Topology Based Routing Protocols: A Comparison

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Abstract: *Vehicular Ad-hoc Network is kind of mobile ad hoc network which deals with moving vehicles called as nodes. There are two varieties of communications in Vehicular Ad-hoc Network one is Vehicle-to-Vehicle (V2V) and another is Vehicle-to-Infrastructure (V2I). Vehicles send and receive messages to and from each other. Routing is the process of moving messages across an internetwork from source to destination. This paper presents the Qualitative Analysis of topology based routing protocols and their comparison on different parameters.*

Keywords: VANET, AODV, DSR, DSDV, RSU

1. Introduction

Wireless Ad-hoc network is defined as a network which doesn't have a pre-existing communication infrastructure. Network is created by some nodes which are available in the network. In this type of network determination of which nodes to transfer data to which node is done dynamically, depending upon the connectivity of both devices. Ad-hoc network can use flooding data transfer. In Ad-hoc network all devices are treated equally all have same status. Vehicular Ad-hoc Network is kind of mobile ad hoc network which deals with moving vehicles called as nodes. In VANET network, the messages are transferred to each other by the node or a router. Vehicular ad-hoc networks (VANETs) come up as vehicles outfitted with GPS and Wi-Fi devices find it important to communicate with each other. There are two varieties of communications in VANET one is Vehicle-to-Vehicle (V2V) and another is Vehicle-to-Infrastructure (V2I) also referred to as Vehicle to Roadside unit (V2R)[1]. In V2V communication vehicles send and receive messages to and from each other. These messages may be coverage of road congestion, accidents ahead, etc. V2I communications are among nodes and road aspect infrastructure, e.g. covering an incident or a malicious node, finding nearest petrol station, on-line toll payment, etc. transport communications consists of vehicles (nodes), road aspect units (RSUs) Usually, VANET is used to evade the traffic and driving problem. Driving means, changing location constantly. More than 60% accidents take place owed to the delay of less than half second. These kinds of problem are avoidable by introducing the VANET. To employ VANET we have to know about few simulation tools like NS-2, SUMO, and GlomoSIM etc [2].

 Routing is the process of moving information across an internetwork from source to destination. Vehicular Ad-hoc Networks (VANET) have dynamic nature of node and topology. So this mechanism provide optimal path between network nodes by reducing the overhead [3][4]. Routing protocols are classified in two main categories Topology Based Routing Protocols and Position Based Routing Protocols. Topology based routing protocol is traditional VANET routing protocol. It uses source to destination information that is stored in routing table. There are three types of sub-categories in topology based routing protocols i.e. Proactive Routing Protocols, Reactive Routing Protocols and Hybrid Routing Protocols[5]. Whereas, Position based

routing or geographic routing is based on the positional information of nodes in routing process. For utilizing the source node it sends a packet to the destination node using geographic position of individual node. In this protocol each node is able to decide its location and its neighbour node through GPS (global positioning system). It stores destination position of node and attach it in packet header which help to forward packets to the destination without a needs of route discovery, route maintenance. It is commonly classified in three sub categories i.e. Delay Tolerant Network Protocols (DTN), Non Delay Tolerant Network Protocols (Non DTN) and Hybrid Protocols [6].

Destination Sequence Distance Vector Routing Protocol (DSDV)
DSDV is one type of table driven protocol. This protocol provide loop free routing, decreases the extra traffic by utilizing the frequent updates in routing table, It's also reducing routing overhead and it's always choose optimal path with the use of shortest path algorithm. DSDV provides the sequence number to avoid the duplication entry into the routing table. The protocol doesn't provide multi path routing and also don't have any control over network congestion [7]. DSDV protocol guarantees loop free paths. We can avoid extra traffic with incremental updates instead of full dump updates [8].This algorithm is suitable for small ad-hoc networks but the regularly updating routing table, less bandwidth and essentially requirement of new sequence number at the time of network topology change shows the shortcoming of this protocol and make it unsuitable for long and highly dynamic network environment like VANET[9].

Ad Hoc On-Demand Distance Vector Protocol (AODV)
AODV is reactive (on-demand) protocol. It is proposed for Mobile ad hoc Network. Packet headers not included for routes in AODV. It is highly dynamic in nature and reducing overhead. Routing information is stored in source node, destination node and intermediate nodes along with active routing in data transmission. It can be applied to large scale adhoc network [10]. In AODV, three steps involved for routing, route discovery, route establishment and route maintenance for the communication path. This protocol mainly contains three control message in communication which are Route Request (RREQ), Route Reply (RREP) and Route Error (RERR) messages for establishing connection with source to destination node. Source node broadcast RREQ to all neighbours node if any node has destination

path than intermediate node also broadcast RREQ. If destination found than destination node send RREP to source node with sequence number. Then source node select higher sequence number path for routing path. AODV also support multipath routing for communication. AODV needs extra bandwidth for broadcasting control message [11]. Because of its reactive nature, AODV can handle highly dynamic behavior of Vehicular Ad-hoc networks. AODV for both unicasts and multicasts uses the flag in the packets[12].

Dynamic Source Routing Protocol (DSR)

DSR provide a high on-demand routing process, its low overhead protocol and fast reacts on the frequent changes in network topology. DSR protocol provides successful data packet delivery on change in network nature. DSR allows multi hop routing in dynamic nature of network. Two main processes in this protocol are: Route discovery and Route maintenance[13]. When source node need to communicate with node whose path is unavailable. In this scenario, Source node starts up a route discovery process in which the source node broadcasts route request message. The destination node on receiving a RREQ packet, It sends back route reply message to source node. Source node keeps the route in route catch for future communication. If routing fail than it sends back to route error to the source node. In DSR protocol every packet has intermediate node, source node delete path in cache and then store alternative path for destination [14].The benefit of DSR protocol is clearly shown in a network with low mobility; because it can use the alternative route before starts a new process for route discovery. However, the multi routes may lead to additional routing overheads by adding all route information to every data packet, besides, as the network span larger distance and including more nodes, the overhead will frequently increase and as result network performance will be degraded [15].

2. Comparative Study of AODV, DSR and DSDV on the Basis of Qualitative Metrics

In order to evaluate the performance of routing protocols, we used qualitative metrics in particular.

Qualitative Metrics: The performance is measured on the basis on empirical study. It is a broad category of performance analysis which is subjective, descriptive and difficult to measure.

Qualitative Metrics: Qualitative Metrics have following parameters listed in Table1 :

Table 1: Qualitative Metrics

S. No	Qualitative Metrics	Definition
1	IEEE Standard	Deal with requirement of different types of network (LAN, MAN, WAN).
2	Behavior of Routing	Tells the type of algorithm and strategy to be followed by the protocol for transferring the data.
3	Unidirectional link support	Means that the data transfer will be in one direction only.
4	Security	Helps in protection of routing protocol from any breach of its service.
5	Scalability	Capability of protocol to accommodate the
6	Complexity	Define structure of routing protocols i.e. hoe the different modules interact and connect with each other.
7	Power Consumption	Battery consumption of mobile nodes through data transfer, searching of paths etc.
8	Delay	Occurs when the required message does not reach its destination within the specified time interval.
9	Multicasting	Ability of routing protocol to transfer data to specified group location.
10	Routing Scheme/ Topology structure	Define the order request that is transferred from one place to another.
11	Routing Metric	To select the best path among available paths.
12	Diameter	Defines the reachability of any network (perimeter for the nodes).
13	Periodic Broadcast	Generates time to time beacons to check availability of links and connected path information.
14	Route Selection	Specifies the type of Route
15	Route	How many routes are possible to communicate.

Table 1 lists the various qualitative metrics along with their denotation. Taking the metrics listed in the table above, the comparison between these protocols can be extracted out.

Comparative Analysis of AODV, DSR AND DSDV on the Basis of Qualitative Metrics

Comparison of AODV, DSR and DSDV has been done on the basis of Qualitative metrics as shown Table 2 :

Table 2: Comparison between AODV, DSR and DSDV

S.No	Qualitative Metrics	AODV	DSR	DSDV
1	IEEE Standard	802.11	802.11	802.11
2	Behavior of Routing	On demand	On demand	Table - Driven
3	Unidirectional link support	Yes	Yes	Yes
4	Security	No	No	No
5	Scalability	Yes	No	No
6	Complexity	Moderate	Moderate	Moderate
7	Power Consumption	More	Less	Less
8	Delay	Less	More	Shortest
9	Multicasting	Yes	Yes	Yes
10	Routing Scheme/ Topology structure	Flat	Flat	Flat
11	Routing Metric	Shortest Path	Shortest Path	Shortest Path
12	Diameter	Large	Small	Small
13	Periodic Broadcast	Yes	No	Yes
14	Route Selection	Shortest and Updated	Shortest and Updated	Link State
15	Route	Multiple Route	Multiple Route	Single Route

Table 2 enlists the comparison between AODV, DSR and DSDV on the basis of Qualitative metrics as the line of comparison.

3. Conclusion and Future Scope

This research aimed at study of VANET which made the use of various protocols and comparison between them. The protocols compared in this research are AODV, DSR and DSDV. Here, these protocols are evaluated on the basis of their characteristics and metrics in order to find out the most efficient protocol to be used during the routing mechanism.

This paper presents a survey on different routing protocols and also discusses the working methodology with advantages and disadvantages of routing protocols. In order to find out the most efficient protocol amongst the various routing protocols this study analyzes and compares the characteristics of reactive routing protocols on the basis of different qualitative metrics. For future scope, quantitative analysis of these protocols will be done by using the simulation tool which will make the use of simulation approach where these position based routing protocols will be compared and analyzed on the basis of different parameters namely, Throughput, time delay and end to end delay.

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