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Management of Node in VANET by Shifting The Position of Road Side Units

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Abstract— Vehicular Ad hoc Network (VANETs) is a sub-class network of Mobile Ad hoc Network (MANETs). It has similar behavior as MANETs but different in mobility of nodes and their nodes speed. The mobility of nodes in VANETs organized in fixed pattern and speed of nodes is very high. Basically here VANETs vehicles can communicate to other vehicles directly or via intermediate fixed architectures. Most of time on highway or rural area the density of vehicles varies a lot and if any vehicle wants communicate with other vehicle directly may faces many problems. To overcome these problems the intermediate infrastructure needs to pay a very important role. In this paper we analysis the performance of three different placement strategies of infrastructure based relays and also find cost effective separation of infrastructures intermediate RSUs using NS2 Simulator.

Keywords- Vehicular Ad-hoc Network (VANET), AODV, IEEE 802.11, OBU, RSU.

I. INTRODUCTION

Vehicular Ad-hoc Networks (VANETs) are sub class of MANETs it inherits the properties of mobility of node from MANET but the mobility of nodes in VANET is fix pattern and highly mobile. It is self-organizing network in which vehicles are represented as mobile nodes in communication that do not rely on any fixed network infrastructure. In rural or urban areas we are facing traffic problem due to communication gap between vehicles. Now we are interested to improve traffic problem in both environment by reducing the communication gap between vehicles by various net-work technique VANETS were basically designed to avoid traffic jam, road accidents and provide speed control etc. in both environments. Initially VANETs were implemented in urban environment to improve traffic related problem after got success in urban areas it might be also helpful in rural areas or highway where communication gap between vehicles is very high and density of vehicles is very rare. VANETs are helpful to provide weather information and internet access for vehicle drivers. VANET networks are implemented through creation of wireless links between vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) also allowing drivers to communicate among themselves to avoid road accidents. In rural environment Vehicle to Vehicle communication is not possible so for but Vehicle to Infrastructure and Infrastructure to Vehicle Communications are

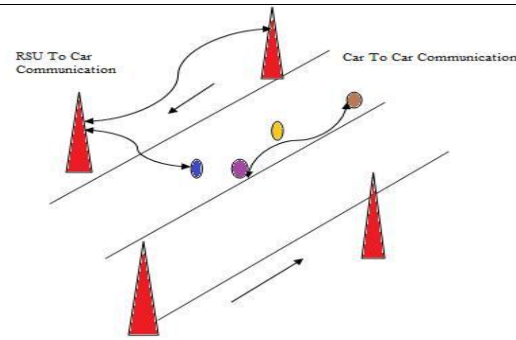

Figure 1. Structure of Vanet Ad-hoc Networks

allowed, which use Road Side Units (RSUs) for bridging the communication gap between vehicles. In VANETs, vehicle speed is confined by predefined roads and speeds would be random. On highway vehicles speed may vary and due to this varying speed of vehicles and connectivity between RSUs and vehicles, many challenging issues such as routing the data and data sharing with security are encountered. In this paper, we compare different placement of RSUs using Net-work Simulator 2, as an intermediate node which is trying to improve communication between vehicles so that accidents must be reduced. At last we are interested in finding the most cost efficient separation which may give better connectivity than the infrastructure less communication and lesser than complete infrastructure communication.

II. RELATED WORK

Data dissemination is a key component of Infotainment and safety services in Vehicular Ad Hoc Networks. For infotainment services data broadcasting starts from a Road Side Unit (RSU) and propagates to a multiplicity of On Board Units (OBU) to increase extension of RSU range to selecting single node [1]. But before describing RSU supported routing scheme let concentrate on some routing schemes designed for Ad hoc networks try to establish connections between mobile nodes. For example Perkins and Royer [2] proposed the Ad hoc On-demand Distance Vector (AODV) routing scheme. When the source nodes search for the destination node, it uses a flooding approach to broadcast. Route Request (RREQ) packets. On receipt of the RREQ messages, the destination node responds with a Route Reply (RREP) message along the desired route. Theoretically, DSDV and AODV can establish connections between any two nodes in an Ad hoc network; however, given the large number of cars and their highly dynamic positions, the overhead incurred in a VANET is unacceptably high, On the other hand, many VANET-based protocols focus on the inter-vehicle broadcast mechanism. For example, the MHVB scheme selects the most distant node on each branch to relay broadcast messages. To improve MHVBs performance, [3] utilize at directional antenna to adjust the transmission coverage of each vehicle the broadcast scheme proposed in [4] clusters nodes in the transmission range to yield a better performance. Although the schemes can broadcast messages efficiently, using them to query all nodes to contact the destination of each unicast is still inefficient. There are relatively few unicast routing schemes for VANETs. The GPSR scheme [5] assumes that each can knows the positions of all of its neighbors and destination, and the message is relayed repeatedly to the closed neighbor. To improve the reliability of GPSR, [6] proposes a multi-relay alternative. However, these approaches are only functional when the destinations position is fixed and known by all potential sending nodes, thus they are only suitable for V2R transmissions where the position of the RSU is static. They do not consider how the RSU can efficiently gather the positions of all nodes to enable R2V transmissions. A number of RSU-related schemes have also been pro-posed. Since the positions of RSUs are fixed and known by all vehicles connections to the RSUs can always be established by GPSR-like approaches. Therefore, most V2R-based approaches focus on improving the performance for example, [6] aims to improve the transmission throughput on highways by choosing appropriate relay nodes which prolong the connection lifetime. Under the scheme presented in [7], a proxy node is selected to cache the messages of the other nodes and transmit them afterwards. Compared to research on V2R, there have been relatively few studies of R2V, and most works, such as [8] and [9], focus on the R2V broadcast. To the best of our knowledge, the scheme proposed in [9] is the only one that considers R2V unicast. The scheme assumes that the current positions of all cars are known, and searches for a path that is very reliable and has a long lifespan. Before deciding the route, it is necessary to gather and update the information about vehicles. How to achieve this efficiently under a low signaling overhead is still an open issue.

A. Ad hoc on Demand Distance Vector (AODV)

Ad hoc on Demand Distance Vector Routing (AODV) is an example of pure reactive routing protocol. AODV belongs to multihop type of reactive routing. AODV routing protocol works purely on demand basis when it is required by network, which is fulfilled by nodes within the network. Route discovery and route maintenance is also carried out on demand basis even if only two nodes need to communicate with each other. AODV cuts down the need of nodes in order to always remain active and to continuously update routing information at each node. In other words, AODV maintains and discovers routes only when there is a need of communication among different nodes. AODV uses an efficient method of routing that reduces network load by broadcasting route discovery mechanism and by dynamically updating routing information at each intermediate node. Change in topology and loop free routing is maintained by using most recent routing information lying among the intermediate node by utilizing Destination Sequence Numbers of DSDV [10].

III. PROTOCOL IMPLEMENTATION

AODV protocol is implemented here and AODV works on three basic principles that is 1. Route Discovery: AODV uses route discovery by broadcasting RREQ to all its neighboring nodes. The broadcasted RREQ contains addresses of source and destination nodes in order identify those particular nodes for which route have been demanded. 2. AODV Route Table Management: Managing routing table information in AODV [11] is handled with the destination sequence numbers. The need for routing table management is important to make communication loop free. 3. AODV Route Maintenance: AODV maintains only the loop free routes, when the source node receives the link failure notification it either start the process of rebroadcasting RREQ or the source node stop sending data through invalid route[12].

IV. PERFORMANCE EVALUATION

To evaluate cost effective environment with mobility on nodes simulations are performed using Network Simulation (NS2). The simulations are carried out for a 4 lane highway with a length of 2 km and a width of 10 m per lane. Vehicle velocity varies from 50 to 100 km/h. All vehicles have the same 802.11 MAC parameters. And number of RSUs is 10 and their range is 100 m and same is the range of vehicles, number of vehicles varies from 5 to 15. In all the simulations, the system time is set to 50 s. Vehicles communicate in a V2V [13] and V2I mode. Each packet has 1024 bytes and can be transmitted over 500 slots, at a rate of 1.2 Mbps.

A) Delay: The delay of a network specifies how long it takes for a bit of data to travel across the network from one node or endpoint to another

B) Packet arrival ratio: Total ratio of the number of received data packets to the number of total data packets sent by the source.

C) Throughput: Throughput is the rate of successful message delivery over a communication channel.

D) Packet Loss: Packet loss is the failure of one or more transmitted packets to arrive at their destination.

E)

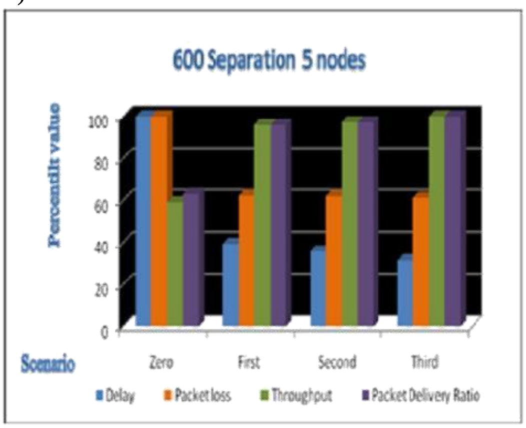

Figure 2. Comparison of metrics over different scenarios

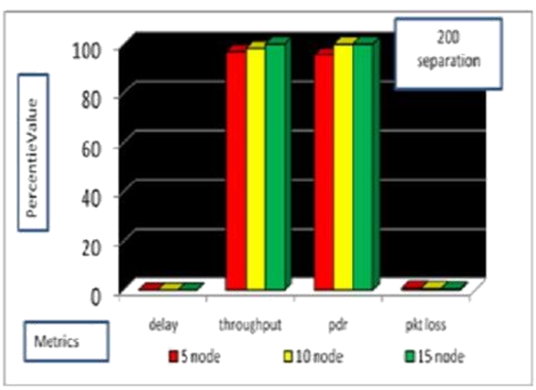

Figure 3. Behavior of metrics over different no. of nodes in 200 separations

In this we have taken three cases:

Case1: Comparing Different Orientation of RSUs There has been considered three different placements to RSUs at road as above mention. In scenario 1, it has introduced RSUs at one side of the road, scenario 2, RSUs at the center of the road and scenario 3, RSUs implemented across both sides of the road.

Case2: Comparing different separations of RSUs After comparing different placements of RSUs, Now there is interesting fact to see the effect of separation of RSUs on the scenario. To implement this, it taken various numbers of RSUs and according to result of case: 1, for this, it has been elected scenario 3 and first it has taken ideal separation in which vehicle to RSUs, RSUs to vehicle and RSUs to RSUs communication is possible and after that step by step there is an increment in the separation.

Case3: Findings Cost effective solution In the whole work while studying of the cases, it has been found that there is motivation to reach on the most cost effective solution as there is need. For this it is concluded that the better result is interpreted which comes from above two cases and to get cost effective separation, there has been introduced cost as in terms of number of RSUs. When there is an increment in number of RSUs in the scenario [14].

V. RESULT

In this section it has been discussed that the results of the simulations were conducted for the selected protocol.

CASE: 1 COMPARING DIFFERENT ORIENTATION OF RSUS In this case, three different scenarios such as scenario-1, scenario-2, and scenario-3 has been compared. In scenario-1 we have placed 4 RSUs at the same side of road in scenario-2 we have placed same number of RSUs on the mid of the road and in scenario-3 we have placed 4 RSUs across the road. According simulation result, it has found that Scenario-3 shows better result than other scenarios. Shown in Fig. 2

CASE 2: COMPARING DIFFERENT SEPARATIONS OF RSUS In this case, there has been are analyzed to know effect of separations of RSUs and variation of vehicular

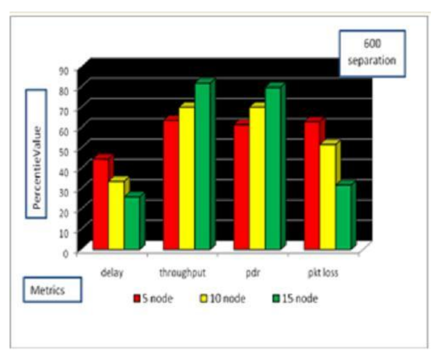

Figure 4. Behavior of metrics over different no. of nodes in 600 separations

nodes in highway over metrics. To analysis the effect, it has been selected scenario-3 in which RSUs are situated both sides of road, AODV [15] routing protocol, 50 seconds simulation time, metrics as delay, throughput, packet delivery ration, packet loss and no. of vehicle nodes 5, 10, and 15 and are also varies separations. In 200 meter separation, it is an ideal case. Shown in Fig. 3

Now increasing separation between RSUs that is 600 meter and some metrics show increasing mode and some show decreasing mode as communication delay, packet loss of network are increase and throughput, packet delivery ratio are decrease. Shown in Fig. 4

In 900 meter separation, the result shows maximum delay, maximum packet loss, minimum throughput and minimum packet delivery ratio over different no. of vehicle nodes, because separation between RSUs is very high. RSUs do not take participate or very less participation in communication network. Most of time only vehicle to vehicle multi-hopping possible is there when vehicles node comes in nearest communication range. There is less or no intermediate nodes give its presence. Shown in Fig. 5

CASE 3: FINDINGS COST EFFECTIVE SOLUTION In previous case, it has been observed that metrics affect as the separation increases and also metrics depends on vehicle density on road. Now here summering all separations, no.

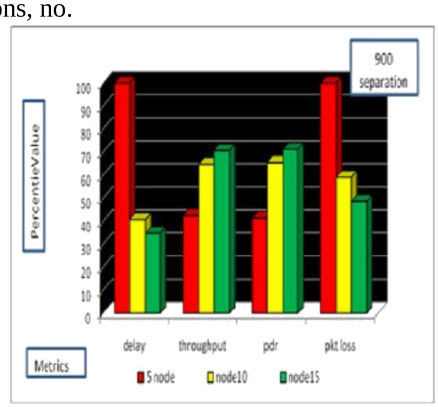

Figure 5. Behavior of metrics over different no. of nodes in 900 separations

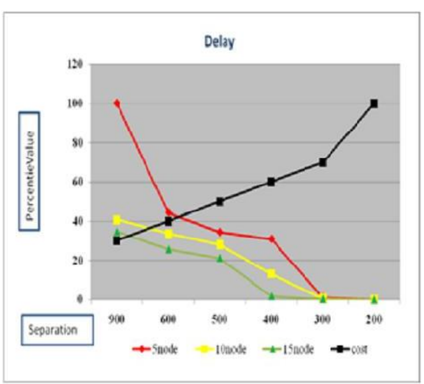

Figure 6. Behavior of delay over different separation of RSUs

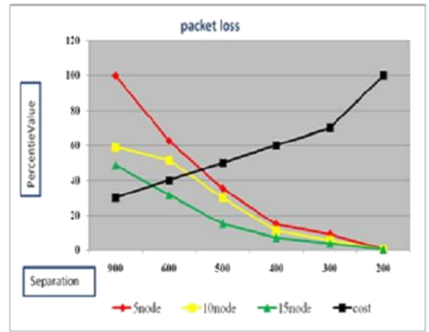

Figure 7. Behavior of packet loss over different separation of RSUs

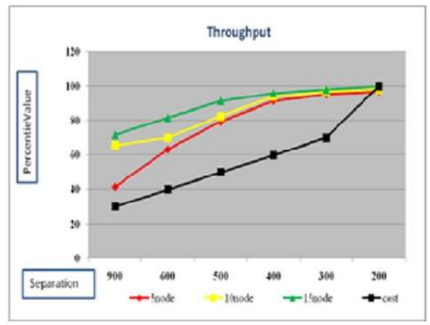

Figure 8. Behavior of throughput over different separation of RSUs

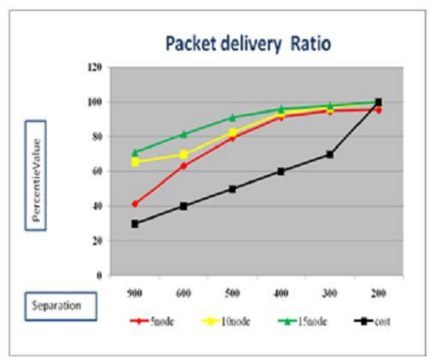

Figure 9. Behavior of packet deliver ratio over different separations of RSUs

Of vehicle nodes and introducing cost are in term of no. of RSUs using in implementation of scenarios. It has been observed that communication delay decreases with increasing cost of scenario and also decreases with increasing vehicle density on road, because as increasing vehicle density direct vehicle to vehicle communication takes part and it decreases cost of scenario, but communication in rural area different where less possibility of vehicle to vehicle communication using multi-hopping process. Cost effective solutions are shown in Fig. 6-9

VI. CONCLUSION

From the simulation results, it has been analyzed that by using four different metrics on AODV routing protocol and different placement of RSUs. There is division of work into three cases. In the first case, it has also analyzed that the scenarios in which RSUs are planted on both sides of a road, provides the best conditions for VANETs in rural environment. This has been happened because, without depending on the distance or the speed of the vehicles (from each other), the RSUs has provided a constant coverage to the vehicles allowing them to update themselves. In the case second, it has been gotten behaviour of metrics over different separations of Roadside unit which work as intermediate nodes which help in routing technique and cover that gap and also help in data disseminations. After analyzing case second results it has been reached that some metrics show decreasing behavior with increasing separations of RSUs and decreasing vehicle density and some metrics show in-creasing behavior with increasing separations of RSUs and decreasing vehicle density. In case third, there is significant finding that the cost effective separate of RSUs in highways and rural environments there has elected AODV [16] routing protocol and it has been better to take scenario third in which RSUs are planted on both sides of a road and analyzed results according to correlation theory it has been found that there is relationship between two different metrics how significantly they have effected each other and it has also found that the cost effective separation is approximate 500-600 meter.

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