STUDY OF VARIOUS ROUTING PROTOCOL FOR VANET

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ABSTRACT

In this paper we present comparative analysis of VANET (Vehicular Ad-Hoc Network) routing protocols. The analysis is based on different parameters. Vehicular Ad Hoc Network (VANETs) is a network where a short lived network is formed among the vehicles. Vehicles itself are the nodes within the network. VANET is formed by vehicles so node movement is restricted by the factors like road structure, traffic congestion and traffic rules and regulations. In VANET there are two kinds of communication can be done i.e. Vehicle to vehicle and vehicle to infrastructure. Therefore the performances of such communication i.e. Vehicle to Vehicle and Vehicle to infrastructure depend on the various protocols such as DSDV, AODV, DSR, ZRP. In this paper we discussed this protocol and their working.

Keywords: VANET, AODV, DSDV, DSR, ZRP.

1. INTRODUCTION

With the automobiles accidents increasing day by day, the need for Intelligent Transportation Systems (ITS) has been felt. The GLOBAL STATUS REPORT ON SAFETY of World Health Organisation puts that more than 1.2 million people die on world's roads every year and as much as more than 50 million are injured. WHO has predicted that going by the current rate of fatalities caused by road accidents, road traffic injuries will become the fifth leading cause of death by 2030. To improve safety and traffic efficiency in vehicles, there has been significant research efforts made by government, academia and industry to integrate computing and communication technologies into vehicles, which has resulted in the development of intelligent transportation systems. Vehicular Ad HOC Networks (VANET) are a special class of Mobile Ad hoc Networks where the nodes are vehicles and roadside units, where each node takes the role of sender receives and router to broadcast information to the vehicular network or transportation agency which is then used for ensuring safe and free flow of traffic.

The vehicles on the road communicate with each other either in Peer-to-Peer (P2P) manner or by using the existing infrastructure. In the former case, the communication is called as Vehicle-to-Vehicle (V2V) while in the later; it is called as Vehicles-to-Infrastructure (V2I). The infrastructure support is provided by the nearest Road Side Units (RSUs), which may act as an intelligent router to control all the activity of the vehicles on the road. If the vehicles are within the range of RSUs, then messages are forwarded to them directly else these are passed to nearest RSUs of the vehicles. But due to the high mobility and sparse distribution of the vehicles on the road, routing among the vehicles always remains a challenging task which may cause a long message delivery delay.

The message delivery in VANETs follows store and forward strategy in which messages are kept at some of the intermediate nodes until the best forwarding nodes (Vehicles/RSUs) are found. This process may have long delay due to this strategy. Vehicles specify the area where the message has to be transferred and intermediate nodes relay the message to vehicles in that particular area. For transmitting messages either of the three geographical routing schemes namely Geo Unicast, Geo Broadcast, Topologically scoped broadcast can be used. In Geo Unicast messages are Unicast to vehicles in particular area. In Geo Broadcast the intermediate nodes unicast the messages until it reaches the desired area where the message is broadcasted to reach all vehicles in that area. In Topologically scoped broadcast message is broadcasted to all vehicles in a hop neighborhoods.

Adhoc on Demand Distance Vector Routing Protocol (AODV) is a reactive routing protocol for wireless adhoc networks. AODV first introduced in 1999, uses a route discovery phase to find a route to the destination. The source sends a broadcast Route Request message to all its neighbour nodes. On receiving the message, each node records the previous hop called as backward learning and broadcasts it further. This continues till the destination is reached. The recorded nodes are used by the destination to send back Request Reply back to the source. This phase
also involves recording the previous hops. The recording of previous hops in the first step helps the destination to send data back to the source.

Dynamic Source Routing Protocol (DSR) is a topology-based reactive routing protocol for wireless networks. In DSR, introduced in 1996, the source indicates the sequence of nodes to be followed to reach the destination in a data packet. Query packet records the sequence of the nodes, which are communicated to the source by the destination. Finally, the source uses this sequence to route packets to the destination.

Destination Sequenced Distance Vector Routing Protocol (DSDV) is a topology-based proactive routing protocol. DSDV, introduced in 1994, uses a table-driven routing scheme where each entry in the routing table contains a sequence number. The number is generated by the destination, and the sender needs to send out the next update with this number. If a router receives new information, then it uses the latest sequence number. If the sequence number is the same as the one already in the table, the route with the better metric is used.

2. LITERATURE REVIEW

Gayathri et al. [1] introduced the concept of VANET, its applications, infrastructure & requirements & challenges. Kevin C. Lee et al. [2] presented a taxonomy of routing protocols in VANET. Monika et al. [3] described the importance of VANET for road accidents by making its importance realize for drivers as the knowledge from VANETS can help reduce road accidents. Rakesh Kumar et al. [4] described VANET as a subclass of Mobile AdHoc Networks that provided a distinguished approach for ITS, and describes the needs of survey of routing protocol in VANET, its importance and necessity for ITS. Yasser Toor et al. [5] discuss about the possible applications that can be used in VANETs and stresses more on the application of VANETs in providing safety to the vehicles by preventing accidents through the use of communication in wireless networks. They explore the various implementation issues to provide quality services in wireless environment. Shaikhul Islam Chowdhuer et al. [6] compared performances of reactive routing protocols namely Ad Hoc Demand distance Vector (AODV), Dynamic source Routing (DSR). They concluded by taking the tradeoff between performance metrics that in VANET, AODV is more appropriate than DSD. Niansheng Liu et al. [7] presented the results of simulation model of three mobile adhoc routing protocols viz. DSDV, DSR and AODV for the freeway scenario and concluded that AODV is more suitable for the freeway VANET.

3 TYPES OF PROTOCOL

3.1 Routing Protocol

The primary goal of routing protocols in ad-hoc network is to create a path between source and destination with minimum overhead and minimum bandwidth use so that packets are transmitted in a timely and orderly manner.

The existing routing protocols in VANETs can be classified into three categories:

- Proactive Routing Protocol (Table Driven)
- Reactive Routing Protocol (On-Demand Driven)
- Hybrid Routing Protocol

3.1.1 Proactive Routing Protocol (Table Driven)

In a proactive routing protocol, every node keeps one or more tables representing the overall topology of the network. These tables are updated frequently in order to maintain up-to-date routing information from each node to every other node. To maintain the up-to-date routing information, topology information needs to be exchanged between the nodes on a regular basis, leading to reasonably high overhead on the network. In additional, the routes will also be available on request. Many proactive protocols begin from conventional link state routing, along with the Optimized Link State Routing protocol (OLSR).

Example: DSDV

[A] Dynamic Destination-Sequenced Distance-Vector Routing Protocol (DSDV)

DSDV is developed on the basis of Bellman–Ford routing algorithm along with some changes. In DSDV routing protocol, each mobile node in the network keeps a routing table. Each of the routing table contains the record of all available destinations and the number of hops to each. Each table entry which is originated by the destination node, is tagged with a sequence number. Periodic transmissions of updates of the routing tables help to maintain the topology information of the network. If there is any new significant change in the routing information, the updates
are transmitted immediately from the respective nodes. So, the routing information updated may either be event driven or periodic. DSDV protocol requires each mobile node in the network to broadcast its own routing table to its current neighbours which is either done by broadcasting or by multicasting. Through the broadcasting, the neighbouring nodes can make out about any changes that has occurred in the network due to the movements of nodes. The routing updates could be sent in any of the two ways: one is called a “full dump” and another is “incremental”. In case of full dump, the complete routing table is sent to the neighbours, where as in case of incremental update, only those entries which require changes are sent.

### 3.1.2 Reactive Routing Protocol (On-Demand Driven)

Reactive routing protocols are On-demand protocols. These protocols do not try to keep correct routing information on each and every node all the times. Routing information is collected only on demand, and route determination based on sending route queries throughout the entire network. The primary advantage of reactive routing is that, the wireless channel is not subjected to the routing overhead data for routes that may never be consumed. While reactive protocols do not have fixed overhead needed by keeping continuous routing tables, they may have significant route discovery delay. Reactive search procedures can also add a considerable amount of control traffic to the network because of query flooding. Because of these weaknesses, reactive routing is less relevant for real-time traffic or in scenarios with a high volume of traffic between a large numbers of nodes.

Example:- DSR, AODV

### [B] Dynamic Source Routing Protocol (DSR)

DSR allows nodes in the VANET to dynamically find out a source route across multiple network hops to any destination. In DSR protocol, the nodes are required to maintain route caches or the known routes. The route cache is updated when any new route is identified for a particular entry in the route cache. Routing in DSR is done using two basic phases: route discovery and route maintenance. When a source node wishes to send a packet to a destination node, firstly it consults its route cache to determine whether it already knows about any route to the destination or not. If any entry occurs for that destination previously, the source uses it to send the packet to the destination node. If it doesn’t exist, then it initiates a route request broadcast. This request consist of the destination address, source address, and a distinct identification number. Each intermediate node checks whether it knows about the destination node or not. If the intermediate node doesn’t know about the destination node, it again forwards the packet and finally it reaches to the destination. A node processes the route request packet only if it has not previously processed the packet and if its address is not present in the route record of the packet. A route reply is generated by the destination node or by any of the intermediate nodes when it knows about how to reach the destination.

### [C] Ad Hoc On-Demand Distance Vector Routing (AODV)

As in VANET, nodes (vehicles) have high mobility and moves with high speed. Proactive based routing is not suitable for it. Proactive based routing protocols may fail in VANET due to consumption of more bandwidth and large table information. AODV is a reactive routing protocol, which operates on hop-by-hop pattern. The Ad hoc On-Demand Distance Vector (AODV) algorithm enables dynamic, self-starting, multihop routing between participating mobile nodes wishing to establish and maintain an ad hoc network. AODV allows mobile nodes to obtain routes quickly for new destinations, and does not require nodes to maintain routes to destinations that are not in active communication. Route Requests (RREqs), Route Replies (RREPs), and Route Errors (RERRs) are the message types defined by AODV. In AODV routing, upon receipt of a broadcast query (RREQ), nodes record the address of the node sending the query in their routing table (Fig. 2a). This procedure of recording its previous hop is called backward learning. Upon arriving at the destination, a reply packet (RREP) is then sent through the complete path obtained from backward learning to the source (Fig. 2b). At each stop of the path, the node would record its previous hop, thus establishing the forward path from the source. The flooding of query and sending of reply establish a full duplex path. After the path has been established, it is maintained as long as the source uses it. A link failure will be reported recursively to the source and will in turn trigger another query-response procedure to find a new route.
AODV Route Discovery

AODV uses route discovery by broadcasting RREQ to all its neighboring nodes. The broadcasted RREQ contains addresses of source and destination, their sequence numbers, broadcast ID and a counter, which counts how many times RREQ has been generated from a specific node. When a source node broadcast a RREQ to its neighbors it acquires RREP either from its neighbors or that neighbor(s) rebroadcasts RREQ to their neighbors by increment in the hop counter. If node receives multiple route requests from same broadcast ID, it drops repeated route requests to make the communication loop free.

AODV Route Table Management

Routing table management in AODV is needed to avoid those entries of nodes that do not exist in the route from source to destination. In AODV Managing routing table information handled with the destination sequence numbers.

AODV Route Maintenance

When nodes in the network detects that a route is not valid anymore for communication it delete all the related entries from the routing table for those invalid routes. And sends the RREP to current active neighboring nodes that route is not valid anymore for communication. AODV maintains only the loop free routes.

3.1.3 Hybrid Routing Protocol

Hybrid routing protocol depends upon the idea of organizing nodes into groups and then allowing different functionalities to nodes both inside and outside a group. Because only a part of routing table size and update packet size are involved (instead of the whole); due to which, the control overhead is decreased. The most popular way of constructing hierarchy is to group nodes physically close to each other into clearly distinct clusters. On behalf of the cluster each cluster has a leading node known as cluster head, to communicate to other nodes. Another approach is to have implicit hierarchy. In this manner, each and every node has a local scope. Different routing strategies are used inside.

Example:- ZRP

[D] Zone Routing Protocol (ZRP)

ZRP is appropriate for a wide variety of VANETs, especially for those networks which are having large span and various mobility patterns. In the ZRP protocol, each node proactively maintains routes inside a local region, which is known as routing zone. Route establishment is done by using a query-reply method. For establishing different zones in the network, a node first has to identify who its neighbours are. A neighbour is defined as a node with whom direct communication can be established, that is, within one hop transmission range of a node. Neighbours detection information is used as a basis for Intra-zone Routing Protocol (IARP). Rather than
blind broadcasting, ZRP protocol uses a query control method to reduce route query traffic by pointing query messages outward from the query source and away from covered routing zones. A covered node is a node which belongs to the routing zone of a node that has received a route query message. During the time of forwarding the query packet, a node recognizes whether it is coming from its neighbour node or not. If yes, then it spots all of its known neighbouring nodes in its same zone as covered. The query is thus conveyed till it reaches the destination. The destination in turns sends back a reply message to the source via the reverse path and creates the route.

4. CONCLUSION
In this paper, behavior of reactive routing protocol (AODV), proactive routing protocol (DSDV) and hybrid routing protocol (ZRP) have been analyzed under the microscopic mobility model. The evaluations made on these protocols bring out some important characteristics of these protocols when they are used in VANET. From the obtained results, it is observed that reactive protocol (AODV) performed well because mechanisms of route discovery, route maintenance and elimination of periodic broadcasting are used by AODV and almost all reactive protocol is best than DSDV because of table driven approach used by almost all proactive protocols, because of this approach introduced extra overhead in the network which degrades it’s performance

REFERENCES