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ROUTING PROTOCOL IN VEHICULAR AD-HOC NETWORK: A REVIEW

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Abstract **-** Vehicular Ad-hoc network (VANET) is a form of Mobile Ad-hoc Network (MANET). VANET is a self-organizing,infrastructure lessnetwork i.e. used to provide communications among nearby vehicles(V2V) & between vehicles & nearby fixed equipment i.e. roadside equipment (V2I). VANET has a dynamic topology, large &variable network size & high mobility, these characteristics led to need for efficient routing protocol.VANET routing protocols are divided into different categories: Topology, position & network based.In this paper we discuss about Topology based protocols.Themain objective of this paper is comparative study of AODV, DSDV &TORA in VANET.

Keywords:VANET,routing protocol,AODV,DSDV,TORA

I. INTRODUCTION

VANET is a subclass of mobile ad hoc wireless networks (MANET) which is a component of Intelligent Transportation Systems (ITS). VANET used in many applications of Intelligent Transportation System (ITS) for reducing congestion, road safety, and betterment in traffic flow. Vehicular Ad hoc Networks (VANETs) are based on short range wireless communications (e.g., IEEE 802.11). The Federal Communications Commission (FCC) has allocated 75MHz in 5.9 GHz band for licensed Dedicated Short Range Communication (DSRC) for vehicle-to-vehicle (V2V) and vehicle to infrastructure (V2I) communications. The radio range for VANETs is several hundred meters, typically between 250 and 300 meters. For communication to occur between vehicles and roadside units (RSUs) as shown in figure 1 , vehicles must equipped with some sort of radio interface or Onboard Unit (OBU) that enables short-range wireless ad hoc networks to be formed .

Many projects like “CarTALK 2000” [1] or other projects like ”FleetNet – Internet on the Road” [2] have been developed based on concepts of MANETs and VANETs. In practice, many applications in VANETs need the support of multi-hop communication. For example, a moving vehicle may want to download audio songs from a server located several miles away. For multi-hop communication we need routing algorithms. Routing in VANETs is different from MANETs due the characteristics of VANETs, e.g., high dynamics, mobility constraints, high speeds of vehicles. High dynamics in a large scale network will lead to uneven network density, which varies by time and location. It means that network might be sparsely connected in one area but densely connected in other area. On the other hand, some characteristics of VANETs, like mobility constraints and predicable mobility, provide the opportunities to facilitate routing in VANETs.

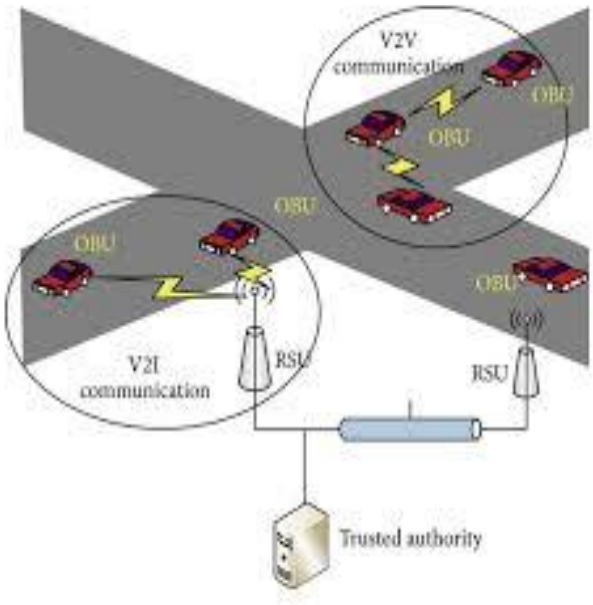

Figure 1: Vehicular Ad-hoc Network

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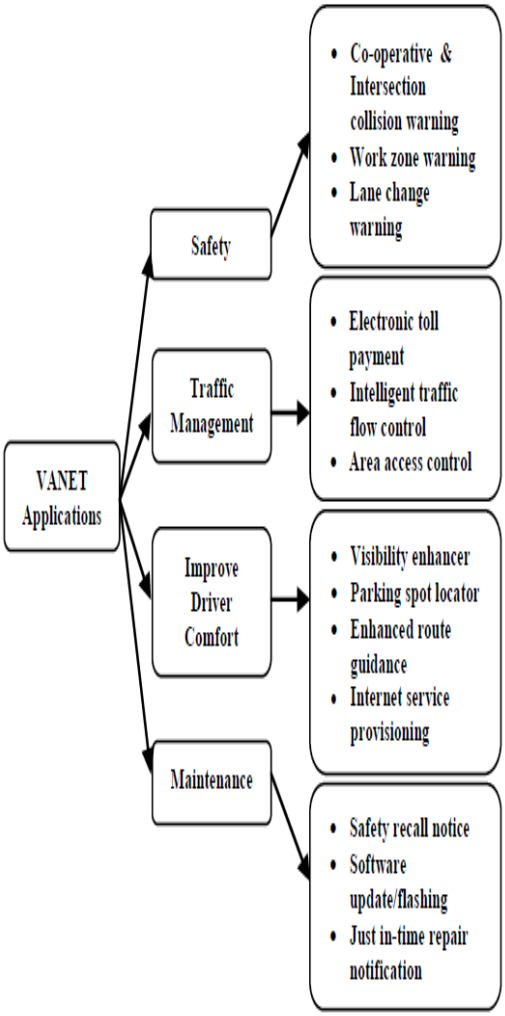

Figure2: VANET applications

In a VANET network routing is an important mechanism for finding and maintaining a communication path between a pair of remote nodes.The performance of the routing protocol degrades with speed and size of the network, so designing of efficient routing protocols are always challenging in high mobility environment that is main characteristic of VANET.

II. PROTOCOL OVERVIEW

Routing is the process to transfer data packets from source to destinationalong best suitable route. In this paper topology-based routing protocols are studied. Some of these protocols are shown in figure 2. These use link's information within the network to send the data packets from source to destination.

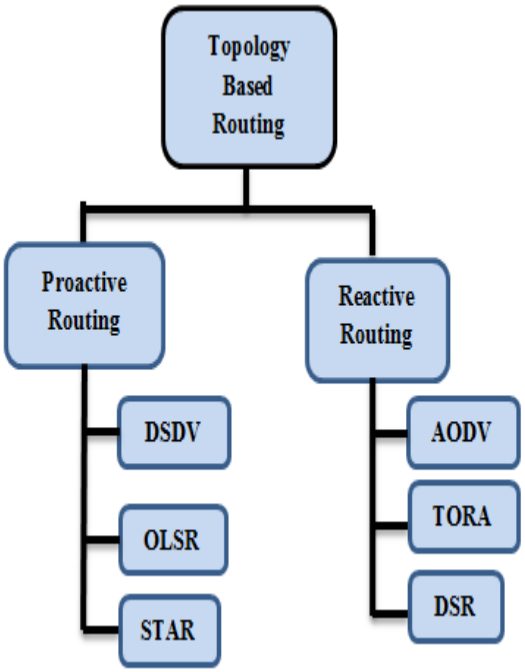

Figure 2: Topology based routing protocol

Topology based routing approach can be further categorized into:-

1. Proactive (table-driven) routing protocols
2. Reactive (on-demand) routing protocols

1. Proactive (table-driven)

Proactive routing protocols are mostly based on shortest path algorithms. They maintain and update information on routing among all nodes of a given network at all times even if the paths are not currently being used. Thus, even if some paths are never used but updates regarding such paths are constantly broadcasted among nodes [4]. Route updates are periodically performed regardless of network load, bandwidth constraints, and network size which is one

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of the main drawbacks of using this approach in VANETs.

1.1: *Destination Sequence Distance Vector Routing (DSDV)*

It is table driven routing scheme for ad-hoc mobile network based on classical Bellman Ford routing algorithm. Solving routing looping problem, increases convergence speed and reducing control overhead message was the main contribution of this algorithm. In DSDV nodes transmit update periodically to its neighbor node with the information of its routing table. DSDV routing protocol maintain a routing table that store cost metric for routing path, address of next hop up to the destination and the destination sequence number assigned by the destination node. Whenever the topology of the network changes, a new sequence number is necessary before the network reconverges and the node changed routing table information into event triggered style and send updates to its neighbor nodes. The "full dump" and "incremental update" is two ways in DSDV for sending information of routing table updates. As like name "full dump" the complete routing table is send in update message while incremental update contains only the entries with metric that have been changed since last update was sent [5].

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 large and highly dynamic network environment like VANET.

2. Reactive Routing

On demand or reactive routing protocols were designed to overcome the overhead problem, that was created by proactive routing protocols, by maintaining only those routes that are currently active [6]. These protocols implement route determination on a demand or need basis and maintain only the routes that are currently in use, thereby reducing the load on the network when only a subset of available routes is in use at any time [7].

2.1. *Ad Hoc On Demand Distance Vector (AODV)*

The Ad hoc On-Demand Distance Vector (AODV) [7-8] is reactive routing protocol which means it establish path to destination only when node has something to send. 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.It is capable of both unicast and multicast. For route discovery and maintenance purposes following types of control messages are defined by AODV.

RREQ: When node has data to send it broadcast route request message (RREQ) to its neighbors. This message is forwarded by intermediate nodes until destination is reached. RREQ packet contain information RREQ ID, destination IP address, destination sequence number, source IP address, originator sequence number.

RREP: On receiving RREQ message intermediate nodes unicast route reply message (RREP) to source if it is valid destination or it has path to destination and reverse path is constructed between source and destination. RREP packets contain information hop count, destination sequence number, Source &Destination IP address.

RERR: Whenever there is link failure route error message (RERR) is used. RERR contain information Unreachable Destination IP Address, Unreachable Destination Sequence Number.

2.2: Temporally Ordered Routing Algorithm (TORA)

TORA[8] belongs to the family of link reversal routing in which directed a cyclic graph is built which directs the flow of packets and ensures its reachability to all nodes. A node would construct the directed graph by broadcasting query packets. On receiving a query packet, if node has a downward link to destination it will broadcast a reply packet; otherwise it simply drops the packet. A node on receiving a reply packet will update its height only if the height of replied packet is minimum of other reply packets.

The main drawback is it is not scalable, with increase in number of nodes route discovery becomes difficult which affects the throughput.TORA generates more traffic with high speed mobility & increase in number of nodes which results in higher delay as compared to AODV.

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III. Comparison of AODV,DSDV & TORA routing protocols

Routing protocols	Routing Maintenance	Route discovery	Route forwarding method	Route Failure
AODV	Reactive	On Demand	Wireless Multihop	The error route is broadcasted to erase the invalid path
TORA	Reactive	On Demand	Wireless Multihop	Flooding the updated route throughout the network
DSDV	Proactive	Computes periodically	Wireless Multihop	Error route will be recovered if there is no alternative path.

IV. CONCLUSION

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. TORA is also not scalable & introduces routing overheads. Hence DSDV& TORA are not suitable. AODV is a reactive routing protocol, used for long range communication. It is suitable for highly dynamic network,reduces control overhead & has less delay compared to DSDV & TORA.

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