broadcast storm problem which is caused by superfluous rebroadcasts. In [30], authors proposed DDBC protocol which is targeted towards the urban areas. Performance analysis shows decrease in transmission delay and in increase in packet delivery ratio.

All the above mentioned techniques are targeting some of the challenges that are faced in VANETs scenario. Some techniques target average transmission, some target packet delivery ratio while other pinpoint their technique around the information coverage area of data dissemination. But issues with these techniques is that they don't address all the basic challenges that are faced during VANETs environment.

Table 3.1: Comparison of different VANET techniques

Authors	**broadcast storm problem**	**PDR**	**Delay**	**Information Coverage**	**High Density**	**Low Density**	**High Speed**	**Low Speed**	**Scenario**	**Simulator**
G Farrokhi et al. [31]	✓	✓	✓	✗	✗	✓	✓	✗	highway	NCTUNS
Ihn-Han Bae [32]	✓	✓	✗	✗	✓	✗	✗	✓	generic	MATLAB
Faisal Khan et al. [33]	✗	✓	✓	✗	✓	✓	✗	✓	urban	NS-3
Ambuj Kumar et al. [34]	✗	✓	✗	✓	✓	✗	✗	✓	generic	OMNeT++, SUMO, VEINS
Bingyi Liu et al. [35]	✗	✗	✓	✗	✓	✗	✗	✓	urban	OMNeT++, SUMO
Sami Alwakeel et al. [36]	✗	✓	✗	✗	✗	✓	✓	✗	generic	NS-2
Wei Liu et al. [37]	✗	✓	✓	✗	✓	✓	-	-	highway	NS-2, SUMO, TranNS
OS Eyobu et al. [38]	✗	✗	✓	✗	✗	✓	✓	✗	highway	NS-3
Daxin Tian et al. [39]	✓	✓	✓	✓	✓	✗	✗	✓	urban	OMNeT++, SUMO, VEINS
Proposed technique	✓	✓	✓	✓	✓	✗	✗	✓	urban	OMNeT++, SUMO, VEINS

Table 3.2: Simulation Parameters

Parameter	Value
Simulation Area	3km X 3km
Simulation time	500s
Simulation runs	50
Transmission range	250m
Data Transmission Rate	6 Mbps
MAC protocol	IEEE 802.11p WAVE
Node Density	30-125/km
Node Velocity	12-20 m/s
Maximum acceleration	2.6 m/s^2
Distribution model	Nakagami-m
Accident interval	15s
Accident duration	30s

Chapter 4

Methodology

4.1 System Model

- Network Model:Our simulation scenario is based on an urban area for dissemination of the data which is mainly happening via vehicle-to-vehicle communication. The vehicles can have multiple routes to the same or different destinations.
- Channel Model: The fading model of radio wave propagation is represented by Nakagami-m distribution. The probability of transmission of packets between the source node i and receiver node j which are successfully sent for channel fading is represented by [40].

$$\begin{aligned} Prob_{ij}^{f}(dist_{ij}) &= 1 - \frac{\gamma(m, \frac{m}{\Omega}x^2)}{\Gamma(m)} \\ &= e^{-\frac{m}{\Omega}x^2}\frac{2m^m}{\Gamma(m)\Omega^m}x^{2m-1} \end{aligned} \tag{4.1}$$

$\frac{\gamma(m, \frac{m}{\Omega}x^2)}{\Gamma(m)}$ in Eq. 4.1 represents the cummulative distributive function for signal reception power less than x^2, and x^2 is describing the reception threshold of the propagation signal, Ω represents the average power level of the receiving signal and m describes the fading parameter defined as the distance between the vehicles i and j which is represented by $dist_{ij}$ as following

$$m = \begin{cases} 3, & dist_{ij} < 50m \\ 1.5, & 50m \leq dist_{ij} < 150m \\ 1, & dist_{ij} \geq 150m \end{cases} \tag{4.2}$$

Moreover, we have also considered the interest compatibility: Each vehicle has its own interest such as some vehicle are interested in parking information and other may be interested in accidents and traffic congestions information. Let V_i be the vehicle with k interest then interest vector of V_i is given in eq. 4.3.

$$\vec{V_i} = (v_i^1, v_i^2, \cdots, v_i^k) \tag{4.3}$$

interest vector of V_j is given in eq. 4.4

$$\vec{V_j} = (v_j^1, v_j^2, \cdots, v_j^k) \tag{4.4}$$

Now cosine similarity formula eq. 4.5 gives

$$sim(\vec{v_i}, \vec{v_j}) = \cos(\theta) = \frac{\vec{V_i} \cdot \vec{V_j}}{\|\vec{V_i}\|\|\vec{V_j}\|} \tag{4.5}$$

The interest compatibility model is used in the process of head election. Now we are interested to compute the mutual interest of vehicles V_i and V_j, which are given in Eq. 4.6

$$IC(\vec{V_i}, \vec{V_j}) = \frac{\sum_{\alpha=1}^{k}(V_i^{\alpha} * V_j^{\alpha})}{\sqrt{\sum_{\alpha=1}^{k}(V_i)^2}\sqrt{\sum_{\alpha=1}^{k}(V_j)^2}} \tag{4.6}$$

In order to improve the network lifetime, a cluster head is selected based on two factors, interest compatibility, and the probability of successful packet transmission. Interest compatibility among vehicles can be computed using Eq. 4.6. Whereas, the channel model used to determine the successful reception of the packets is using Eq. 4.1. Now by using eq, 4.6. Cluster head eligibility (CHE) of vehicle i and its neighboring vehicles j calculated using Eq. 4.7

$$CHE_i = \frac{AvgIntComp_i}{AvgDist_i \times AvgRelDist_i} \tag{4.7}$$

Where $AvgIntcomp_i$ shows the average interest compatibility, determines $Intcomp$ between vehicle i and its neighboring vehicles j , Eq 4.8.

$$AvgIntcomp_i = \frac{\sum_{j=0, j\neq i}^{n} IntComp(\vec{V_i}, \vec{V_j})}{n-1} \tag{4.8}$$

Here N shows the total number of vehicles. The average distance between vehicle V_i and its neighbor vehicle V_j is computed using Eq. 4.9.

$$AvgDist_i = \frac{\sum_{j=0}^{N} \sqrt{((x_j - x_i)^2 + (y_j - y_i)^2}}{N} \tag{4.9}$$

Moreover, to find the average relative distance between the vehicle V_i and neighboring vehicles V_j is computed using eq. 4.10.

$$AvgRelDist_i = \frac{\sum_j \sqrt{((x_j - x_i)^2 + (y_j - y_i)^2}}{N} \tag{4.10}$$

Using the cosine similarity matrix, vehicles can know the interest of other vehicles. The vehicle having the highest compatibility matrix is selected as the cluster head.

The location and velocity of the CH_i at time interval t [41] denoted by $\vec{Loc_i}(t)$, $\vec{v_i}(t)$ and Δt represents the delay the packet is facing while being transmitted, which can be calculated as following, Eq. 4.11

$$\vec{Loc_i}(t + \Delta t) = \vec{Loc_i}(t) + \vec{v_i}(t)\Delta t \tag{4.11}$$

The location and speed of CM_j is calculated as following Eq. 4.12, where j = 1,2, ..., M *where* M = No. of CMs:

$$Loc_{ij}(t + \Delta t) = Loc_{ij}(t) + v_{ij}(t)\Delta t \tag{4.12}$$

To check whether the CM_j is in transmission range of the CH_i, we use Eq. 4.13

$$| \ Loc_{ij}(t + \Delta t) - Loc_i(t + \Delta t) \ | \leq R \tag{4.13}$$

4.2 Clustering scheme

The following concepts have been used in this section to fully understand the working of the proposed algorithm.

- Unregister Node (UN): the vehicle which is not affiliated with any cluster.
- Cluster Head (CH): the administrative vehicle of the cluster
- Cluster Member (CM): the vehicle which belongs to a cluster head
- Gateway Node: the node which is affiliated with atleast two distinct clusters
- Cluster Association Request (CAR): a request sent by UN to CH to be added to its cluster
- Cluster Head Announcement (CHA): a broadcast message sent by CH to declare its CH role

4.3 Cluster head selection

In this section, we will discuss the methodology used in this paper for the purpose of the selecting the CH for the cluster to be formed in order to disseminate the data and emergency messages to the cluster members.
when the simulation is started, the vehicles also known as nodes in the simulation come one by one into play, every vehicles broadcasts its basic details about itself i.e. vehicle's speed, direction, road id etc in its transmission range. If a node wants to become a cluster head, it has to wait for some interval which is calculated on basis of some parameters which will be discussed later on. Fig 4.1 the pictoral representation of proposed scheme

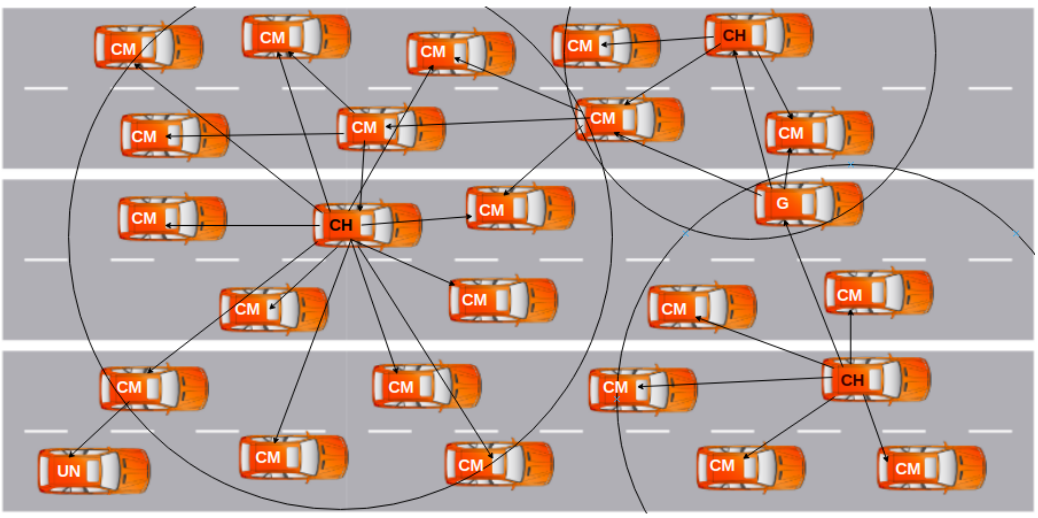

Figure 4.1: Proposed clustering scheme

During this interval an unregistered cannot neither become a CH nor a CM. The reason behind this is to assess the neighborhood what kind of messages are flowing in the reception range of the node, to look for any existing clusters that are available or to find an already existing cluster head to which this node to send affiliation request to become its member. After this interval if the vehicle has received any CHA message which is being broadcasted in the vehicle's reception range then it will send its cluster association request to that specific CH and the algorithm for cluster formation comes into play for CH to add the node into members list and be a part the cluster.
If the respective node doesn't receive the CHA message after the specific time interval then the node itself will perform the self-assessment for the CH role on the basis of direction and relative distance with respect to other nodes

that are moving along the node in its transmission range.
The parameters i.e. direction and relative distance are checked with other nodes, for example direction of the node considering for CH role should be same as that of other nodes in its transmission range and the relative distance between them should not be large enough in order to have good link connectivity between the nodes. If the node is not eligible for the CH role considering these parameters then it will again wait for interval t and go through same process all over again in order to find a suitable CH or to become a CH itself. If the node is eligible for CH role then it will proceed to cluster formation algorithm assuming itself as the CH and will remain the CH during the simulation unless the node loses all its members then the node elected as CH will resign from its CH role and will either become unregistered node or a cluster member of another cluster.

Algorithm 4.1 – Cluster Head Selection

```
1:  UN ← Unregistered Node
2:  CH ← Cluster Head
3:  Timer timer
4:  flag ← 0
5:
6:  while ( flag = 0 ) do
7:      UN scans for interval timer
8:      if (CH.Found) then
9:          goto Algorithm 4.2
10:     else
11:         Performs self-assessment for CH role
12:         if CH.Eligibility = true then
13:             flag ← 1
14:             goto Algorithm 4.2
15:         else
16:             goto step 7
17:         end if
18:     end if
19: end while
```

4.4 Cluster formation

In this section, we will discuss the methodology of cluster formation used in the simulation after a cluster head is selected or an unregistered node looking for cluster or a cluster member monitoring its cluster head. Algo 4.2
After the algorithm for the cluster head selection is executed then the algorithm for cluster formation is executed for the purpose of associating an unregistered node with a cluster or cluster head monitoring its cluster members and entertaining new members upon receiving new requests or cluster members monitoring their respective cluster head to check whether the link is alive and cluster head is present and hasn't disconnected
When an unregistered node has found a suitable CH, it shall transmit a Cluster Association Request (CAR) to the respective cluster head, the CH upon receiving the association request will acknowledge the request with a confirmation message and will add the node as its cluster members.
The cluster member will monitor its link with the CH to check whether the CH is alive or not i.e. disconnected. Link connectivity is constantly checked with heartbeat messages that are sent periodically to state that the link is alive. If everything goes well then the cluster member will keep monitoring the CH link, but if the link connectivity with the CH is lost then node will remove the CH from its entry table and will change its state from cluster member to unregistered node. This unregistered node will start scanning for the CH in the neighborhood for interval t. During this interval t, if the unregistered node gets Cluster Head Announcement (CHA) then it will associate itself with the respective cluster head by sending the CAR message and all the process for addition of cluster member and monitoring CH link will start again.
But if for some reason, the node doesn't get CHA message then the node will assess itself based on direction and relative distance and will announce itself as CH. Now the newly formed CH will have two main responsibilities to take care of alongside data dissemination. Firstly it will have to entertain the association requests which are being sent by the unregistered nodes who want to be added to the cluster and secondly to monitor the link connectivity, to check whether the cluster members are active or disconnected.
When the CH receives an association request, it will add the entry of the new member into its table and start monitoring its link. If for some reason the link connectivity between the CH and Cluster member is lost which can be identified by the absence of heartbeat messages then the CH will remove the entry of that node from it's cluster member's table. The CH will continue monitoring its members which have their entry in CH's table. But if a situation arises when the CH removes the cluster member from its table and

no more members are left in it then the CH will resign from it CH role and will become an unregistered node again. This node will again go through all the process for the cluster formation or cluster head selection whether it got a CHA or made itself a CH on basis of self-assessment.

4.5 Emergency Messages

The following concept is used for the dissemination of emergency messages. The section discusses how the emergency message are tackled whether it is received by a cluster head, cluster member or an unregistered node. Our main goal alongside others in the dissemination of emergency message is to reduce the delay so that it could the other vehicles as fast as possible, because normal data dissemination aren't time critical unlike emergency messages which should be conveyed asap without causing the congestion in the network. The emergency messages should be delivered in such a fashion the network congestion is avoided, desired information coverage is achieved and delay is minimized as much as possible. Algo 4.3

During our simulation scenario, the network is initialized with the cluster head selection and cluster formation algorithm which takes care of cluster heads, cluster members and unregistered nodes. When an emergency message is received on a node. One of the first things that is checked is the node status whether it is cluster head, a cluster member or unregistered node. If the node who has received it is a CH then the emergency message is immediately disseminated to its cluster members. There is no reason to delay the emergency message at the CH node because cluster members should be alerted asap as it is received at CH.

If the node which has received the emergency message is a cluster member then it will not disseminate the message immediately instead it will use a technique known as delay-based broadcast in which the node will start a timer and only after the timer has expired will the node be able to broadcast the message.The value of the timer is not fixed. It rely on the distance among source vehicle and receiving vehicle of the same message. There timer's values varies with different distances between the two nodes. For example, a timer for a message between two nodes which are close to one another will have a greater value than a timer for a message between two nodes which are at a greater distance will have smaller value. Using such technique will allow only the furthest vehicle/node to broadcast the message increasing the information coverage, reducing the delay caused due to broadcast storm problem and improving packet delivery ratio.

In a typical scenario, the cluster members forwards the received message to it's CH and then the CH disseminates the message to its members. This is an additional hop when considered in case of emergency messages and we want to minimize the delay for these messages as they are time critical. For this reason, the node elevates its privileges and is able to broadcast the emergency message itself after its timer has expired. The cluster member will disseminate the emergency message to it's CH and broadcast it to neighboring nodes regardless of its cluster members. If the emergency message is encountered by a gateway vehicle, it will act same as any cluster member.

There are no explicit acknowledgements using this techniques rather a technique known as implicit acknowledgements are used instead. When a message is encountered at the node from the opposite direction for which it is running a timer for the same message then message received is taken as implicit acknowledgement which means a node farther away has received the same message and there is no compulsion to disseminate/broadcast the message therefore the vehicle running the timer for data dissemination cancels the timer and the broadcast.

If an emergency message is received at an unregisterd node then it will start a timer for that specific message on basis of the distance with the source node which generated/forwarded the message. And only after the timer has expired and the same message wasn't received during the timer, will be unregistered node be able to broadcast the emergency message as it has no cluster head or cluster members for that matter.

Algorithm 4.2 – Cluster Formation

CM: Cluster Member
CH: Cluster Head
M: Message
Time timer $\leftarrow \Delta$t
Time $timer_u \leftarrow \Delta$t
$CH_{flag} \leftarrow false$
$CM_{flag} \leftarrow false$
$SelfCH \leftarrow false$
$list_m \leftarrow 0$
while $true$ **do**
    if Message on Channel == true **then**
        $Message\ M \leftarrow Received$

        if $(M_{type} == CHA)$ & $(CH_{flag} == false)$ & $(SelfCH == false)$ **then**
            $Message\ M_m$ = new Message(CAR)
            Send(M_m, CH)
            $CH_{flag} \leftarrow true$
            $SelfCH \leftarrow false$
            timer $\leftarrow \Delta$t
        end if

if $(M_{type} == CM)$ & $(SelfCH == true)$ **then**
    if $list_m$.exist($M_v info$) **then**
        $list_m$.UpdateInfo(M_{vinfo})
    else
        $list_m \leftarrow M_{vinfo}$
    end if
end if
if $(M_{type} == CHA)$ & $(CH_{flag} == true)$ **then**
    timer $\leftarrow$ Δt
end if
end if
if $CH_{flag} == true$ **then**
    $Message\ M_b$ = new Message($Beacon$)
    Send(M_b, CH)
end if
if $timer$ expired & $SelfCH ==$ false **then**
    if $SelfEligible()$ **then**
        $Message\ M_h$ = new Message($CHAnn$)
        Send(M_h, $Broadcast$)
        $SelfCH \leftarrow true$
        $timer_u \leftarrow \Delta$t
    end if
end if
if $SelfCH == true$ & $timer_u$ expired **then**
    Remove expired CMs
    $timer_u \leftarrow \Delta$t
    if $list_m$.Empty **then**
        $SelfCH \leftarrow$ false
    end if
end if
end while

Algorithm 4.3 – Emergency Messages

```
CM: Cluster Member
CH: Cluster Head
EM: Emergency Message
Time timer ← Δt
EM ← received
if (is_CH == true) then
    Send(EM,CMs)
else if (is_CM == true) then
    start timer for broadcast to CMs & CH
    if (EM received during Δt) then
        cancel timer & stop broadcast
    else
        broadcast EM on timer expiration
    end if
else
    start timer for broadcast
    if (EM received during Δt) then
        cancel timer & stop broadcast
    else
        broadcast old message on timer expiration
    end if
end if
```

Chapter 5

Results & Discussion

5.1 System Specification

The experiments for the evaluation of the proposed techniques are performed on system with the specification given in Table 5.1

Table 5.1: System specification

Name	Specification
CPU	Intel Core (TM) i5-7200 CPU 2.7 GHz
RAM	8 GB - DDR4 2133 MHz
GPU	2 GB - GeForce 920 MX
OS	Ubuntu 16.04.03 LTS
Simulator	OMNet++ , SUMO, VEINS

In this section, we have evaluated the proposed mechanism on OMNet++ [42] , Simulation of Urban Mobility (SUMO) [43] and VEINS [44] platform and is compared with the clustering and probabilistic broadcasting (CPB) [45], cluster-based emergency message dissemination (Jin's Model) [46] and pure flooding. Fig 5.1 show the eclipse-based environment of OMNeT++ .Fig 5.2 show the SUmulation of Urban MObility (SUMO) tool and Fig 5.3 shows the framework of VEINS. While Fig 5.4 shows the situation where an accident has occurred and messages are being transferred alerting other vehicles about the accident, so that necessary action is taking into effect.

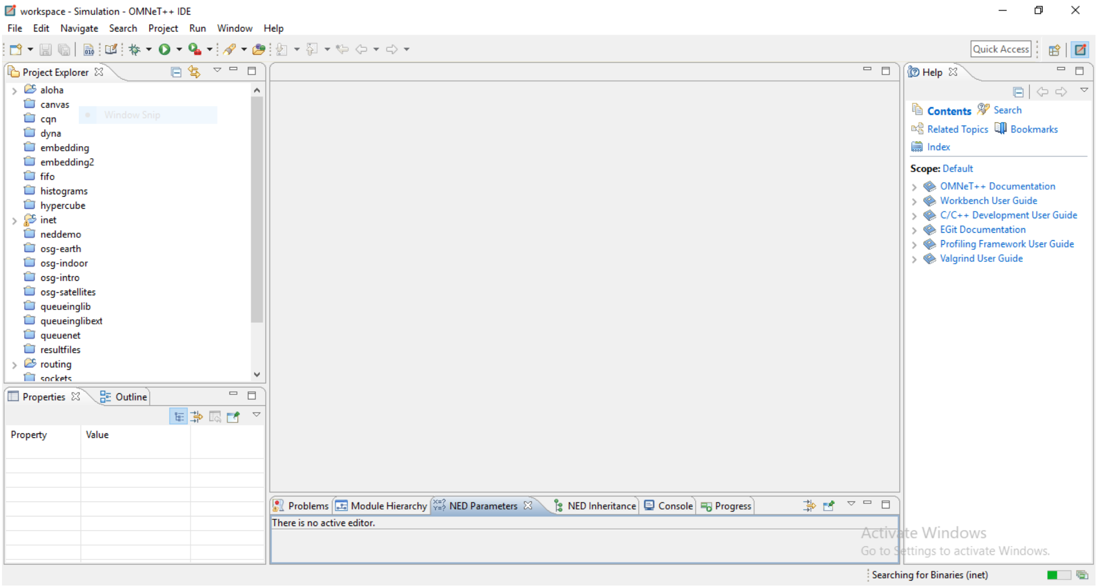

Figure 5.1: Development environment of OMNeT++

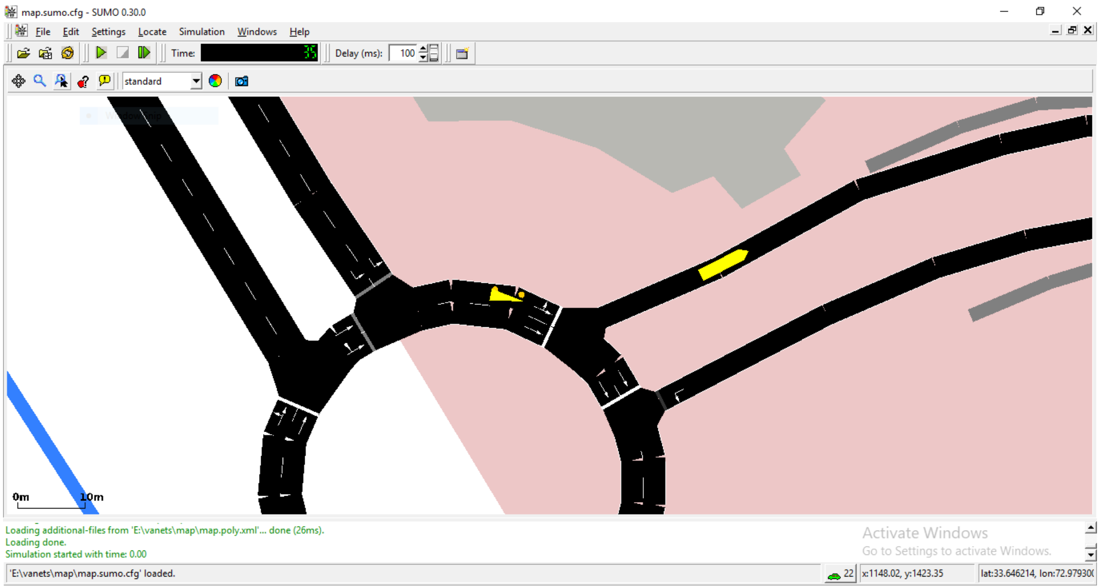

Figure 5.2: Preview of SUmulaiton of Urban MObility

5.2 Simulation Scenario

The simulation scheme is evaluated in an urban area, where vehicles can drive in any direction they desire. The vehicles are placed randomly on the road to simulate an urban area. The density varies from 20 to 125 vehicles/km, the

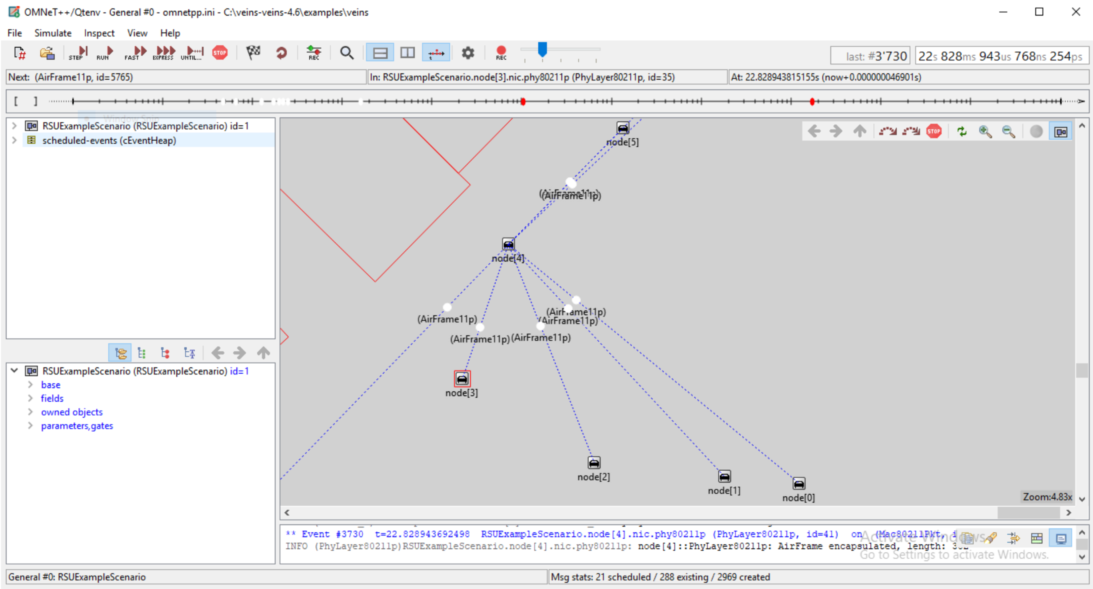

Figure 5.3: A look into VEINS framework

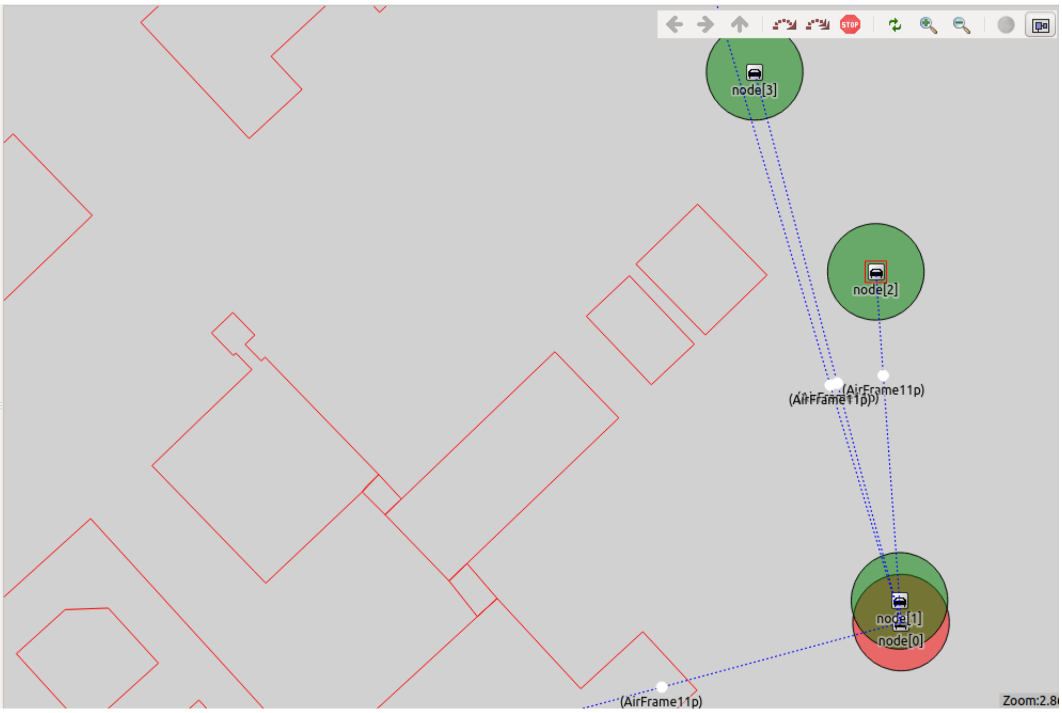

Figure 5.4: An accident scenario in VEINS framework

roads are two-way. The uptime of the simulation runs are averaged around

500 seconds and the simulations runs are about 50.

5.3 Performance metrics

The following metrics are used to evaluate the scenario for the given two algorithms.

- Information Coverage: the percentage of area covered by the trnasmitted packets that are successfully received
- Average Transmission Delay: the time taken by a packet to reach from the transmitting node to the receiving node.
- Packet Delivery Ratio: it is the ratio of the received packets to the overall transmitted packets.
- Vehicle Density: The number of vehicles per km.

5.4 Performance Analysis

Figure 5.5 shows the percentage of information coverage w.r.t node density. Fig 5.5 describes the two techniques used in comparison with these two parameters i.e. Clustering and Probabilistic Broadcasting (CPB) and the Proposed scheme. The figure unveils that the percentage of information coverage stays almost the same as that of CPB rather the proposed scheme under-performs but we see an increase in the information coverage as the node density increases. The reason behind this is because of low density i.e less numbers of vehicles are available to disseminate the message , therefore they cover a smaller area of the Urban environment. Hence is the information coverage is low with lower density. As the density of the vehicles increases, so does information coverage because more and more vehicles are covering the urban area. After a while, when the node density reaches a certain point then the information coverage starts to decrease and doesn't increase with rise in vehicle density. The wisdom behind this is that a higher vehicle density beyond a certain desired point causes congestion in the network which is disadvantage of increasing the vehicle density beyond certain limits.

Figure 5.6 shows the average transmission delay w.r.t node density. The two algorithms i.e. Clustering and Probabilistic Broadcasting (CPB) and the Proposed scheme are compared in this diagram showing that the average transmission delay doesnt show that much of a difference between the two

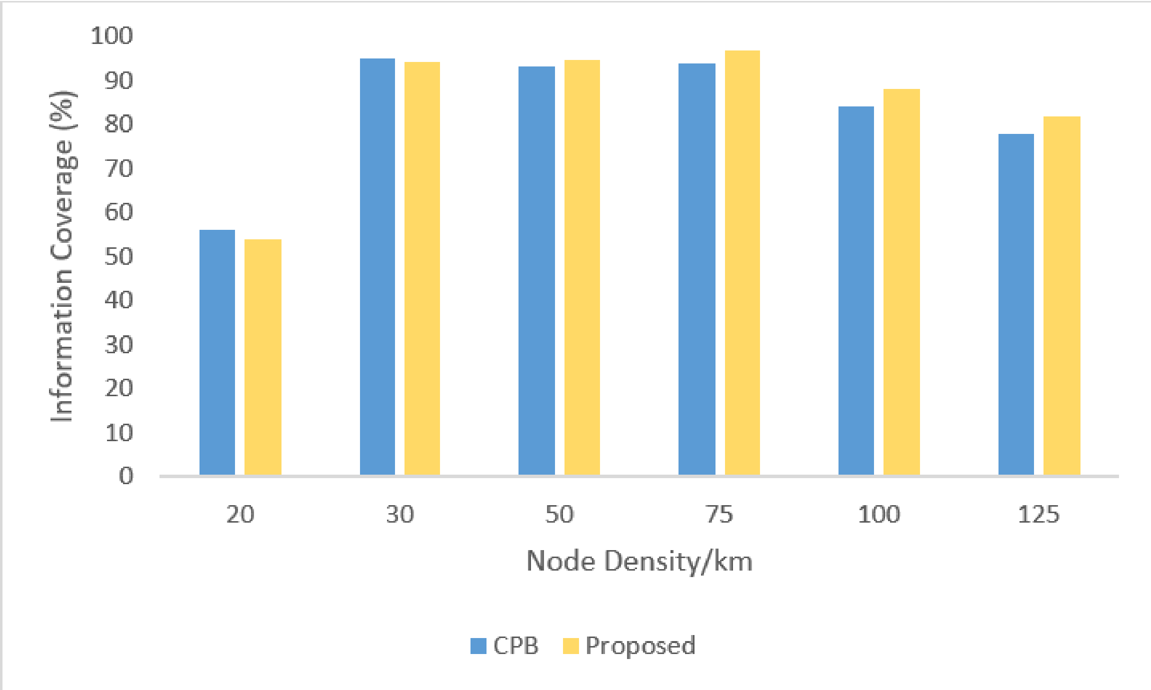

Figure 5.5: Comparing CPB with Proposed Scheme w.r.t. Information coverage vs. Node density

algorithms with lower density but with the increase in the node density, a prominent change can be observed.This is because the proposed algorithm tackles the emergency messages better in a higher density than the CPB algorithm. The flaw in CPB algorithm is that it doesn't tackle the emergency messages, we used their same mechanism for the emergency messages that they use for there normal messages to show their statistics and compare them with our proposed scheme.

Figure 5.7 shows the packet delivery ratio w.r.t node density. Clustering and Probabilistic Broadcasting (CPB) and the Proposed scheme are compared in this diagram showing that the packet delivery ratio is not greatly increased compared to smaller node density but as we scale up the node density, the packet delivery ratio increase because the nodes come closer to one another and overlaps in the transmission range of the other vehicles. Thus the packet delivery ratio increases to some extent when node density is increased but there comes a point when an increase in node density have a decreasing effect of packet delivery ratio i.e. the amount of successfully encountered packets is decreased and major factor behind that is congestion

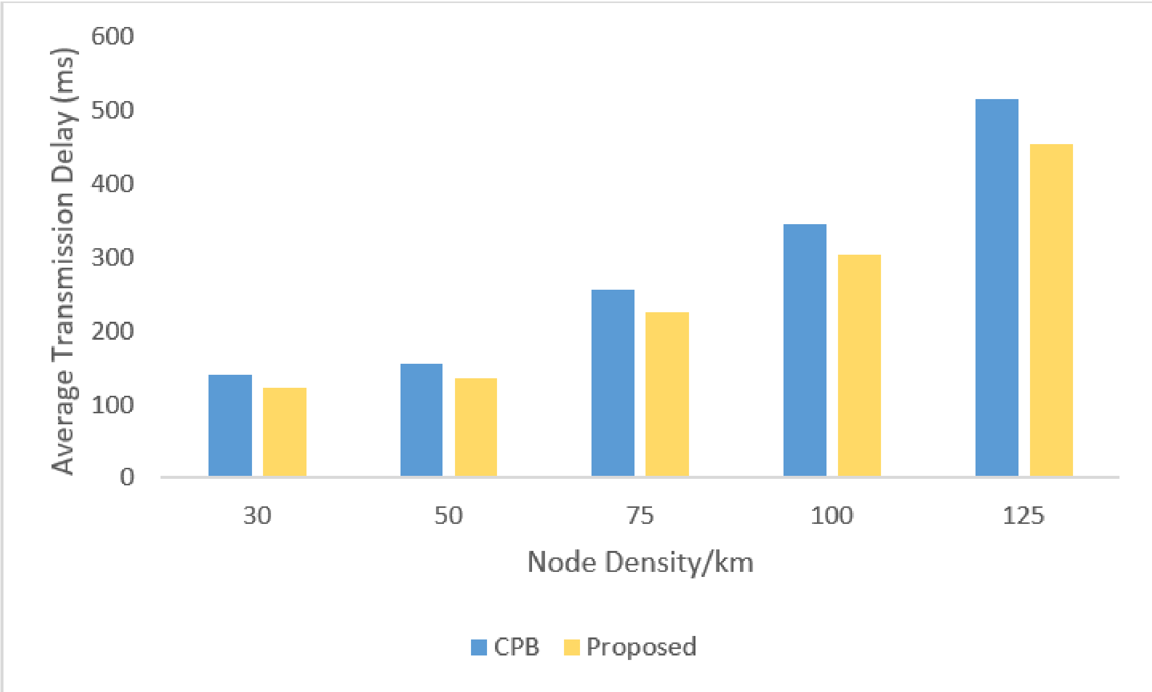

Figure 5.6: Comparing CPB with Proposed scheme w.r.t. Average Transmission Delay vs. Node density

of the network.

In Fig 5.8, the packet delivery ratio is evaluated with the velocity of the vehicles comparing the two mechanisms i.e. CPB and proposed mechanism. The packet delivery ratio decreases with rise in the velocity of the vehicles in the simulation implementing the two algorithms. The contributing factor for this decrease is that the network lifetime of clustering node decreases as the vehicles move faster and faster therefore they remain in contact for less amount of time, hence they have shorter network lifetime. Which in-turn effects the packet delivery ratio as there are lesser and lesser network lifetime with increasing velocity of the vehicles.

Fig 5.9 describes the two techniques used in comparison with these two parameters i.e. Jin's Model and the Proposed scheme. The figure reveals that the percentage of information coverage of Jin's Model underperforms compared to Proposed mechanism in lower node density level, but as the node density increase then the Jin's Model start to catch up with our mechanism. The observation is low amount of vehicles are available to disperse the message , accordingly they cover a little territory of the Urban envi-

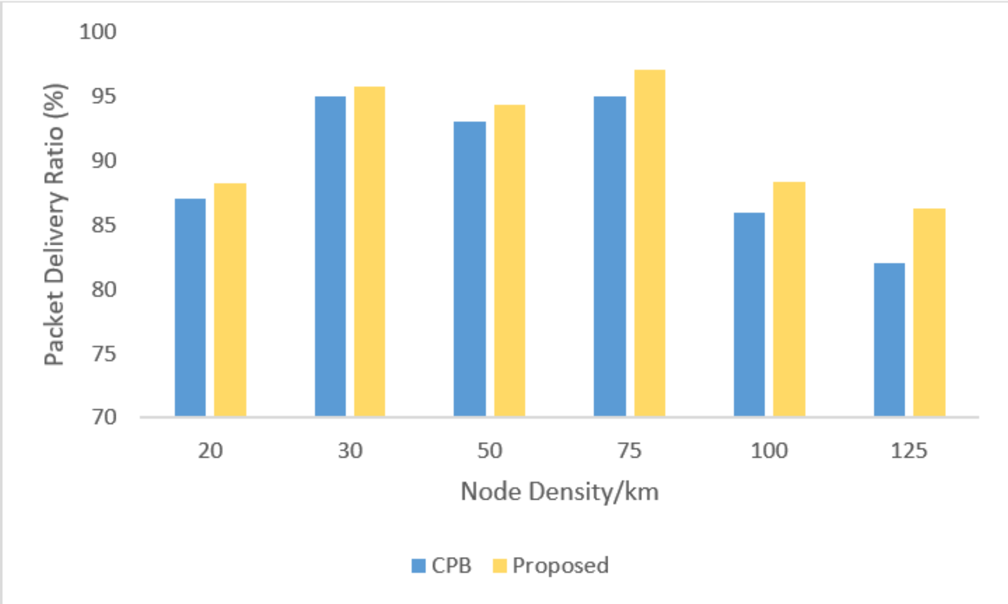

Figure 5.7: Comparing CPB with Proposed scheme w.r.t. Packet delivery ratio vs. Vehicle density

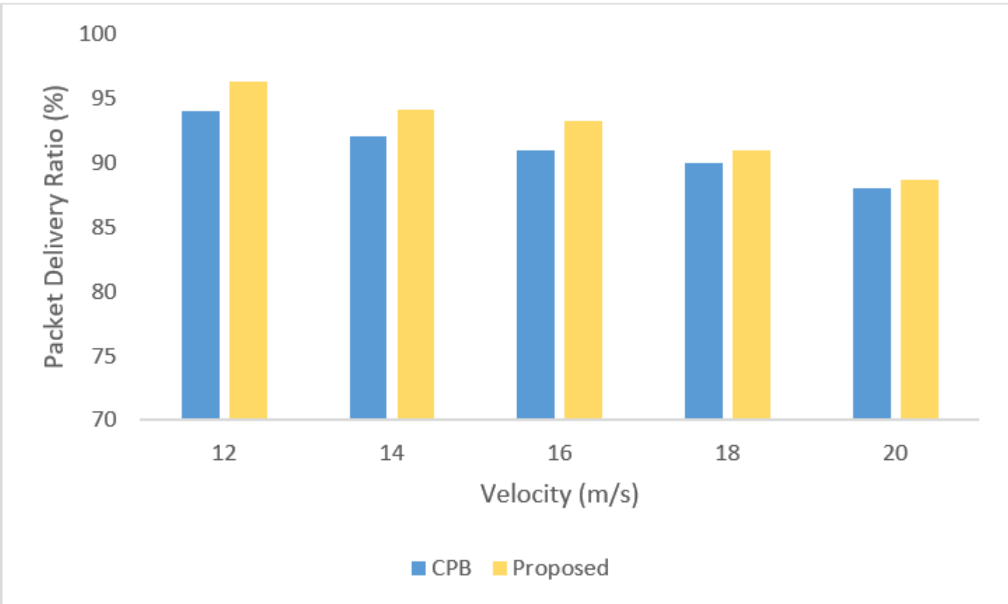

Figure 5.8: Comparing CPB with Proposed scheme w.r.t. Packet delivery ratio vs. velocity

ronment. Hence, the coverage of information is low in lower node density. Information coverage increase with a rise in the vehicular density as more and more nodes are dispersing the messages. There comes a point when the information coverage becomes saturated and doesn't increase with rise in node density rather it decrease with increase in vehicular density. The factor behind this is, network congestion starts to occur due to which information coverage can't increase any further.

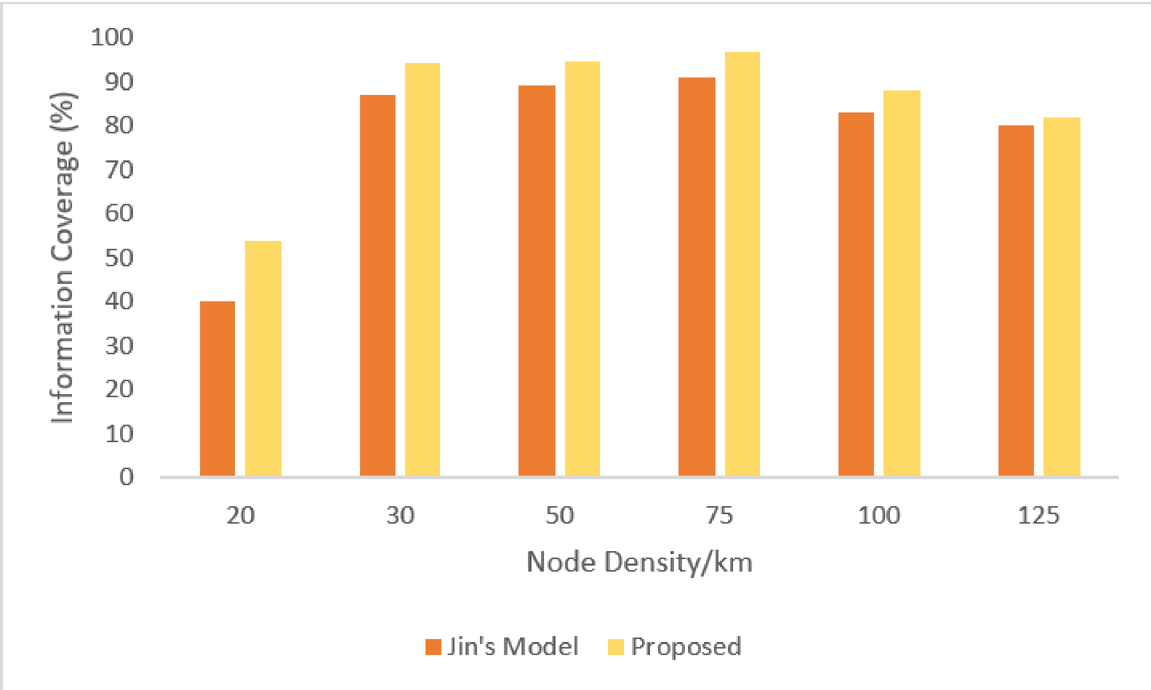

Figure 5.9: Comparing Jin's Model with Proposed Scheme w.r.t. Information coverage vs. Node density

Figure 5.10 shows the average transmission delay w.r.t node density. The two algorithms i.e. Jin's Model and the Proposed scheme are compared in this diagram showing that the average transmission delay does not a major difference when the node density is kept low, where as meaningful changes is seen when is node density is increased.The main reason is that the proposed algorithm tackles the emergency messages better in a higher density when compared to Jin's Model.

Figure 5.11 shows the packet delivery ratio w.r.t node density. Jin's Model and the Proposed scheme are compared in this graph, we observe

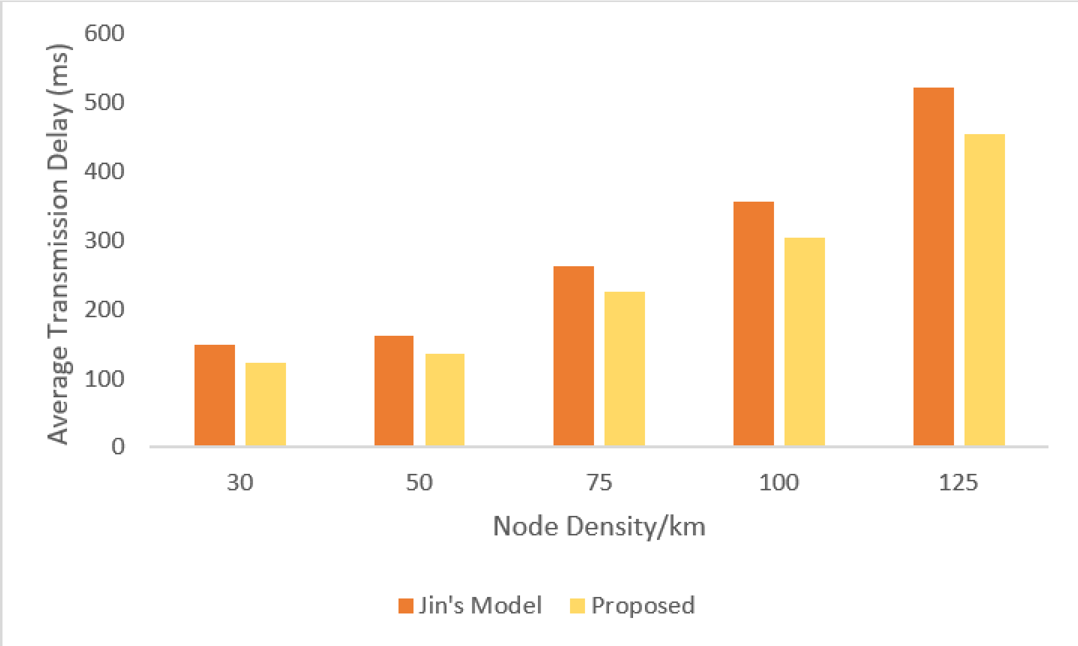

Figure 5.10: Comparing Jin's Model with Proposed scheme w.r.t. Average Transmission Delay vs. Node density

that the packet delivery ratio is not having a major difference in lower node density. But as the node density is increased beyond a certain threshold the packet delivery ratio increases because the nodes come closer to one another and overlaps in the transmission range of the other nodes. Although after reaching saturation the packet delivery ratio decreases with increase in node density i.e. the amount of successfully encountered packets is decreased and the major factor behind that is congestion of the network.

In Fig 5.12, the packet delivery ratio is evaluated with the velocity of the vehicles comparing the two mechanisms i.e. Jin's Model and proposed mechanism. It can be seen that the packet delivery ratio is decrease with rise in the velocity of the vehicles. The major reason behind this is the decreasing network lifetime of clustering nodes as the vehicles move faster, hence they have shorter network lifetime. This directly effect the packet delivery ratio of the network.

Figure 5.13 shows the percentage of information coverage w.r.t node density, describing the two techniques used in comparison with these two parameters i.e. flooding and the Proposed scheme. The figure shows an interesting facts that the percentage of information coverage of flooding outperforms

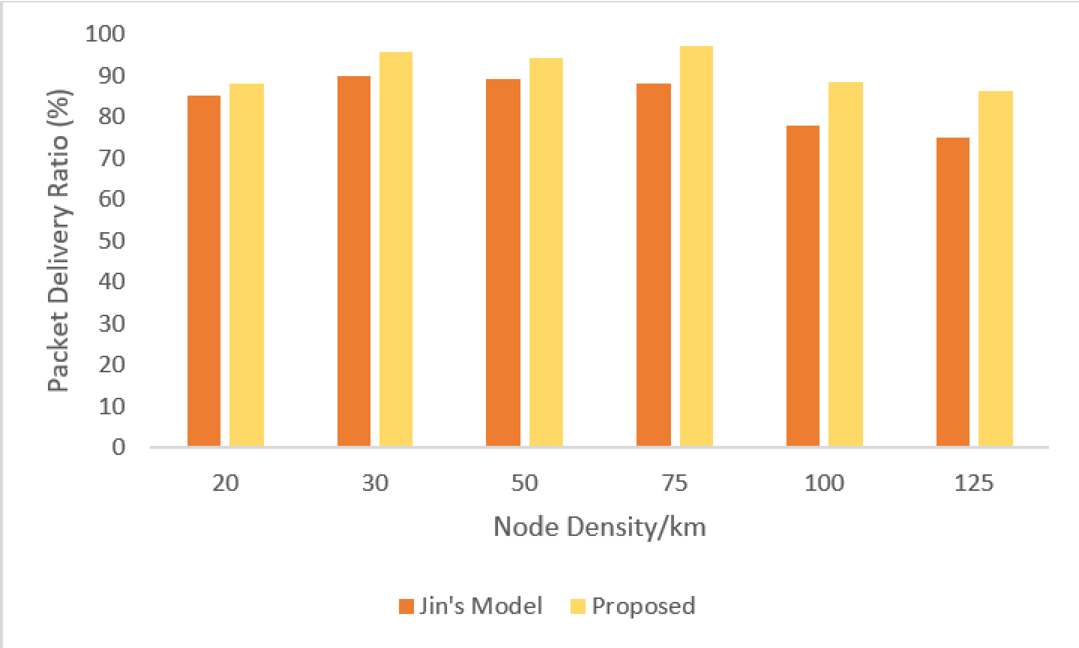

Figure 5.11: Comparing Jin's Model with Proposed scheme w.r.t. Packet delivery ratio vs. Node density

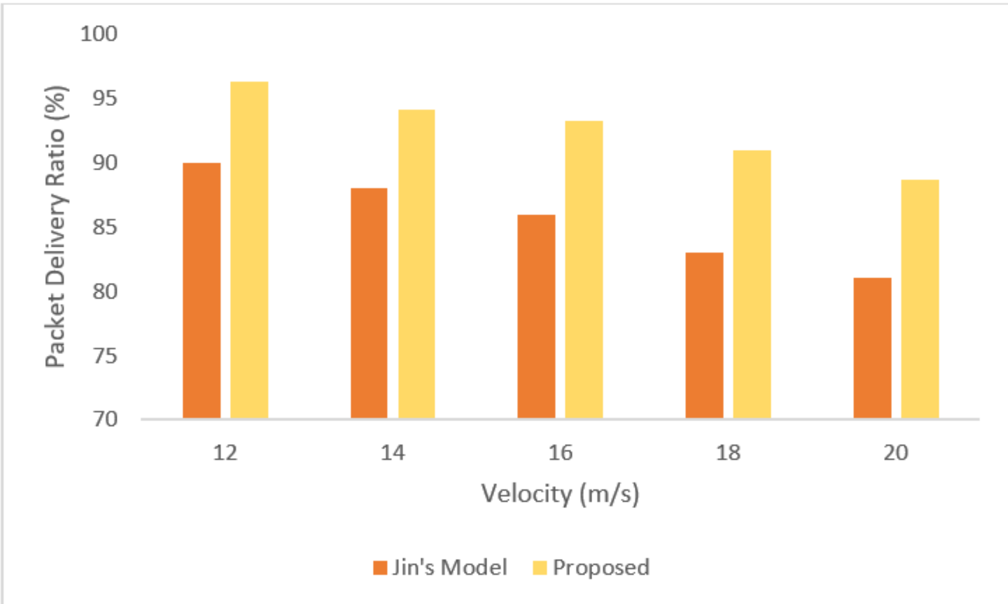

Figure 5.12: Comparing Jin's Model with Proposed scheme w.r.t. Packet delivery ratio vs. velocity

from the proposed technique in lower node density. This is mainly due to the reason that in flooding mechanism, every vehicle broadcasts the recieved messages regardless of its environment but as the node density increases, our proposed mechanism wins the race in the longer run. The main factor of this is that as the vehicular density increases, the flooding technique causes network congestion due to unnecessary rebroadcasts which causes packet collisions and in-turn packet losses ,therefore they cover a smaller area of the Urban environment. Hence the information coverage of flooding technique is low in high node density. As the density of the vehicles increases, information coverage of our proposed technique also increase, because more and more vehicles are covering the urban area. After a while, when the node density reaches a certain point then the information coverage starts to decrease and doesn't increase with the rise in node density. The main factor behind this is that a higher node density beyond a certain desired point causes congestion in the network which is disadvantage of increasing the node density beyond certain limits.

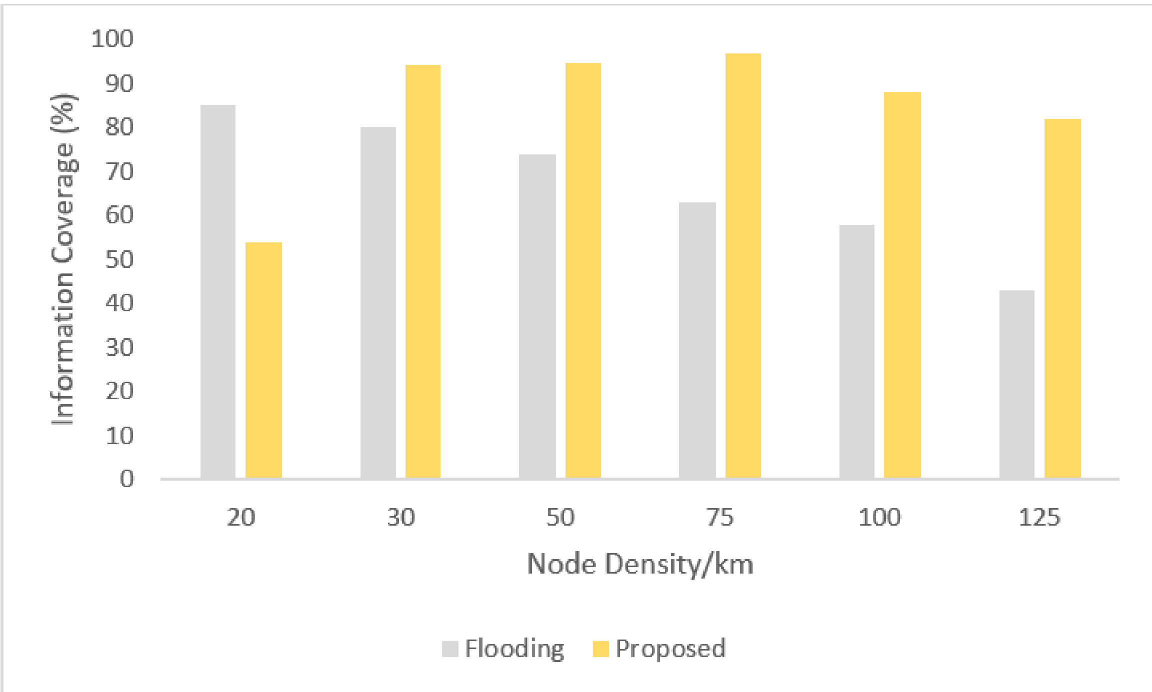

Figure 5.13: Comparing flooding with Proposed Scheme w.r.t. Information coverage vs. Node density

Figure 5.14 shows the average transmission delay w.r.t node density.

Flooding and the Proposed scheme are compared in this scenario. It is worth noticing that the flooding mechanism is performing very well as compared to our proposed mechanism in lower node density.The crucial factor behind this is that flooding technique broadcasts the incoming messages without any computation or delay, so vehicles receives the messages in a very short span. But as the node density is increased, the transmission delay increases with such a measure that it under-performs our proposed mechanism. A prominent change can be observed.This is because the proposed algorithm tackles the emergency messages better in a higher density than the flooding mechanism. The flooding mechanism fails in higher node density due to the unnecessary rebroadcasts causing the network congestion and packet drops.

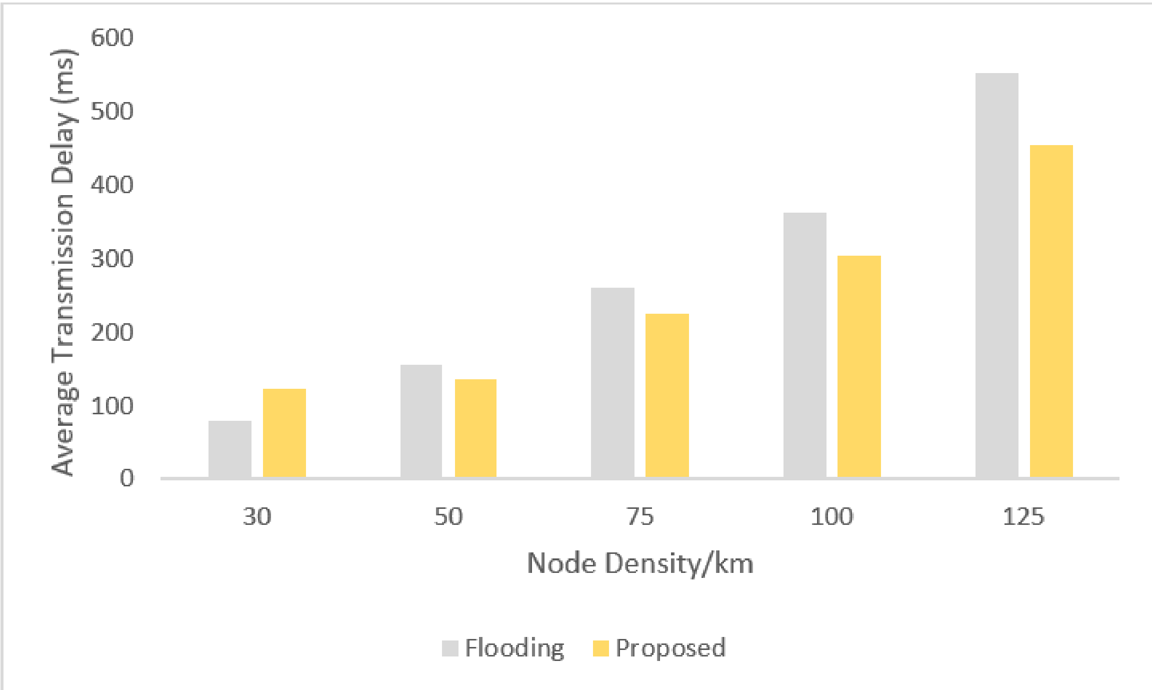

Figure 5.14: Comparing flooding with Proposed scheme w.r.t. Average Transmission Delay vs. Node density

Figure 5.15 shows the packet delivery ratio w.r.t node density. Flooding and the Proposed scheme are compared in this graph, It can be observed that our proposed mechanism is a clear winner in this situation whether it is higher or lower node density.The main reason flooding mechanism is lacking behind in packet delivery ratio is because of the unnecessary broadcast that every vehicle performs causing the network congestion. This further the packet collisions and packet drops occur at a larger scale. After the saturation of packet delivery ratio is achieved packet delivery ratio decreases with increase in node density i.e. the number of successfully received packets is decreased and the major factor behind that is congestion of the network.

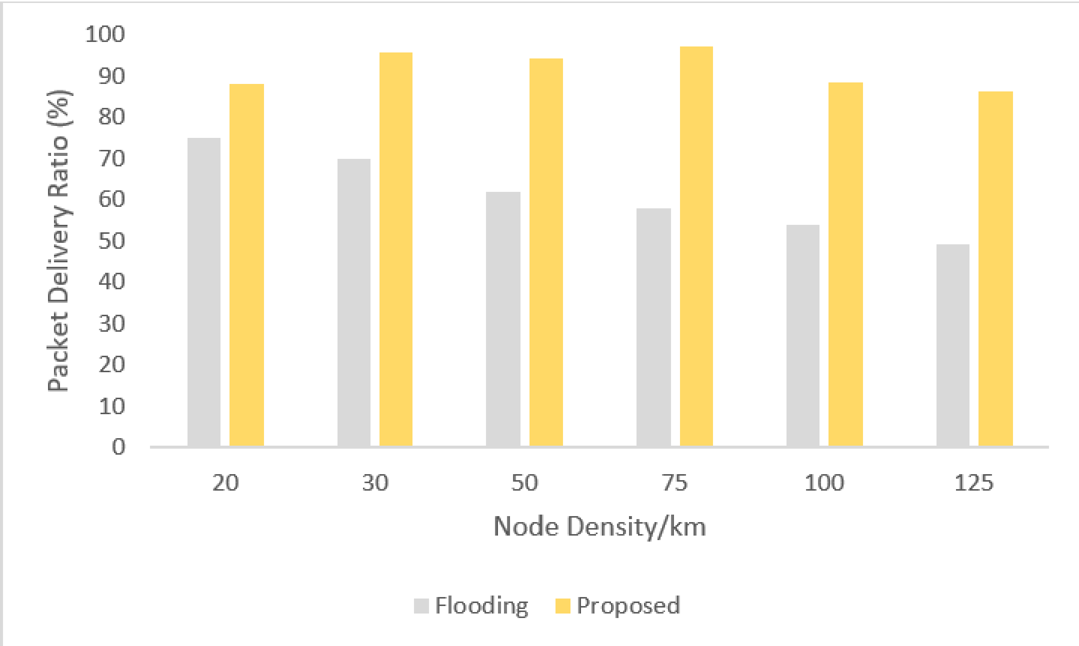

Figure 5.15: Comparing flooding with Proposed scheme w.r.t. Packet delivery ratio vs. Node density

In Fig 5.16, the packet delivery ratio is analyzed with the velocity of the vehicles comparing the two mechanisms i.e. flooding and proposed mechanism. It can be seen that the flooding technique performs very poorly as the velocity of the node is increased. The packet delivery ratio is decreasing with rise in the velocity of the vehicles. The major reason behind this is the unnecessary rebroadcasts and decreasing network lifetime of clustering nodes as the vehicles move faster, hence they have shorter network lifetime.This is major issue with the flooding mechanism.

In Fig 5.17, different beacon intervals are tested to see its effect on average transmission delay compared with vehicle density of the proposed technique. It is seen that the proposed technique executes much better at 50 ms beacon interval and doesn't perform that well when tested on other intervals i.e. 15 ms, 25 ms, 35 ms, 50 ms. The reason behind the poor performance of the proposed technique on intervals other than that of 50 ms is because of frequent generation of beacons. Due to which, the performance of proposed

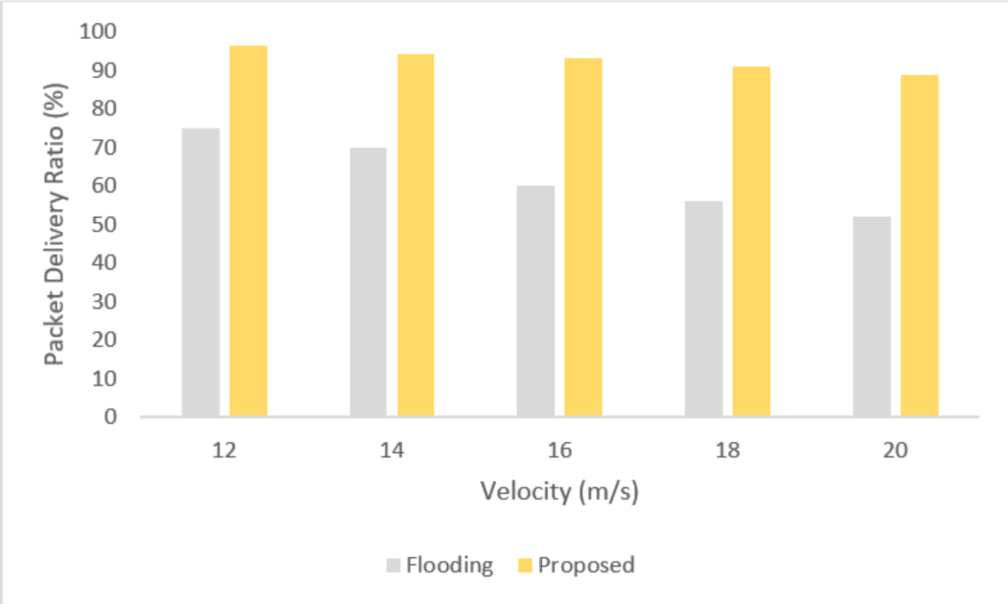

Figure 5.16: Comparing flooding with Proposed scheme w.r.t. Packet delivery ratio vs. velocity

technique degrades.

In Fig 5.18, multiple intervals of beacon generation are simulated to observe its impact on packet delivery ratio vs vehicle density of the proposed technique. Upon analysis of results,our proposed technique performs better at 50 ms interval of beacon generation. All other intervals of beacon generation 10 ms, 25 ms, 35 ms, 50 ms. The main factor of poor performance of the proposed technique is due to unnecessary beacon generations which caused congestion in vehicular network.

In Fig 5.19, proposed technique has been observed at different beacon intervals to see its effect on packet delivery ratio vs vehicle's velocity. Of all the intervals, 50 ms interval of beacon generation performs best among all other intervals of beacon generation 10 ms, 25 ms, 35 ms, 50 ms. Main contributing factor behind this is the unnecessary periodic beacon generations.

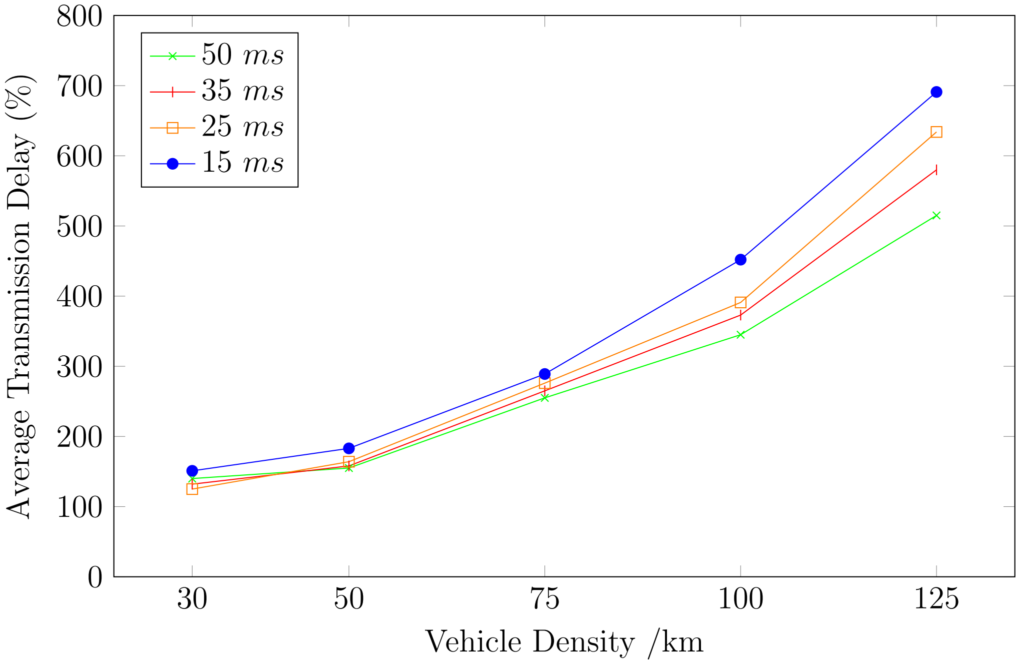

Figure 5.17: Average Transmission Delay compared with Vehicle Density w.r.t different beacon interval of the proposed mechanism

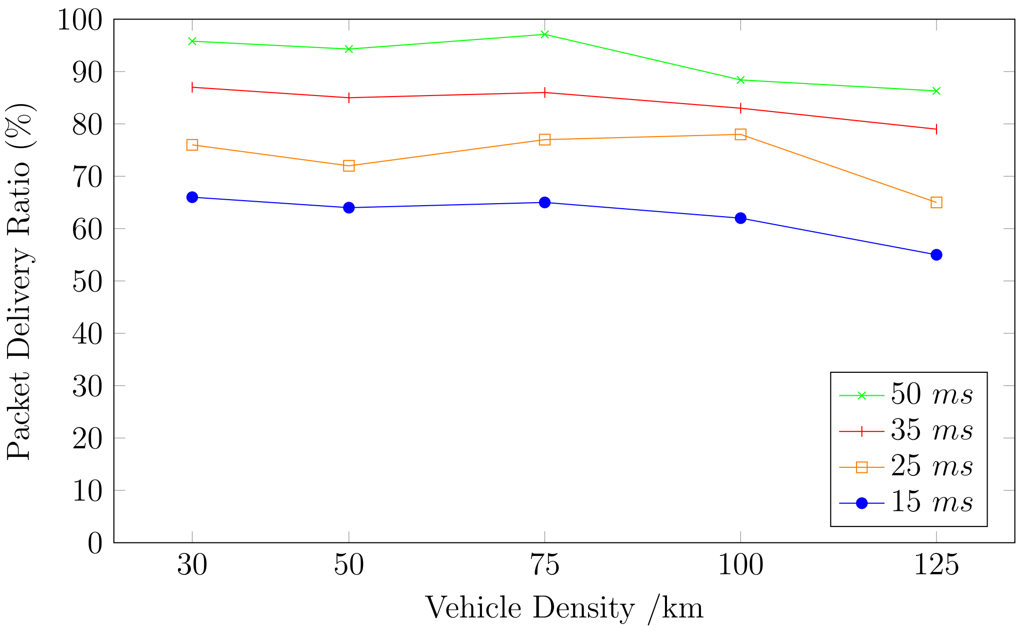

Figure 5.18: Packet Delivery Ratio compared with Vehicle Density w.r.t different beacon interval of the proposed mechanism

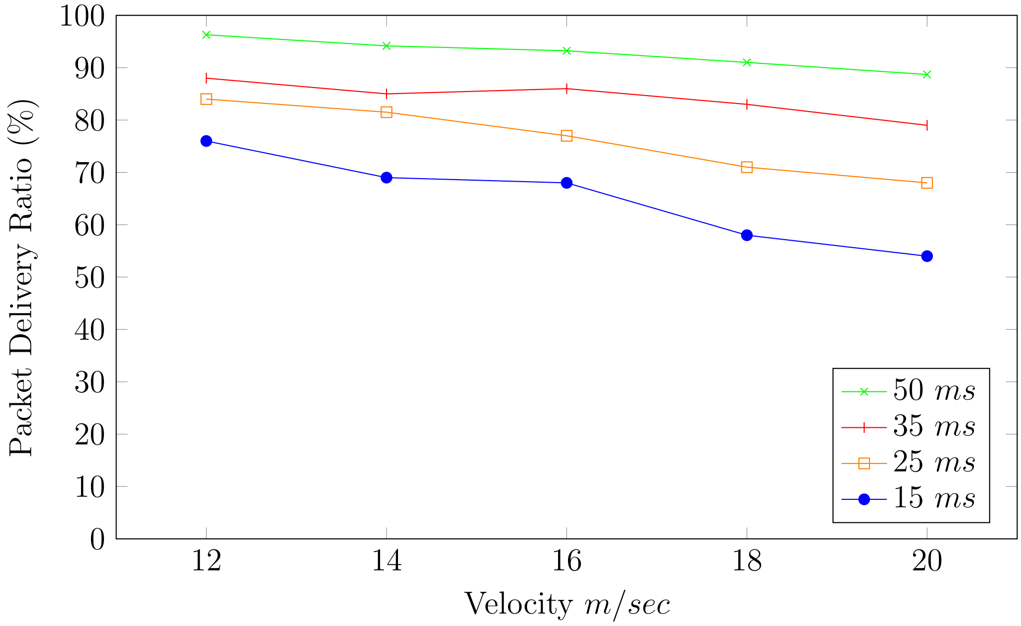

Figure 5.19: Packet Delivery Ratio compared with changing Velocity w.r.t different beacon interval of the proposed mechanism

Chapter 6

Conclusion & Future Work

Lastly, this chapter concludes the presented research work. In which, section 6.1 presents the conclusion of this research work and 6.2 covers the future directions and some other research challenges that need to be addressed and section .

6.1 Conclusion

In conclusion,we were aiming to reduce the average transmission delay for emergency messages so that they may be received successfully while keeping the messages count low as possible while avoiding network congestion. The emergency messages should be delivered as soon as possible as they are very time critical and they can entirely useless if there are unnecessary delay, which render the purpose of emergency messages pointless. Our proposed mechanism achieved this goal of delivering timely emergency messages for the deserving vehicles, in order to take necessary action based on these messages. The results show that the overall information coverage is improved as there are no unnecessary rebroadcasts and only the needy messages are rebroadcasted for the timely dissemination. The packet delivery ratio is increased with the decrease in the average transmission delay. Different beacon intervals are tested to see its effect on average transmission delay compared with vehicle density of the proposed technique. It is seen that the proposed technique executes much better at 50 ms beacon interval. It is observed that our proposed scheme works better in higher node density and low velocity of the vehicles moving in the urban areas. This is because in higher velocity, network lifetime decrease and there is less time for the vehicles to remain in contact. There packets doesn't reach that many vehicles as they should. This lesser contact time of vehicles causes the packet delivery ratio to drop as the messages are not being delivered to the desired vehicles. Hence, the information coverage area is also effected by the high velocity of the concerned vehicles.

6.2 Future Work

There is still a room for improvement for dissemination of information. One key factor that needs attention is to minimize the average transmission delay in urban areas. The region with lower density and high velocity of vehicles should be catered for dissemination of emergency messages. Where as on highway scenario, the vehicle's velocity is quite high. There should be more focus on the clustering techniques and increasing the lifetime of vehicles which are moving at higher speed. With advancement in Telecom sector, LTE and 5G services could be used alongside infrastructure to increase the information coverage of data messages as well as emergency messages. Currently the cluster size of VANET's network is bottlenecked by the transmission range of the CH of cluster. But by the use of Cloud-based services and Fog-Computing, this bottleneck issue can be bridged.

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Annex

Installation of OMNeT++, SUMO and VEINS

This section provides step by step installation process of OMNeT++, SUMO and VEINS to run a basic simulation in Ubuntu 16.04.

Setting up environment for Smooth installation of omnet++ 5.1.1

First of all check python version , omnet run smoothly with python2.7 instead of 3.x, type "python" in terminal to check version Ubuntu comes installed with python2.7
Secondly, install java if not installed already with this command:

sudo apt-get install openjdk-8-jdk

download omnet++ 5.1.1 archive from internet and extract it in **home/<user>/directory**
Link to download omnet++ 5.1.1

"https://www.omnetpp.org/component/jdownloads/category/32-release-older-versions?Itemid=-1"
After extracting OMNeT, enter into OMNeT directory by terminal by typing **"cd omnetpp-5.1.1"** assuming that you are already in the user directory in terminal.
type pwd and copy directory now type the following command to set paths

gedit ~/.bashrc

A file will open ,now we have to set path : (write this code with your respective directory and add /bin at the end)

export PATH=$PATH:/home/ubuntu/omnetpp-5.1.1/bin

export OMNET_DIR=/home/ubuntu/omnetpp-5.1.1

(after writing to the file , save it and close it)
after saving, type following command in terminal:

source ~/.bashrc

now type the following command to install the necessary libraries for OMNeT , without these packages **./configure** command would give error.

sudo apt-get install build-essential gcc g++ bison flex perl tcl-dev tk-dev libxml2-dev zlib1g-dev default-jre doxygen graphviz libwebkitgtk-1.0-0 qt4-qmake libqt4-dev libqt4-opengl-dev openscenegraph libopenscenegraph-dev openscenegraph-plugin-osgearth osgearth osgearth-data libosgearth-dev openmpi-bin libopenmpi-dev nemiver qt5-default

then type the following command in terminal, if everything goes well, after configuration "good" will be show after execution

./configure

then type the following command, this will take some time so be patient.

Type **"make"**

after **"make"** command is completed, type following to run OMNeT++ 5.1.1

omnetpp

After typing **"omnetpp"**, OMNeT++ will be opened.

INET Installation

after running omnetpp , install INET framework , if it doesn't show up by default then go to **"help"** menu and click on **"install simulation models"** and install INET framework after installing INET framework, run **"build all"** from **"project"** menu

Installing Sumo and its packages

after building all, download the following packages from
"http://sumo.dlr.de/wiki/Contributed/SUMOPy#Linux"
with the help of **"sudo apt-get install <package>"**
python-numpy
python-wxgtk2.8
python-opengl
python-imaging
python-matplotlib
python-mpltoolkits.basemap
as mentioned on the site above , downloading **python-wxgtk2.8** on ubuntu 16.04 may give error if so then use the following commands for installing it.

sudo add-apt-repository ppa:nilarimogard/webupd8
sudo apt-get update
sudo apt-get install python-wxgtk2.8
this will install **python-wxgtk2.8**
after this we will install **sumo** using the terminal command that is:
sudo apt-get install sumo
this will install sumo

Importing Veins and Running Example

next step is to import veins 4.6 in omnetpp project
first of all download veins 4.6 from **"http://veins.car2x.org/download/"** and extract it to the same folder/directory where **omnetpp** is extracted
after extracting veins 4.6 , we need to import it in **omnetpp** , click on **"file"** then click **"import"**, after that select **"general"** and then **"existing projects into workspace"** and click next.
select root directory by clicking on browse button and add vein 4.6 folder and click finish.
now we need to build all project once again by clicking **project→ build all**.
after building open new terminal and drag **"sumo_launchd.py"** to the terminal,it will write the path to that file itself, then add **"-vv -c"**.
now search for **"sumo-gui"** in **"computer"** folder and drag it into the terminal ,now your command would look something like this.
"/home/sarmad/veins-veins-4.6/sumo-launchd.py' -vv -c '/usr/bin/sumo-gui"
press enter to execute the above command.
after running the above command , it will say **"Logging to /tmp/sumo-launchd.log Listening on port 9999"** now go into omnetpp and right click on **omnetpp.ini** which lies inside the **veins→examples→veins→omnetpp.ini** and **"run as"→"omnet++ simulation"** Thats it.