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ROUTING PROTOCOL FOR VEHICULAR ADHOC NETWORK

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Abstract: Vehicular Ad hoc network(VANET) are special type of Mobile Adhoc Networks(MANET) where wireless equipped vehicles from a network are continuously travelling along the road. Node movement feature of Vehicular ad hoc network (VANET) closely resembles with that of mobile ad hoc network (MANET) but its high speed mobility and unpredictable movement characteristics are the key contrasting feature from that of MANET. The similarity nature suggests that the prevailing routing protocol of MANET is very much applicable to VANET. However, on the same line, the dissimilarity characteristics result in frequent loss of connectivity. In VANET, topology changes rapidly and there is frequent disconnection which makes it difficult to design an efficient routing protocol for routing data among vehicles called vehicle to vehicle communication. Many routing protocols were implemented like AODV, AOMDV, SD-AOMDV, DSDV, CBDRP. SD-AOMDV adds the speed and direction as two mobility parameter. By enhancing the performance of SD-AOMDV routing protocol, packet delivery ratio, and throughput can be increased and end-to-end delay can be reduced.

Keywords: VANET, AODV, AOMDV, SD-AOMDV

1. INTRODUCTION

Vehicular Adhoc Network is a technology that uses moving cars (Vehicle) as a node in a network to create mobile network. VANET is autonomous, self organizing wireless communication network. VANET turns every participating car into wireless node. As cars or vehicles fall out of signal range and drop out of the network, other cars can join in, connecting vehicles to one another so that mobile network is created. There are several VANET application [1] like vehicle collision warning, secured distance warning, driver assistance, cooperative warning, driverless vehicle. There are various factors which are related to vehicle and roads. Factors associated with vehicles are maximum speed of the vehicle, acceleration, deceleration, direction of vehicles and factors associated with roads are its length, speed limit on the road, number of lanes, junctions, traffic signals. Standardization is already underway for communication to and from vehicles. The Federal Communication Commission (FCC) in the United

States has allocated 75MHz bandwidth, around the 5.9GHz band for vehicle to vehicles and vehicles to road side unit which is also called as infrastructure communications through the Dedicated Short Range Communications (DSRC) services.

Routing is an essential building block for VANETs, which determines how the data can be delivered from a vehicle to another vehicle in the network. Many location-based routing algorithms have been proposed, which share the core idea that a packet destined to a remote vehicle is always forwarded towards the direction of the destination. By following such a routing strategy, the packet can eventually

reach the destination node. Most of existing location-based routing algorithms, however, take it for granted that the location information of the destination vehicle is accessed in real time. Nevertheless, such assumption is impractical in the real world.

There are various challenges for VANET such as high speed of vehicle, dynamic route finding from source to destination, building, reflecting objects, roadside objects, other obstacles in path of radio communication, changing direction of vehicles, concern about security, authentication of vehicle, security of data and sharing of multimedia services. High speed of vehicle requires regular routing table update whereas dynamic route finding would result into high time loss before static communication.

MANET protocols are not useful for vehicle to vehicle communication in VANET. Various types of protocols used in VANET are shown below:

Proactive protocols are like wired networks. Each node has table that contains the latest information regarding routing of nodes in the network. But the disadvantage is that they do not support wide networks, as they need to maintain node entries for every node in the routing table of every node. This results in more overhead in the routing table due to which more bandwidth is consumed. Destination Sequenced Distance Vector Routing (DSDV) protocol [1],[2] is a table driven routing protocol for adhoc network. Initially every vehicle broadcasts its own route tables to its neighbor vehicles. The neighbor vehicles update routing table with the help of Full Dump Packet and Incremental Packet. Full Dump Packet contains information of every vehicle participating in the VANET. These packets are transmitted periodically after a time interval which is a long time interval. Incremental Packet contains updated information of vehicle position since last Full Dump Packet. These packets are transmitted periodically in short time interval and are stored in a table. Routes are selected with the latest entry stored in the table. DSDV is used in networks where locations of nodes are less dynamic. If position of a vehicle changes very often, its performance decreases because more Full Dump Packets are needed to sent in the network, which results into wastage of bandwidth.

Reactive Protocol do not store routing information at the network nodes if there is no communication[3], [7]. If a source node wants to send the packet to the destination node then this protocol searches for the best possible path and then establishes the connection to transmit and receive the packet. Adhoc On Demand Distance Vector routing (AODV) protocol and Adhoc On Demand Multipath Distance Vector (AOMDV) routing protocol are the types of reactive protocol.

Hybrid Routing protocols have proactive and reactive characteristics which are designed to improve the scalability of proactive protocols while maintaining lower routing control. Zone Routing Protocol (ZPR) is a type of hybrid routing protocol, it divides the network into different zone where each zone may have different size. Routing within zone is called as intra zone routing which is performed by using proactive protocol. And routing between zones is called as inter zone routing is done by a reactive protocol.

2. RELATED WORK

AODV is a distance vector routing protocol, when a node wants to establish new communication with another node, it searches for an available path to the destination node in its routing table [3], [4], [6]. AODV is an ad hoc on demand routing protocol. That means that routes are only established when needed

to reduce traffic overhead. AODV supports unicast, broadcast and also multicast. If there is no path available, then it sends a route request (RREQ) message to its neighborhood. The node that receives this message search for a path to the destination node. Each node follows this process until this RREQ message reaches to a node which has a valid path to the destination node or RREQ message reaches to the destination node itself. Then the destination node after receiving RREQ message will send a route replay (RREP) message to the sender of RREQ message. At the end of this RREP process path between source and destination node is created and is available for further communication. In this process when there is no path available to the destination node or a node loses connectivity to its neighbor, a route error (RERR) message is issued for a node. This message is used to update or recalculate the path when an intermediate node leaves a network or loses its next hop neighbor. AODV maintains a routing table, which contains the information like next hope node, a sequence number, and a hop count.

AOMDV is an extension of AODV protocol [3]. AOMDV is proposed in order to increase the reliability of data transmission or to provide load balancing. Load balancing is important because of limited bandwidth between the nodes. AOMDV protocol can find node disjoint and link disjoint paths. After multiple paths are found AOMDV stores the path in the routing table. The source node will select one established path according to timestamp. The routing entries for each destination consist a list of the next hops along with the respective hop counts. All the next hops have the same sequence number. This is useful in keeping track of a route. For each destination node store the maximum hop count for all the paths which is used for sending route advertisement of the destination. Loop freedom is check for a node by accepting alternate path to destination, if it contains a less hop count for that destination. To establish node disjoint routes, each node does not immediately reject duplicate RREQ's. Each RREQ's arriving via different neighbors of the source defines a node disjoint path. This is because nodes cannot be send duplicate RREQ's, so any two RREQ's arriving at an intermediate node via different neighbor of the source could not have traversed the same node. For getting multiple link disjoint routes, the destination replies to duplicate RREQ's. This means that the destination only replies to RREQ's arriving via unique neighbors. Each RREP may get intersect at an intermediate node, but each takes a different path to the source to ensure link disjointness.

Advantage of AOMDV is that it allows intermediate nodes to replay to RREQ's, while still selecting disjoint paths. But the disadvantage is that it has more message overheads during route discovery due to

increase flooding and since it is a multipath routing protocol, the destination replies to the multiple RREQ's those results in longer overheads.

SD-AOMDV is improved version of AOMDV [5]. SD-AOMDV protocol adds mobility parameters: speed and direction. When a source node wants to send a packet to the destination node, first routing protocol gets direction and speed of source node. Then it gets direction and speed of destination node. Based on direction and speed of both source and destination intermediate nodes that can be participating in route between source and destination are specified. If source and destination are moving in same direction, the protocol must only select intermediate node that move in source and destination direction. If source and destination are moving in different direction the protocol must only select intermediate node that move in source or destination direction. Protocol also selects intermediate nodes that are moving in appropriate speed between source and destination. Intermediate nodes that have minimum difference between its speed and average speed of source and destination is calculated. For all disjoint paths the forward path with the minimum speed metric values, the path with minimum hop count is selected. The path satisfies the following condition will be selected to forward packets: Minimum (Maximum (difference between (Node speed, Average speed and destination)[k]),hop), where K is the number of disjoint paths to destination node.

SD-AOMDV Data Structure:

Source number	Sequence	SrcDir
Hop count		SrcSpeed
Destination number	Sequence	SpeedMetric

SrcDir, SrcSpeedMetric are added as new fields into original RREQ packet structure in AOMDV.

RREQ Packet Structure of SD-AOMDV:

Source IP Address	Hop Count
Destination IP Address	SrcDir
Destination Sequence number	AvgSpeed
Last hop	SpeedMetric
First hop	DestDir

Where AvgSpeed is the average speed of source and destination, SrcDir, DestDir is source and destination direction, SpeedMetric is speed metric of RREP packet. In routing table AdvertisedMetric, DestSpeed and DestDir fields are added as new fields into original routing table entry structure specified in AOMDV.

Routing table entry is shown below:

Dest	Dest speed
Seqno	DestDir
Advertised hop count	Advertised Speed Metric
Route List { List of Available path }	

DSDV protocol is a proactive routing protocol which is a modification of conventional Bellman-Ford routing algorithm [2]. In DSDV, each node maintains an entry of the table contains the address identifier of a destination, the shortest known distance metric to that destination measured in hop counts and the address identifier of the node that is the first hop on the shortest path to the destination. A sequence number is also associated with each route to the destination. The route labeled with the highest sequence number is always used. The routing table updates can be sent in two ways: a full dump or an incremental update. A full dump sends the full routing table to the neighbors and could span many packets whereas in an incremental update only those entries from the routing table are sent that have a metric change since the last update and it must fit in a packet. When the network is relatively stable, incremental updates are sent to avoid extra traffic and full dump are relatively infrequent. In a fast changing network, incremental packets can grow big so full dumps will be more frequent.

DYMO is a reactive (on demand) routing protocol, which is currently developed in the scope of the IETF's MANET working group[2]. DYMO builds upon experience with previous approaches to reactive routing, especially with the routing protocol AODV. It aims at a somewhat simpler design, helping to reduce the system requirements of participating nodes, and simplifying the protocol implementation. DYMO retains proven mechanisms of previously explored routing protocols like the use of sequence numbers to enforce loop freedom. At the same time, DYMO provides enhanced features, such as covering possible MANET-Internet gateway scenarios and implementing path accumulation. Besides route information about a requested target, a node will also receive information about all intermediate nodes of a newly discovered path.

There is a major difference between DYMO and AODV. AODV only generates route table entries for the destination node and the next hop, while DYMO stores routes for each intermediate hop. To efficiently deal with highly dynamic scenarios, links on known routes may be actively monitored, e.g. by using the MANET Neighborhood Discovery Protocol or by examining feedback obtained from the data link layer. Detected link failures are made known to the MANET by sending a route error message (RERR) to

all nodes in range, informing them of all routes that now became unavailable. Should this RERR in turn invalidate any routes known to these nodes, they will again inform all their neighbors by multicasting a RERR containing the routes concerned, thus effectively flooding information about a link breakage through the MANET. DYMO was also designed with possible future enhancements in mind. It uses a generic MANET packet and message format and offers ways of dealing with unsupported elements in a sensible way.

Proactive protocols are easier to implement and exhibit relative stability than reactive protocols. However, a storm of control messages is required to maintain an accurate view of the network topology when they are applied to a highly mobile VANET environment. This intuitively results in heavy traffic contention, collisions of packets due to mass flooding broadcasts between neighboring nodes, and, consequently, a significant waste of the scarce wireless bandwidth. Reactive protocols are hence preferred for dynamically changing VANET environments as they offer a smaller routing overhead and less memory intensive since they do not keep track of the states of all the nodes in the network. The performances of reactive routing protocols in various traffic conditions in VANETs have been simulated and studied by various groups of people. Those simulation results show that most reactive routing protocols (e.g., AODV and DSR) suffer from poor route convergence and low communication throughput. For example, in AODV is evaluated with six sedan vehicles. Its results show that AODV is unable to quickly find, maintain, and update long routes in the VANET environment. In addition in their real-world experiment, it is almost impossible for a TCP connection to finish its three-way handshake to establish a connection due to route failures and excessive packets loss under AODV.

CONCLUSION

SD-AOMDV protocol is improved version of AOMDV, which in turn is the improved version of AODV protocol for vehicle to vehicle communication. Speed and Direction this two mobility parameters are added to improve the performance of AOMDV protocol. By adding few

more parameters to SD-AOMDV, packet delivery ratio can be increased and end to end delay can be decreased, which will improve the performance of SD-AOMDV routing protocol. Secure and efficient communication in VANET is also possible.

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