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NS2 based VANET Modeling and Simulation of Emergency Scenarios for Ambulance System

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Abstract: Emergency scenarios are very common in any kind of traffic situations. In a country like Pakistan there are many such cases where traffic congestions become fatal for those have emergency cases. In this paper we have tested different IEEE standard for working in simulation scenarios in order to check which standard performs better in these scenarios. We have used 802.11b and 802.11p and have compared these two in terms of outputs. We have calculated two parameters like relationship of throughput and call stress, and Packet Deliver Ratio (PDR) VS Call Stress in 802.11b and 802.11p.

Keywords: VANETs, Emergency, Throughput, Packets;

I. INTRODUCTION

Researches nowadays being conducted for making better life experiences of humans [1], [2]. Information and Communication Technology (ICT) plays an important towards the betterment in every field like security, education and communications [3]. People get injured and lose their lives whenever there is an accident on the road. The cause of accidents may be driver's fault, traffic rules violation and others [4]. "Vehicular Ad-hoc Networks (VANETs)" is a field of research which has gathered significant importance as it deals with improvisation of flow of traffic and to make travelling safe and sound [5]. It helps in reducing accidents as well as intimates the driver about circumstances like traffic jam and some other mishap [6]. VANETs also help in providing convenience and comfort to the passengers as well as the drivers [7]. VANETs provide Intelligent Transportation Systems (ITS) which helps us to save life, energy and avoid mishaps [8]. The conventional transport system can be made better with the help of VANETs because it uses Information and communication Technologies (ICT) to improvise. The major cause of development of VANET is that with the help of it warning messages can be generated making travelling more secure. The major applications of VANETs technology is to make sure about road safety, warning about lane changes, emergency warnings or accident warnings [9]. VANET is categorized as either "vehicle-to-infrastructure (V2I)" communication or "vehicle-to-vehicle (V2V)" communication [10]. Table 2 lists all the abbreviations that have been used throughout this paper.

II. RELATED WORK

The research carried out by [12] has proposed a protocol named as "Black-burst and Multi-channel based Multi-hop Broadcast (BMMB)" protocol. It is designed to deal with event-driven emergency messages broadcasting in urban environment. The existing protocols which are based on black-burst methods are compared with their proposed protocol and their protocol is efficient enough to cut the repetition partitions in order to find optical segment. The proposed protocol also is able to ignore Clear to Broadcast (CTB) collision whenever it is searching the relays.

In [13] the research has been carried in designing warning system for emergency scenarios which is able to make use of roadside infrastructure (for example lights at traffic signals) in vehicle communication. In their system the vehicles receive a warning signal when a emergency vehicle is approaching them. Not only this but, vehicles also receive the route information. These two functions allow the timely necessary action to be taken.

The authors in [14] have presented a framework in order to calculate probability networks that are based on IEEE 802.11p at medium access control layer. The simulation was performed in simulation tool NS2 and their proposed enhanced DSR was able to outperform other routing protocols in terms of successful delivering of packet.

Evaluation and comparison of the "dynamic source routing (DSR)", "swarm intelligence" and "ad-hoc on–demand distance vector (AODV)" is performed by [15]. From the results in their research show that protocols which are based on swarm intelligence are better in terms of data delivery (ratio as well as the cost) and throughput when they are compared to DSR and AODV.

The research is being carried by IEEE on "IEEE 802.11p Wireless Access Vehicular Environment (WAVE)" standard for the purpose of providing "Dedicated Short Range Communication (DSRC)" in V2V communication systems. The research in [16] has evaluated WAVE standard. In their research the author has considered parameters like throughput, collision probability and delay for evaluation of this standard. According to their results from simulation the WAVE standard throughput decreases and delay increases in a dense environment.

III. TOOLS AND TECHNOLOGIES

In this section we define we define the tools and technologies like standards used are discussed

A. *IEEE 802.11p standard*

IEEE is defining a new communication standard. They are designing this standard for which future communications between vehicles. IEEE 802.11p is also called "Wireless Access in Vehicular Environments (WAVE)" standard. It is a standard that is to be used for inter vehicle communication in future

B. *IEEE 802.11b*

Dynamic medium sharing is significantly more troublesome in VANETs because of high node movement and quick topology changes. Like MANET, VANET uses single shared medium for transmission. Nodes have difficulty to know for idle channel. PHY/MAC 802.11b standard can be used in VANET environment. It was first standard for wireless networking standard. It uses unlicensed band 2.4 Ghz. Its data rate is about from 7 Mb/s to 11 Mb/s. It uses "Carrier-sense multiple access with collision avoidance" CSMA/CA because of shared medium. It uses listen-before-talking technique due to single shared channel.

C. *"Ad-hoc On-Demand Distance Vector (AODV)"*

It is a routing protocol which is reactive. It creates routing paths in network for on demand communication. For route discovery, first it sends RREQ packets in network and after receiving RREQ by destination node. The destination sensor node replies to source sensor node with RREP packet. All routes are maintained by routing table which it maintains. It uses a timer for entry and removing the paths. It also uses destination sequence number to avoid the routing loops. To identify the packet loss or in case of link breaking, AODV uses RRER massages. Again, AODV sends RREQ massage in network to develop new routing paths. Intermediate nodes are known as forwarding nodes. They discard the duplicate RREQ. They send RREP to sender if they have high sequence number in active route. Otherwise Intermediate nodes broadcast RREQ packets. Figure 1 shows the activity of AODV routing protocol. Where S is sender node, F are intermediates nodes and D is destination node. Red arrows show the RREQ and green arrows show RREP.

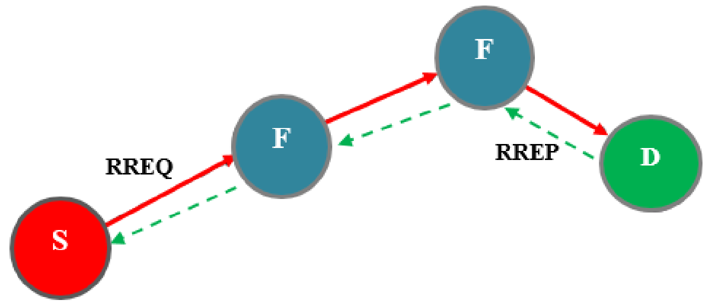

Figure 1: AODV Route Discovery

D. *3.3 NS-2 Simulator*

It is an open-source networking simulating software used mostly in VANET applications [11]. It has IEEE 802.11 support. Its code is written in Object TCL (OTCL) or in C++. We use **google open** street map for design the realistic scenario of vehicular ad hoc network. Open stream map provides .osm extension based file for any piece of the world chose through google open street map website. We have drawn the map of two location of Karachi Pakistan. As Karachi is the largest city of Pakistan in term of population. We picked about 5km area from Civil Hospital Karachi to Agha Khan Hospital Karachi. It is very congested area and huge traffic of vehicles cross in few second. The map of google open street is shown in figure 2.

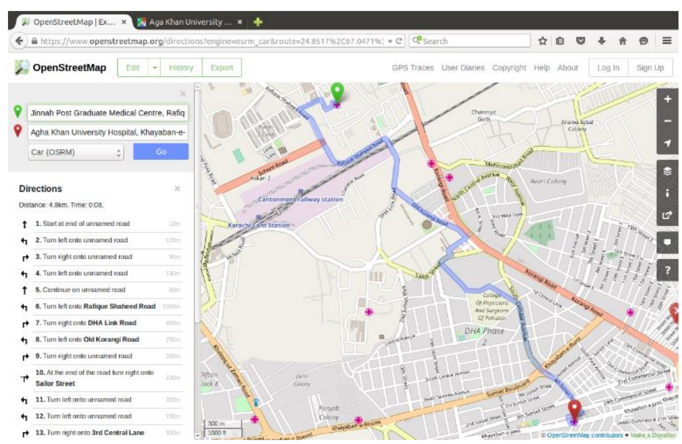

Figure 2: Google Open Street Map

We convert the original map .osm file into native xml file for 250 vehicles using "simulation of urban mobility (SUMO)". SUMO provides a microscopic realistic road traffic topology for VANET scenarios. All vehicles have been directed full control in simulation. It generates mobility with true speed of vehicles and it provides all characteristics of road e.g. traffic signals, road junction, and directions. SUMO convert .osm file into .tcl files. NS2 compiles TCL file into two more files. One is .tr file from that we can easily trace and calculate required results. Second is .nam file that is used for animation of network.

1) 3.3.1 Scenario in NS2

We simulated our scenario in a discrete event simulator known as NS2. We use total 200 nodes out of 250 using wireless channel for communication as shown in figure 3. We simulate urban mobility model for VANET. We choose 802.11p and 802.11b as MAC protocols. Further our scenario parameters are defined in table 1

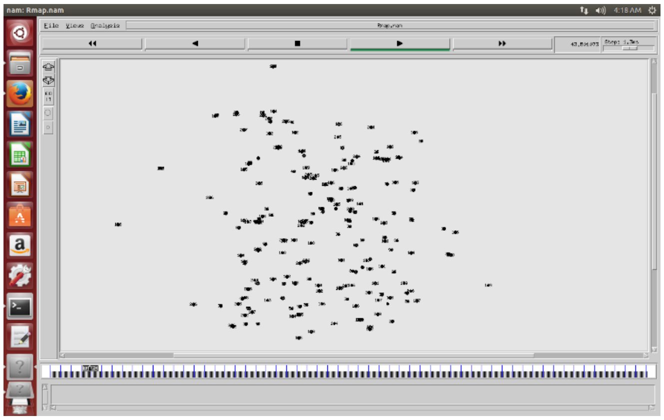

Figure 3: Screen shot of Simulation

Table 1: Simulation Scenario Parameters

Parameters	**Values**
Area	5700 m × 5000 m
Routing Protocol	AODV
MAC Protocol	802.11b and 802.11p
Simulation Time	600
Per call time = Call stress + Call silent time	(10+110), (20+100), (30+90), (40+80), (50+70), (60+60), (70+50), (80+40), (90+30), (100+20)
Connection per node = Simulation-Time / Per- call-time	5 = 600/120
Physical Channel	Wireless Channel
Traffic type	CBR
No of nodes	240

IV. Simulation Results

In this section results of the simulation scenarios are presented

A. 4.1 Throughput VS Call Stress

Figure 4 illustrates relationship of throughput and call stress in "802.11p" and "802.11b". From the figure it could be observed that the output of 802.11p is better than 802.11b. As call stress increases as throughput of 802.11p increases linearly. 802.11p has more control even in high stress with real mobility of vehicles and it proves itself in term of throughput. On the other hand as call stress increases the throughput of 802.11b increases and saturates below 100 kbps.

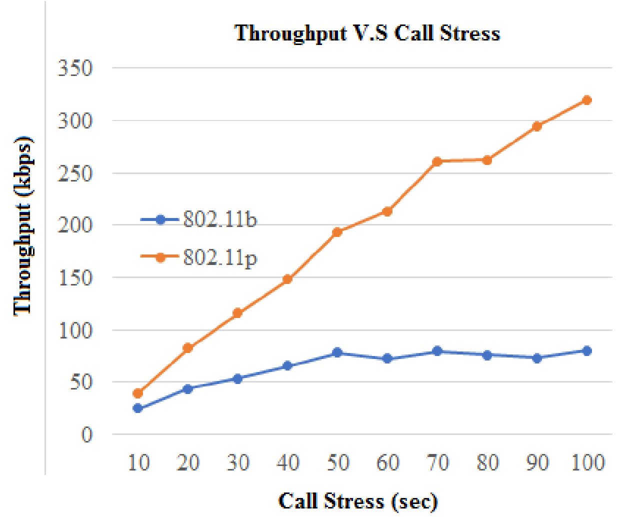

Figure 4: Throughput vs call stress of 802.11p and 802.11b

B. 4.2 Packet Deliver Ratio (PDR) VS Call Stress

It is very important factor of QoS for any network. Figure 5 graph shows the PDR in 802.11b and 802.11p. it can be seen that the PDR of 802.11p is more high than 802.11b. 802.11p maintains itself for PDR in all call stress and does not decay. On other hand 802.11b does not maintain PDR as call stress increases. It decays the PDR in linearly as call stress increases. PDR must be high for good network performance when any protocol does not give good performance in term of PDR, so it is not suitable for the network.

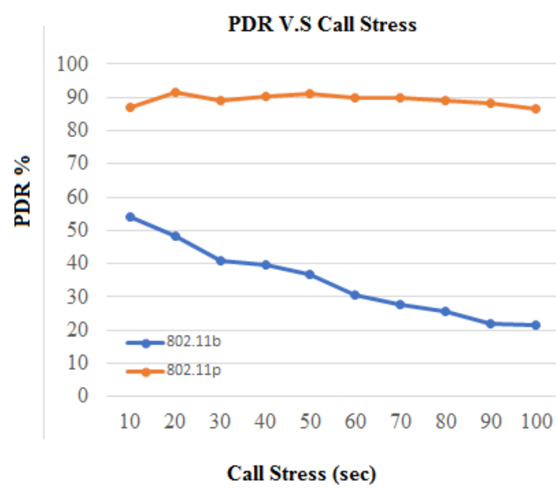

Figure 5: PDR vs call stress of 802.11p and 802.11b

1. Conclusion

In the proposed work a new routing calculation based on the route for Pakistani road situations is designed. The proposed work is for route between Civil Hospital Karachi to Agha Khan Hospital Karachi. We have calculated the traffic congestion by node analysis. We have performed simulations and have compared different standards like 802.11b and 802.11p and it was observed that 802.11p performs better.

Table 2: List of Abbreviations

Abbreviation	Full Form
AODV	Ad-hoc On–demand Distance Vector
BMMB	Black-burst and Multi-channel based Multi-hop Broadcast
CTB	Clear To Broadcast
CSMA/CA	Carrier-Sense Multiple Access with Collision Avoidance
DSR	Dynamic Source Routing
DSDV	Destination Sequenced Distance Vectors
E2ED	End – to – End Delay
FSR	Fish-eye State Routing
ICT	Information and Communication Technology
IEEE	Institute of Electrical and Electronics Engineers
ITS	Intelligent Transportation Systems
NRL	Normalized Routing Load
NS2	Network Simulator – 2
OLSR	Optimized Link State Routing
V2I	Vehicle to Infrastructure
V2V	Vehicle to Vehicle
VANETs	Vehicular Ad-hoc Networks
OSM	Open Street Map
WAVE	Wireless Access Vehicular Environment
DSRC	Dedicated Short Range Communication
SUMO	Simulation of Urban Mobility
MAC	Medium Access Control
PDR	Packet Deliver Ratio
PLR	Packet Loss Ratio

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