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A Review of Performance Evaluation & Enhancement of Proactive and Reactive Routing Protocols of MANET

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Abstract: MANET and VANET are the active research areas and lots of routing protocols have been proposed for use in these areas.. In MANET, nodes are connected through wireless channels in a network and each node acts as a router and as a host. One of the scenario of MANET is Vehicular ad-hoc networks. For communication in VANET, efficient Routing Protocols are needed. Because of highly changing network topology and frequent disconnection it's strenuous to design an efficient routing protocol for vehicles, there can be two types of VANET that are V2V(Vehicle to Vehicle) and V2RSU(Vehicle to Road Side Unit). Because of daily happening of accidents VANET is one of the affecting areas for the refinement of Intelligent Transportation System (ITS) which can insure passengers and road safety. The Intelligent Transport Systems gives information if there exists any emergency and tells about traffic density. the traffic and traffic density. The existing routing protocols for VANET are not efficient enough to meet all traffic scenarios. Worthy routing protocols are required to initiate communication between vehicles in future for passengers and road safety. This paper shows literature survey related to Reactive and Proactive Routing Protocols of MANET as AODV, DSDV, OLSR, DSR. Analysis and characterization of these protocols is shown in the paper which helps in further improvement of existing routing protocols.

Keywords: MANET, VANET, AODV, DSDV, DSR, OLSR.

1. Introduction

One type of the wireless Networks is the Mobile ad-hoc Networks and another type of wireless Network is Vehicular Ad-hoc Network. In MANET, nodes communicate with each other without an existing infrastructure. A mobile ad-hoc network is a set of wireless mobile nodes which forms temporary network without any stable infrastructure. In MANET, each node works as a router and as host. These nodes are peer to peer, self configuring and free to move in any direction because of this links to other nodes changes rapidly.

In MANET, Network is self configuring and performs significant functioning for safeguarding & searching routes. In MANET, each node acts as a router and as a host and the nodes are free to move in any direction because of this the Network topology changes rapidly. Maintaining routes in a rapidly changing network topology is tough. The mobile ad-hoc Networks have characteristics as -

1. multi hop
2. dynamically changing environment
3. Bandwidth constrained links

Because of this characteristics we can not use the protocols of wired networks for wireless networks. One of the challenges in MANET is Dynamic Network Topology. In MANET, nodes do communication with each other in a rapidly changing environment. Other challenges include Routing, Speed, Quality of Service, lack of authorization facilities, attacks related to trust vulnerability, Unicasting, Multicasting, Frequency of updates or Network overhead. The Advantage of MANET technology is that mobile instruments can be used at any point of time. Routing protocols in MANET can be classified into two categories that are proactive and reactive protocols. As shown in the figure-2.

VANET is a subset of Mobile Ad-hoc Networks. It is a newly introduced technology. VANET enables vehicles to

communicate with each other and share information in a wireless network if the vehicles are within the range.

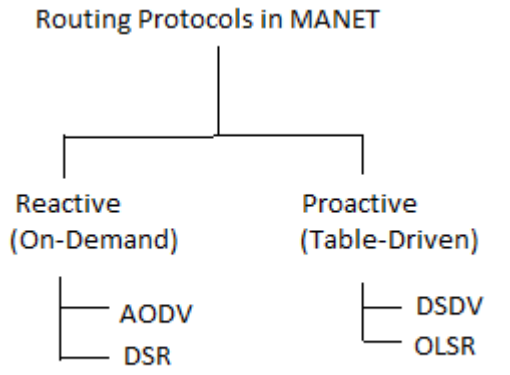

figure-1. classification of routing protocols

VANET has some different characteristics than the MANET that makes it unique.

There can be two types of VANET-

1. V2V - When there is no infrastructure needed, nodes do vehicle to vehicle communication with each other.
2. V2RSU - When Road Side Units are used for routing information exchange with the other vehicles.

An important issue in VANET is the high velocity at which vehicles move that creates problems for information exchange. Widely varying mobility characteristics vehicular or mobile nodes are expected to have remarkable impact on the performance of routing protocols. Although researchers have developed protocols for routing as Ad-hoc On Demand Distance Vector, Destination Sequenced Distance Vector, Optimized Link State Routing, Dynamic Source Routing. These protocols can not be directly used in VANET. Because in VANET, high speed,varied density nodes communicate with each other and there exists rapid variation in link connectivity.

2. Uses Of VANET

Vehicular ad-hoc network is useful in safety issues of vehicles and also useful for providing comfort level to the passengers this areas include -

Comfort Applications: Examples of comfort applications include Traffic Information System(TIS), Weather information system and gas station. These applications provide comfort level to the passengers and also provides traffic efficiency.

Safety Applications: Examples of Safety Applications include Emergency warning system, Co-operative Message Transfer, Post Crash Notification, Cooperative Collision Warning ,Real-time traffic. These safety applications shares emergency and safety data between vehicles which insures the safety of passengers.

Convenience Applications: Examples of convenience applications are Route Diversions, Electronic Toll Collection, Parking Availability etc. Convenience applications provides convenience to the public and passengers in various ways.

3. Some Factors that affect mobility in VANET

In VANET the mobility patterns of nodes affects the maintenance, route discovery, consistency. Here are some factors that affect mobility in VANET-

1.Traffic control mechanisms: Traffic lights and stop signs are the commonly used traffic control tools. Reult of these tools are long queue of vehicles that reduces the speed of the vehicles. Reduced mobility means that there are more static nodes and the rate of route change becomes slow in the network.

2.Interdependent vehicular motion: Movement of surrounding vehicles affect the movement of any other vehicle on the road. We can understand this with the example that a vehicle tries to maintain least distance with a vehicle before it. When a person driving vehicle changes its lane or increases/decreases speed it depends on the surrounding of the vehicle

3.Average speed: Rate of change of network topology is determined by how speedily a vehicle changes its position. The average speed of vehicles is also affected by the speed limit of the road. Acceleration and deceleration of topology and vehicles, broken and new routes also affect the speed of vehicles.

4. Performance Metrics of Routing Protocols

we will estimate five parameters for the differentiation of performance between routing protocols. The parameters are packet delivery ratio, energy of a specific mobile node, throughput, end to end delay, normalized routing load.

1. Packet Delivery Ratio – It's the ratio of number of data packets delivered at destination to the number of data packets generated by the source.
2. Average end to end delay – All the delays that are caused because of buffering at the time of route discovery latency, queuing, retransmission delays, transfer and propagation times.
3. Normalized Routing Load – it can be defined as the

total number of routing packets sent to the total number of data packets received.
4. Throughput – It is the ratio of total number of packets received at the receiver to the total number of packets sent by the sender.
5. Energy – When a node participates in simulation it consumes energy. Mobile nodes consumes more energy as compared to the static nodes.

5. Comparison between MANET and VANET

Similarity between MANET and VANET is that in both ad-hoc networks the nodes are self-organizing and they manage the information by themselves without a server. Vehicular ad-hoc networks have few unique characteristics and hence present as a class of Mobile ad-hoc networks.

Rapidly Changing Dynamic Topology - In Vehicular ad-hoc network, vehicles move at a high velocity, on highways vehicles can move at the velocity of 60-70 mph i.e. 25m/sec. And it can vary for different vehicles.

Frequent Network Disconnections - Rapidly changing dynamic topology results in frequent network disconnections because the link between two vehicles can disconnect very fast. The problem becomes worst if the node density varies because different density of nodes are there on roads and highways. Therefore here exists a need of robust routing protocol that can recognize frequent disconnections and can provide an alternate link quickly for communication without any inturrpt.

Unlimited battery Power – the nodes in VANET should not suffer for power limitations as in sensor networks. In another scenario of ad-hoc networks static nodes have ample energy.

Quality of Services – Any traditional MANET routing protocols do not follow QoS routing strategy. There are many researches done to integrate QoS routing strategies in MANET routing protocols. For Urban VANET(MURU) the Multi-hop Routing Protocols[14], estimate standard factors of a route, basis of that is position of vehicle, speed and trajectories. MURU establishes new metric called "Expected Disconnection Degree"(EDD) that is based on the factors mentioned above. therefore nodes in MURU need to know position of themselves and should have external street map with existence of systematic location facilities.

6. Literature Survey

We have recognized many important segments of literature for routing protocols in MANET and VANET. Reference [4] did Comprehensive Study of Proactive and Reactive Protocols in MANET. They did the comparison on three parameter s e2edelay, packet delivery ratio, throughput between protocols OLSR, AODV, DSDV and TORA and showed that AODV and OLSR performs better than DSDV and TORA. TORA lacks in all three factors.
Reference[6] did Performance differentiation of AODV, DSDV, OLSR and DSR Routing Protocols in MANET. The realistic differentiation of routing protocols DSDV, AODV and DSR is shown. AODV performs best with its ability to maintain connection by exchanging information periodically. Reference[3] did comparative study on MANET routing protocols on parameters throughput, packet delivery ratio, end to end delay and normalized routing load. They did comparative study for 50 and 100 nodes.
Reference[2] compared 3 popular routing protocols AODV, DSDV, DSR and showed that AODV has a stable end to end delay. DSDV has more packet delivery ratio than the AODV and DSR protocols. DSR has highest end to end delay and routing load. This reference showed that AODV is efficient than DSR & DSDV but in case of normalized routing load DSDV is better.
Reference[15] provided a simulation and analysis of routing protocols of VANET for end to end delay in vehicle to vehicle communication. They took urban scenario for V2V communication using Bellman ford routing protocol and found that Bellman ford routing protocol implemented using QualNet performs better than AODV and DSR for end to end delay for all sets of velocity. They showed that Bellman ford suits more for DSRC technology as compared to DSR and AODV protocols.
Reference[16] focused on the performance analysis of three routing protocols that are AODV, OLSR and DSDV. They used NS-3 as their simulation tool. They analyzed routing protocols on four factors that are normalized routing load, packet delivery ratio, end to end delay, throughput. With their analysis of routing protocols they showed that, the OLSR performs better than AODV and DSDV protocols in terms of normalized routing load, throughput, Packet delivery ratio for 2, 3, 4 mobile nodes. They also showed that AODV perform better in terms of end to end delay than OLSR and DSDV. Their study of routing protocols showed that OLSR works better in

MANET but its performance also depends on the network.

7. Routing in MANET

7.1 Classification of Routing Protocols in MANET

Routing protocols in MANET can be broadly partitioned into two categories that are Reactive & Proactive protocols, where proactive protocols are table driven and reactive protocols are on-demand.

7.2 Reactive Routing Protocols

In Reactive Protocols routes are discovered only when the routes are needed.

7.2.1Ad-hoc On-demand Distance Vector Routing(AODV)

It is an on-demand routing protocol i.e. it creates route only when the route is demanded by the source nodes[1,6]. AODV can use unicast and multicast routing as needed by the network. AODV uses sequence numbers to ensure that the current route is a fresh route. AODV uses broadcast IP therefore routing provided by it, does not contain loops.

Whenever we need to send packets from source to a destination for which route is not discovered. It sends a RREQ (route request packet) throughout the network. A node that receives RREQ can reply back with RREP(route reply) message, if it is the destination or it has a route to destination with a sequence number greater/equal to the RREQ. Route Error(RERR) message is used whenever link break occurs. RERR is sent to the source node to inform that the destination is not reachable now. Issues in AODV are that- here for connection setup and for initiation of communication time required is more than the other approaches of route establishment. It may lead to inconsistency in route if intermediate nodes contain old entries. It may lead to heavy control overhead if for a single RREP packet there has many route reply packets. it consume extra bandwidth because of periodic beaconing.

7.2.2Dynamic Source Routing (DSR)

DSR protocol uses source routing method. It is like the AODV protocol as it forms route whenever demanded by the source. DSR is different from AODV in a way that In DSR each intermediate node that broadcasts a RREQ packet adds its own address to a list attached in the packet. Destination node generates RREP message that includes list of addresses received in route request and transmits it back by using same path to the source. DSR protocol do two main mechanisms that are- allowing the discovery of routes & maintenance of source routes in the mobile ad-hoc network.

Route Discovery is used whenever source tries to send data to a destination for which it does not know route. Route Maintenance- using this mechanism source that wants to send packets to destination can be detected. While source is sending packets to destination ,If topology changes route maintenance is done. DSR protocol can be used with ad hoc networks as it uses source routing method, unidirectional links and provides loosp free routes. Issues in DSR found as - the route information within the header will lead to byte overhead, if there exists too many nodes in the network. Unnecessary flooding burden is there on the network. DSR is not able to repair broken links in a local manner.

7.3 Proactive Routing Protocols

In proactive routing protocols information about nodes is stored in the form of tables. Whenever any change occurs in the Network topology then the tables are updated accordingly. Nodes swap topology information so they have route information at any point of time. No route discovery delay is associated while finding new route. DSDV(Destination Sequenced Distance Vector) and OLSR(Optimized Link State Routing) protocols are proactive routing protocols.

7.3.1Optimized Link State Routing(OLSR)

It is a table driven proactive link state routing protocol. It reduces flooding process and control message overhead by marking subsets of neighbours as mutli point relays(MRLs). OLSR uses two types of messages- HELLO message and Topology Control(TC) message.

There are two lists which are maintained by HELLO message. First list maintains neighbours address to which link exists. Second list maintains neighbours address from which control traffic heard but bidirectional links are not confirmed. In OLSR, each node maintains a routing table. This routing table contains destination address, next node address, number of nodes to destination. Main issue in the OLSR protocol is related to the large message overhead which is difficult to maintain.

7.3.2Destination Sequenced Distance Vector (DSDV)

DSDV is a table driven scheme for ad hoc mobile Networks. DSDV protocol is based on Bellman – Ford Algorithm along with some improvements on it. In DSDV , routing table maintains entry about number of nodes to destination in the network and entry for every mobile node. Sequence Numbers are used to differentiate between stale routes & fresh routes. Use of sequence numbers avoid formation of loops. In all available routes, route with highest sequence number is used. Whenever network is stable, incremental updates are sent to avoid extra traffic.

If the Network is idle than also Routing updates are exchanged, for this network uses battery and network bandwidth. If any link failure occurs while route is active, the node upstream propogates a RERR message to the source node for informing about the link failure. Issues in DSDV protocol includes heavy overhead because there exists requirement of periodic update messages. Another issue is related with the wastage of bandwidth because of unnecessary routing information even if no change in the network topology.

8. Flow Diagram of proposed work

This work proposes a solution based on modification on AODV. This approach specifying the correct AODV routing behavior and distributed in the network. Trust Mechanism monitors network for detecting run-time violation of the specifications. Aim of Trust Mechanism is to secure the AODV protocol. Dynamic topologies make it difficult to obtain a global view of the network. Traffic monitoring in wired networks is usually performed at switches, routers and gateways, but an Ad Hoc network does not have these types of network elements so here Trust Mechanism can collect audit data for the entire network. Trust Value is defined as a sequence of related actions performed by a malicious adversary that results in the compromise of a target network. The existence of a security policy that states which actions are considered malicious should be prevented is a key requisite for an intrusion detection system to work. Trust detection is the process of identifying and responding to malicious activities target at computing and network resources.

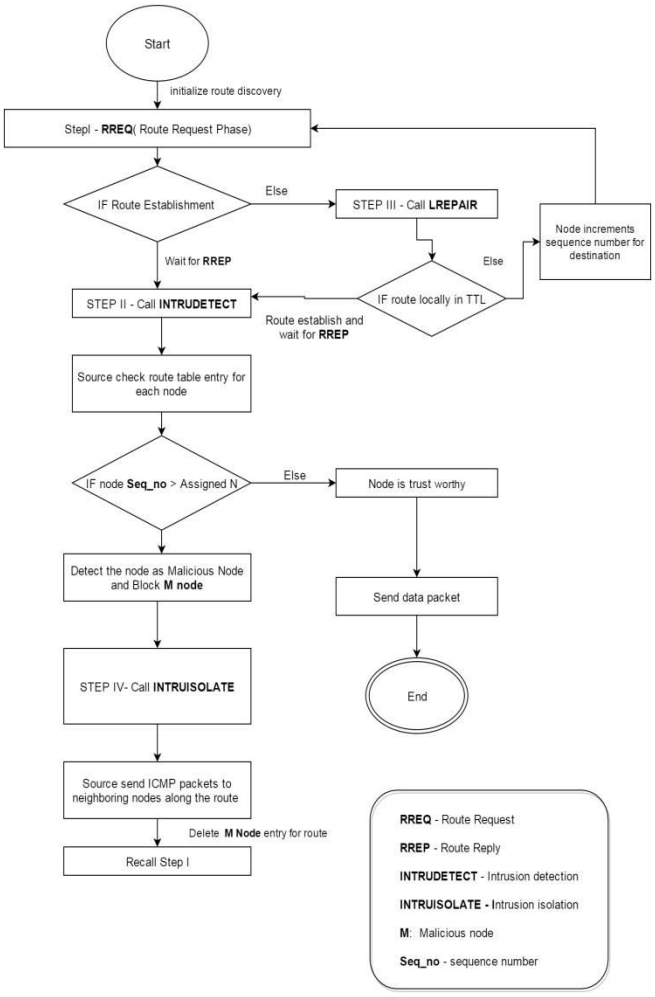

Figure-3. Working of TAODV protocol

9. Conclusion

In this paper we surveyed about Reactive and Proactive Routing protocols of MANET. We did the comparative analysis between the mobile ad-hoc network and the vehicular ad-hoc network. Our literature survey focuses on protocols like AODV, DSR, DSDV and OLSR. the Reactive protocols will be the best if we want to use any existing protocol with the same set of rules in both the VANET and MANET. based on previous research work and study AODV results better than any other reactive protocols for both MANET and VANET.

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