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Comparative Study of P-AODV and Improved AODV in VANET

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Abstract: Vehicular Ad Hoc Network (VANET) is an emerging new technology integrating ad hoc network and improve road traffic safety. One of the main challenges in VANET is of searching and maintaining an effective route for transporting data information. At present some kind of routing protocols used in VANET Hence, an analysis on routing protocols based on various parameters of. VANET is a necessary issue in communication. As one of the most important routing protocols used in Mobile Ad Hoc Networks (MANET), AODV routing protocol is also used in VANET. AODV protocol suffers poor performances when it is directly applied in VANET. In this paper, will discuss two enhanced AODV protocols P-AODV and Improved AODV as well as compare them on the basis of different parameters.

Keywords: Vehicular ad-hoc Network (VANET), Routing Protocols, AODV, P-AODV, Improved AODV.

I. INTRODUCTION

Road safety is a important issue that needs a special attention as there's one death reported every minute on the street. So in many countries various safety measures like traffic lights and speed limits are used but it not as good as expected. Many countries accepted that road safety is going to be a major challenge [1]. So to improve safety VANET is emerged with a large number of applications. VANET is a special case of MANET which is rapidly emerging.

VANET provides a wide range of services which are increasing the safety and afterwards a number of applications that increasing traffic efficiency and provide comfort and commercial applications to the passengers [2]. Nodes are autonomous and play the role of router and host at the same time. The dynamic change in topology shortens the effective time of routing. Also it reduces utilization rate of routing information. Vehicles can be private or belong to an individual or public and provides promising communication to drivers and passengers.

Vehicular networks motives to avoid congestion and finds better routes by processing real time data by this it can save time and also fuel by which it results in economic gain. Routing in vehicular networks are more Feasible and prevails in highly secure manner. VANET increases comfort, avoid traffic jams, decrease travel times, smooth traffic flow, decrease emissions of CO2, NOX, noise etc.

VANET provides entertainment and commercial applications to passengers, they help to minimize the accidents and improve the traffic by providing timing information about collision warning, road sign alarm, in-place traffic view. VANET provides timely information to drivers and concerned authorities by which it will contribute to safer and more efficient roads. VANET is a technology of building robust Ad-hoc network between cars that act as mobile nodes [2]. VANET is done by equipping cars or nodes with devices capable of wireless communication. In VANETs, the types of communication are the following:

- Vehicle-to-Vehicular (V2V) or Inter-Vehicular Communication
- Vehicle-to-Infrastructure (V2I) or Vehicle-to-Roadside Communication

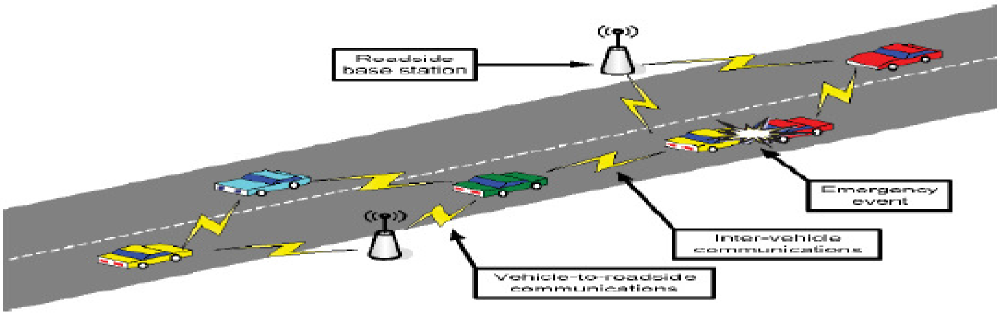

Fig1: Architecture of VANET

V2V is a network among vehicle which provides communication among vehcles.V2V is an automobile technology designed to allow automobiles to talk to each other [3]. The primary benefits of V2V that it protects from road hazards and provide safety. In V2V there is no need of roadside infrastructure. It supports Dedicated Short Range Communication and provides communication upton1km distances.V2V communication technology is fast, reliable and provides real time safety. Vehicles can know the position of other vehicles and will communicate directly to each other.V2V systems is equipped with long range scanning sensors. In any case, if the driver does not respond to the warning alerts, then the vehicle could act itself and stop to a safe point avoiding the collision [4]. The data exchanged between vehicles include vehicle's position; speed of vehicles, steering angle, turn signal status, brake status.V2V provides different types of application Hazard Warning, Incident Report, Route Guidance. It forms a network among vehicles which provides communication among vehicles.

Vehicle to Infrastructure provides solution to longer-range vehicular networks. It makes use of preexisting network infrastructure such as wireless access points (Road-Side Units, RSUs) [3].Communications between vehicles and RSUs are supported by Vehicle-to-Infrastructure (V2I) protocol. The Roadside Infrastructure involves additional installation costs. In road side, Departing vehicles will inform other vehicles about their departure on the highway and arriving cars can send warning messages to other cars traversing that intersection. Most of the deaths caused by crashing of cars are avoidable.

In order to make the communication of vehicles possible, a stable routing protocol is needed to ensure that the message is being transmitted efficiently and correctly. So the design of routing protocols is an emergency research area in VANET that have to deal with this problem of frequent topology change and quick movements of nodes.

Ad Hoc on Demand Distance Vector (AODV) routing protocol is based on reactive approach .AODV routing protocol is the most commonly used topology based routing protocol for VANET. It mainly involve two processes-Route Discovery and Route Maintenance. When a source node which has no routing information in the routing table needs to establish a route to the destination node, the route discovery process is activated. When a route request packet reaches the destination node, the destination node sends a route response packet to the source node and set up a reverse path between the source node and the destination node. When the node changes, certain link on the activated path may break, then the route maintenance process will be started.

The remainder of this paper is organized as follows. Section 2 gives an introduction of Routing protocol and an introduction of AODV. In section 3 we present AODV enhancements in context to realistic VANET. Finally, section 4 presents our conclusion.

II. Different Types of Routing Protocol

Routing is a mechanism that allows two communication entities to communicate continually with each other forward the data packets and maintain the route from routing failure[6][7]. In this paper, topology based protocols are discuss which uses link information which exists in the network to send the data packets form source to destination. Topology based Routing protocols are divided into three categories:

a) Proactive Routing Protocol:

A proactive routing protocol is also called as table driven routing protocol. These protocols maintain the topology information in the form of tables of every node. These tables need to maintain the consistent information of topology. When a change in the topology occurs, the tables are updated frequently in order to have up to date information and to maintain consistency. Routes update is periodically performed regardless of network load and bandwidth constraints which is one of the main drawbacks of using this approach in VANET.

b) Reactive Routing Protocol:

These protocols are called as on-demand routing protocols as they periodically update the routing table and are designed to overcome the overhead problem of proactive routing protocol by eliminating the need of periodically flood the network only those paths that are currently in use. In this route determined only when needed and maintains only the routes that are currently in use. But these protocols use flooding process for route discovery, which causes more routing overhead and also suffer from the initial route discovery process, which make them unsuitable for safety applications in VANET.

c) Hybrid Routing Protocol:

This protocol combines the merits of both proactive and reactive routing protocol. The hybrid routing protocols are zone based means the number of nodes are divide into different zones. This protocol makes the routing more scalable and efficient.

The comparison of the performance of topology-based routing shows that the most significant protocol is reactive routing protocol. On demand protocol is reactive and single path protocol. Ad-hoc On-Demand Distance Vector (AODV) routing protocol is the most commonly used topology based routing protocol for VANET.AODV has been identified as most promising Routing protocol for VANET.

2.1 Ad Hoc on Demand Distance Vector Routing Protocol (AODV)

AODV is one of the most important routing protocols for ad hoc networks. It is a common reactive protocol used in Ad hoc Networks.C.Perkins [11] who created this protocol gives a detail study and analysis of this protocol. It is a single path routing protocol which uses symmetric links between neighboring nodes. In AODV there are three types of control messages RREQ (Route Request), RREP (Route Reply), RRER (Route Error Message).RREQ and RREP are the control messages of Route Discovery Phase and this phase is initiated when source node wants to send a packet to the destination node.RRER is the control message of Route Maintenance Phase in which broken links are repaired.

Source node transmits RREQ packet to the neighboring nodes for which it has no routing information in its table. Source node broadcast route request packet to its neighbors. A route request carries

the source address, Source Sequence Number, Destination address, Destination Sequence number, hop count indicates the most recent path. The pair < source_addr, broadcast_id > uniquely identifies a RREQ. Broadcast id is incremented when source issues a new RREQ[5].When a source node wants to send a RREQ packet to the destination node it broadcast the RREQ to the neighboring node.When an intermediate node has a valid route to the destination it forwards a RREP packet back to the source or if a node can't satisfy the RREQ packet then it will rebroadcast the RREQ to its neighbors after increasing the hop count and the node stores the information about the RREQ for reverse path setup and forward path setup.

All intermediate nodes having valid routes to the destination or destination node itself can send a RREP packet to the source's RREP packet is unicasted to the source [7].Timer is used to delete entry of reverse path set up if RREP packet is not received by the source or RREQ to traverse the network and produce a route reply. When a RREQ will arrive at a node that possess a current route to the destination or the destination node itself, a source node may receive many copies of RREP then it will update its routing table with the greatest sequence number. At the end of route-reply process a path is setup for data transmission between source and the destination. When a node looses connectivity to its neighbor a RRER message is generated to inform other nodes of this link breakage [6].The entry for that neighbor in the table will be set as invalid and finds a new route to the destination or repair the broken link. The source node after receiving RRER packet, searches in its table that there is another route to the destination if it find another route to the destination select that as new route for data transmission (communication) or rebroadcasts a new RREQ packet and finds a new route to the destination.

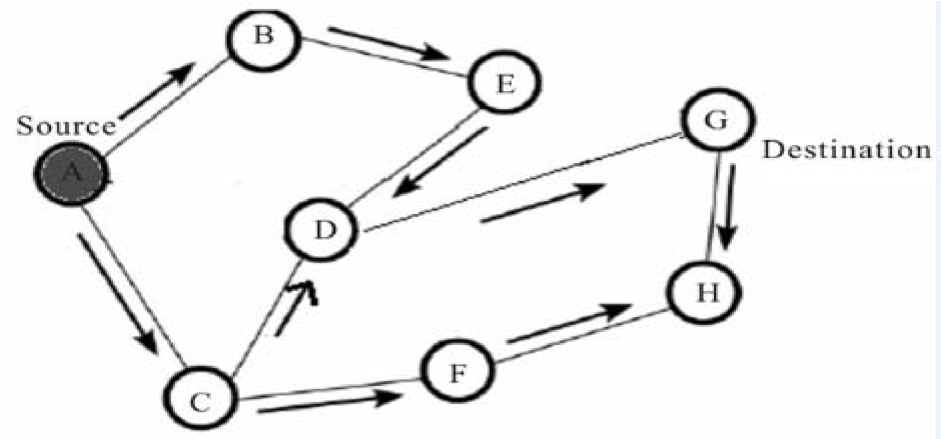

Fig 2: RREQ Broadcast

AODV does not introduce routing overhead, until a RREQ is made. But when RREQ packet is flooded in a network results in a heavy routing overhead and large bandwidth consumption.AODV introduces a high initial latency and the old entries in the table can lead to the inconsistency in the path. Hierarchical design of AODV protocol can't satisfy the performance of VANET. So in this paper we present and analyze various AODV enhancements which occur over and over years as well as their comparative stud

III. AODV Enhancement

There are several AODV enhancements [18] proposed by different authors. In this paper we will discuss two different approaches of VANET P- AODV and Improved AODV.

3.1) P AODV:

Omid Abedi proposed a method [12] to reduce network overhead and design improved AODV protocol Prior-AODV. In this protocol there are different ways to reduce control overhead. One way to reduce control overhead is to restrict the number of route request packets and another way is to restricting route request based on distance. In second approach neighbors of a node are divided in to base on their distances from node into two categories: First one is prior neighbor and second is overhead neighbor. These two neighbors are located in their own zones i.e. prior neighbor in prior zone and overhead neighbor in overhead zone. Prior zone of a node is the distance between threshold distance and transmission range of that node and overhead zone is the zone between node and threshold distance of that node.

In the first method the numbers of RREQ packets are restricted so that the number of discovered routes are limited. When a node receives a RREQ packet and broadcats, then it is restricted to send RREQ packet to its neighbors and it can send RREQ packet to its neighbors until the number of selected neighbors are less than or equal to route boundary. In the second method, when a node wants to find a route to the destination, it will first determine the neighbor's type that whether it is overhead neighbor or prior neighbor. After this, when a source node wants to send a RREQ packet to its prior neighbors, then it will first determine if the prior neighbors are more than number of allowable RREQ, then it randomly selects prior neighbor and send RREQ packet to them [12].If the number of prior neighbors is less than the number of allowable packets .the source node will send RREQ packets to prior neighbors and rest of the RREQ packets to overhead neighbors. The problem of network overhead and route length reduces by making a tradeoff between overhead and throughput.

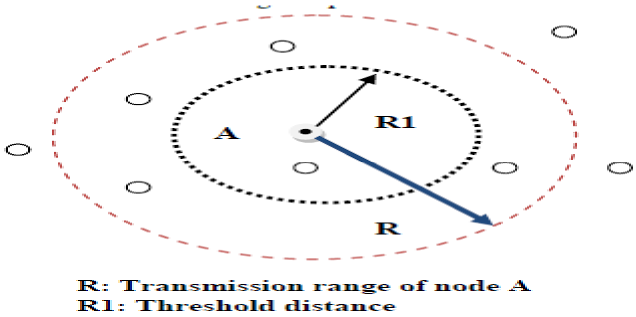

Fig 3: Prior & Overhead neighbor concept used in P-AODV

3.2) Improved AODV:

To reduce the overhead in the network Zehua Chen [13] proposed an enhanced form of AODV protocol called Improved AODV. The main benefit of this protocol is that it reduces the control overhead and provides route stability. In improved AODV routing protocol, author proposes a method with two step optimization in route discovery and route selection process.

In the first step, the route discovery phase initializes and only those nodes will be selected which have similar speed to the source vehicle and are moving in the same direction as the source node. Because the direction of vehicles which are in the same direction will be in communication for longer period of time as compared to which are moving in the opposite direction and with very high speed. By this overhead is reduced, the RREQ packet is not broadcasted to the whole network and route becomes stable.

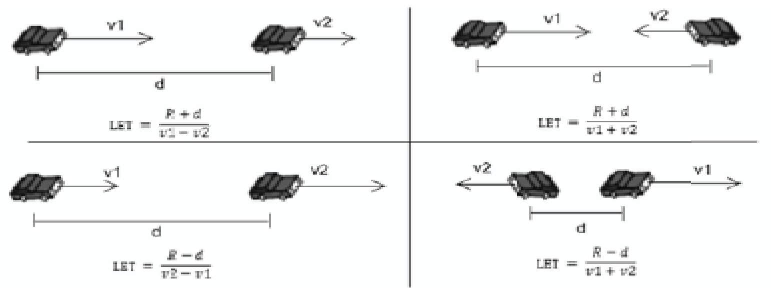

Fig 4: LET of two Vehicles

In the second step, the most stable route will be used for sending packet from source to destination when there are multiple routes from source to destination. In route selection process, the two different strategies are used: Strategy one is by using route expiration time (RET) and the second is by using total route weight. In first strategy, choose the route with the longest lifetime means this route is more reliable for the transmission of data packets. The calculation of RET is performed using the link expiration time(LET).Communication time of two vehicles is defined as LET, the route with minimum LET is selected for transmission. In second strategy, the route is selected on the basis of total route weight. The routes with minimum routes are chosen. The overall overhead is less and obtains higher packet delivery ratio and fewer broken links because the discovery phase is restricted to certain number of nodes.

IV. Conclusion

In this paper, studied and analyzed performance of two enhanced AODV routing protocols P-AODV and Improved AODV. Table gives a relative comparison of different performance metrics and then found that the enhanced AODV protocols performed inadequate for some of the performance metrics.

PROTOCOL	Simulation Time(sec)	Velocity	PDR	NRL	Packet Delay	Broken Links	Traffic Types
P-AODV	1000	medium	ND	ND	ND	Low	ND
Improved AODV	ND	low	High	ND	ND	High	ND

ND: Not Determined, PDR :Packet Delivery Ratio, NRL :Normalized Routing Load

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