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Implementation of AOMDV, OLSR & ZRP Protocol for Analysis of Performance Matrices in VANET Scenario

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Abstract

Vehicular Ad-Hoc Network (VANET) is a wireless technology which is the sub class of the Mobile Ad-Hoc Networks (MANET). In our work we are trying to provide connectivity to vehicles for enabling Intelligent Transportation Systems (ITS). Previously we had preformed a survey to compare routing protocols based in their routing approach. In the work we had simulated Optimized Link State Routing Protocol (OLSR),a proactive routing approach, Ad-Hoc On-Demand Multihop Distance Vector Routing Protocol (AOMDV), a reactive routing approach and hybrid routing approach which is Zone Routing Protocol (ZRP) for VANET keeping performance prospective in mind. In this paper we had preformed the evaluation and analysis of the three protocols for based on VANET Scenario.

Keywords: VANET, MANET, OLSR, AOMDV, ZRP, PDR, Throughput, E2E Delay, NRL

Introduction

The VANET stands for the Vehicular Ad-Hoc Network which is a special class of wireless networks. VANET employs some characteristics of MANET in VANET. Both are wireless ad hoc network, works on dynamic topology and are multihop networks. There is also no centrally located authority to manage packet transfer the nodes handle all by themselves. The key difference of VANET and MANET is the mobility pattern and rapidly changeable topology. VANET addresses the wireless communication between vehicle to vehicles (V2V), and between vehicles and infrastructure access point (V2I). VANET also has some characteristics apart Mobile Ad-Hoc Networks; the most important characteristics are: very fast mobility, self controlled organization, distributed communication, they have restriction on road pattern and no limitation of network size [2] [3] [4]. It's highly dynamic topology, which is because of the vehicles moving at varied but at a great speed, provides the high processing power and the storage capacity. This also raises the need for a communication protocol which could provide a better Packet Delivery Ratio (PDR) in dynamically changing topology. As VANET is designed for avoiding the road accidents high PDR is required. This helps to provide driver with prior control information about traffic congestion change of lane etc. Routing protocols for ad hoc networks can be classifies into several types based on the different criteria. Based on Routing Information and update mechanism we can classify the routing protocols mainly into the three categories: Proactive Routing, Reactive Routing and Hybrid Routing Protocol [6].

Vanet routing protocol

As we have already discussed that based on the routing information the protocol can be broadly classified into three categories [7]:

A. Proactive or Table Driven Routing Protocol:

In our work we had implemented Optimized Link State Routing (OLSR).

Optimized Link State Routing Protocol (OLSR):

Optimized Link State Routing Protocols (OLSR) is proactive and point-to-point routing protocol based on the traditional link-state algorithm. It uses a technique called Multipoint Relaying to optimize network overhead due to flooding process for route setup or route maintenance. The OLSR protocol was introduced accuracy and stability for routing the information network. OLSR has two major concepts, Multipoint Relays (MPRs) algorithm and Optimized State of one-hop neighbors and cover two-hop neighbors or sending link state information for maintenance of routing.

OLSR protocol performs hop by hop routing means each node uses its latest information to route a packet.

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The Fig 1 demonstrates the working of OLSR protocol. Pros of the OLSR routing protocols are; it reduces routing overhead and number of broadcast associated with table-driven approach and has low connection establishment time. And limitation of this protocol is, it needs more time rediscovering a broken link and has wide delay distribution.

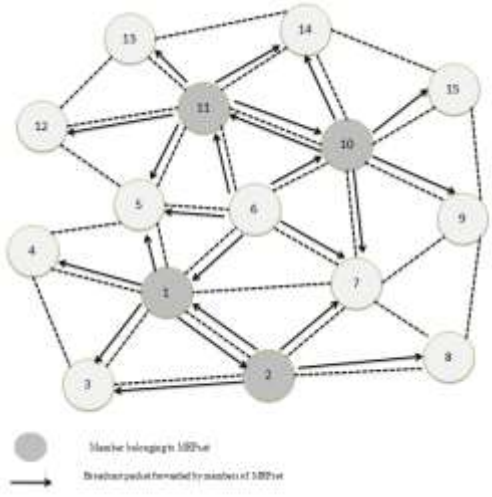

Fig 1: OLSR Routing Network

B. Reactive or On Demand Routing Protocol:

The protocol following obtain necessary path when it is required though connection establishment process. Therefore the protocol under this class does not maintain the network topology information. In this approach we had implemented Ad-Hoc On-Demand Multihop Distance Vector Routing Protocol (AOMDV).

***Ad-Hoc on-Demand Multihop Distance Vector Routing Protocol (AOMDV)*:**

AOMDV protocol is a multi path on-demand protocols it's an extension of the AODV protocol, it discovers multiple route from source to destination in a single route discovery process. It is used in highly dynamic ad hoc networks where the link breakage occurs frequently due to high velocity of vehicles. After each link failure in AODV routing protocol, a route discovery procedure is needed. Route discovery after each link failure results in high overhead and latency. Thus, this limitation can be overcome by having multiple paths available. Route discovery process in this approach will be is preformed when all routes to destination or source fails. The AOMDV protocol is strove to employ routing information. If all paths to either source or destination fail, then in AOMDV route discovery procedure is applied. The AOMDV protocol includes two main sup-procedures [5]:

i. Calculating multiple loop-free paths at each node.
ii. Finding the link-disjoint paths by deployment of distributed protocols.

Pros of the AOMDV protocol are that the routes are established on demand and to find the multiple loop-free routes to destination. It is the distributed protocol to discover link disjoint paths and reduces overhead by providing the multiple paths. Limitation of the protocol is that it has additional overhead for route discover for RREP. Because of periodic route discovery it consumes extra bandwidth.

C. Hybrid Routing Protocol:

This approach uses the features of both the proactive and reactive routing strategy. In this approach we had implemented Zone Routing Protocol (ZRP).

Zone Routing Protocol (ZRP)

The ZRP was proposed limit the drawback of the proactive and reactive routing protocol. The ZRP reduces the control overhead of proactive approach and reduces the latency caused by search operation of reactive approach.ZRP is based on the concept of zones and divides the network into two zone i.e. Inter-Zone and Intra-Zone based on vehicular node distances. Based on the concept of zone ZRP can follow two different routing approaches. The first is proactive routing approach which is Intra-Zone Routing Approach (IARP). IARP is used when destination is inside a zone (i.e. local zone).

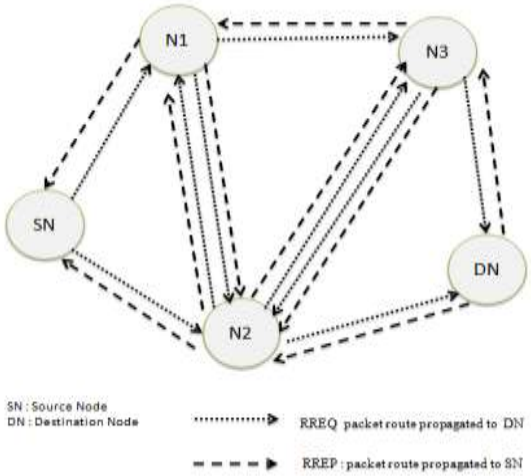

Fig 2: Propagation of RREQ & RREP packet in AOMDV

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The other approach is reactive approach which is an Inter-Zone Routing Approach (IERP). The IERP approach is used when the destination is not present inside the local zone is located in other zone. The behavior of the ZRP is adaptive depending upon the current configuration of the network and nature of the user. The Fig 3 represents the ZRP approach.

Pros of ZRP are, it is adaptive and have less bandwidth. It is scalable and maintains the updated network map and needs requires fewer messages sending time.

Limitation of the protocol is, it has shorter latency for new route discovery. And there is always delimitation for decision about network size and network formation.

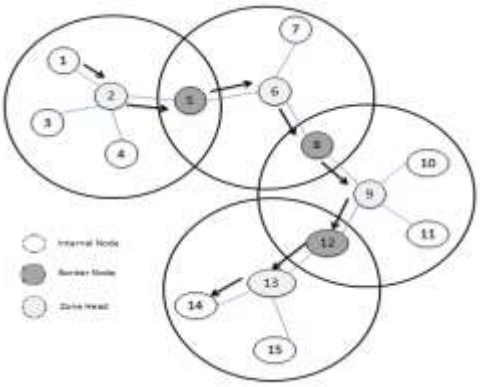

Fig 3: Zone Routing Protocol

Related work

We had implemented this protocol in VANET Scenario for the analysis and evaluation of the OLSR, AOMDV and ZRP protocol by varying node densities. The performance parameter taken into consideration are Packet Delivery ratio (PDR) is the proportion of the total amount of packets reached the receiver and amount of packet sent by the source. Second parameter is Throughput which is the average rate of successful message delivery over a communication channel. End to End (E2E) Delay which is the average delay between the sending of the data packet by the CBR source and its receipt at the corresponding CBR receiver and the last is Normalized Routing Load which is defined as total number of routing packet transmitted per data packet delivered at destination. The analysis of protocol upon the implementation is as follows.

a. Analysis of Packet Delivery Ratio

Figure below is used for detailed analysis of packet delivery ratio. PDR generated via combination of AWK script and Trace files (*.tr file) after the compilation of protocol under VANET environment for 10 to 100 nodes. The figure revels that the PDR of the OLSR Protocol is best for the low vehicular density & decreases when the node density are increased. The PDR of AOMDV decreases with increase in node density, but PDR drops when numbers of nodes keep on increasing. Where as in case of ZRP protocol, PDR drops drastically with increase in the vehicular density.

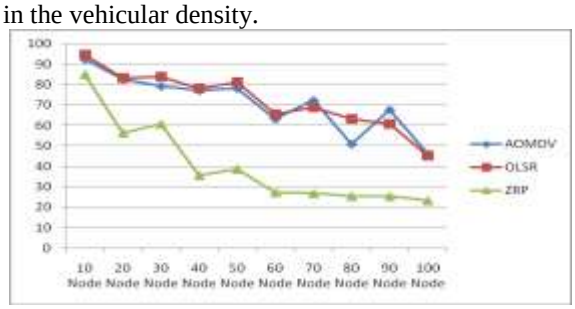

Fig 4: PDR of AOMDV, OLSR & ZRP Protocols for varied Node density

b. Analysis of Overall Throughput (In KBPS)

From the figure below is obtained from the results obtained via AWK script of throughput. The throughput from the generated output is used to drive the certain conclusion for protocol. The throughput of the OLSR protocol increases with increase in nodes but after a limit is reached, throughput drops. While for the AOMDV protocol at first throughput increases up to intermediate node density and then afterwards with increase in node density its throughput fluctuates. While in case of ZRP protocol its throughput increases with the increase in node density and then starts stabilizing.

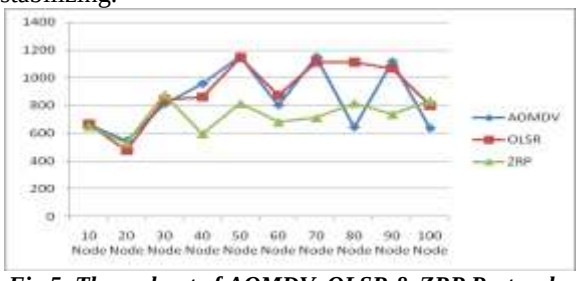

Fig 5: Throughput of AOMDV, OLSR & ZRP Protocols for varying node density.

c. Analysis of End to End Delay

For analysis of End to End delay we can refer figures below. Delay is the extra time taken by a packet to

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reach its destination from source apart from its estimated time. From the figures we can see that end to end delay is not much affected with variation in number of nodes but there is a slight change in delay as End to End delay of OLSR and ZRP protocol decreases as the number of node increases. But in case of AOMDV protocol the delay is increased with the increase in node. As the delay in protocols are in m.sec that is why we can neglect that change in delay.

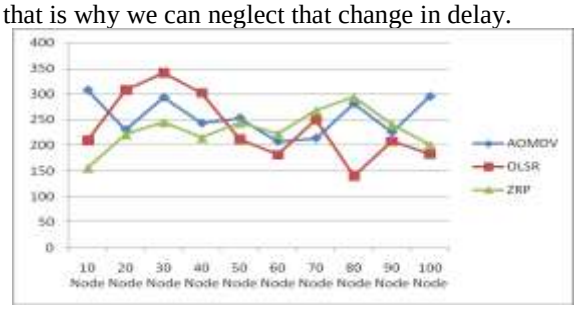

Fig 6: E2E Delay of AOMDV, OLSR & ZRP Protocols for varying node density.

d. Analysis of Normalized Routing Load

Normalized Routing Load, which is total number of routing packet transmitted per data packet delivered at destination, must be optimal. It should be high when number of nodes increases. Because when number of nodes increases then for successful transmission of data packet from source to destination, nodes must have prompt path towards destination. For this process, routing packets or Hello messages are sent which increase or enhance the load in the network. If we talk independently than the ZRP Protocol is having maximum routing load as compared with other protocols i.e. AOMDV and OLSR.

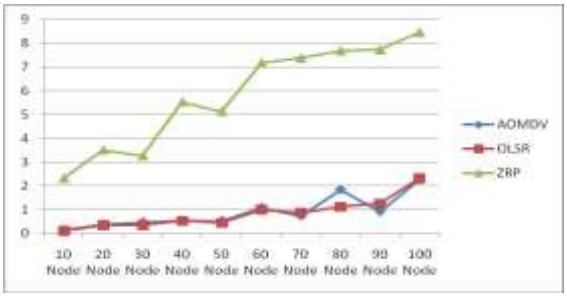

Fig 7: NRL of AOMDV, OLSR & ZRP Protocols for varying node density

Conclusion

Our goal is to compare the various routing protocol for reaching towards a protocol which gives high throughout and packet delivery ratio. For achieving our goal we had targeted and implemented three protocols OLSR, AOMDV and ZRP for our work. The comparative study had been conducted using the NS-2 which is a popular open source simulation tool. We had simulated the protocols under the VANET environment and had varied the node densities from 10 nodes, 20 nodes up to 100 nodes. Upon the completion of implementation and result compilation various performance matrices have been analyzed. The protocols shows pattern in their behavior when implemented through varying node density in VANET. Among the three OLSR is working better with increasing node density it has better throughput and packet delivery ratio along with less delay and normalized routing overhear. AOMDV is also working very well with increasing density but as compared to OLSR, AOMDV is not much optimized its results vary quickly in high density. ZRP protocol is not suited the high vehicular density.

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