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PERFORMANCE ANALYSIS OF REACTIVE & PROACTIVE ROUTING PROTOCOLS FOR VEHICULAR ADHOC –NETWORKS WITH VARYING SPEED OF NODES

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ABSTRACT

The main concern for establishment of communication between vehicles is its very high speed as compared to other MANET Technologies as well as the Density in URBAN areas. To overcome these problems the communication nodes must have channels with high frequency and free bandwidth. Still there are many limitations and drawbacks for successful communication among the vehicles thus this technology is demanding more work on the best methods and the protocols for the communication in vehicular ad-hoc network because the infrastructure in VANET scenario changes rapidly. In this paper nodes have been used as vehicles and based on comparison between two mostly used routing protocols Ad hoc on demand distance Vector routing protocol (AODV) and Dynamic source routing protocol (DSR) in VANET scenario with simulation time of 10sec, 20 sec, 30sec, 40sec and 50sec with 44 nodes with different mobility which are 20m/sec, 40m/sec and 60m/sec and performance has been calculated on the basis of Residual energy and Routing overhead with different environment. The tool chosen for this work is NETWORK SIMULATOR (NS2).

KEYWORDS: VANET, AODV, DSR, Network Simulator-2.35 (NS-2.35)

INTRODUCTION

A computer network is a collection of network devices and computers which shares information, application and services among each other. These networks can be wired or wireless. MANET is a temporary wireless network which does formed without the use of any existing network infrastructure and without any centralized administration. Nodes are mobile in nature in MANET, hence the topology and structure of the network changes frequently. In MANET nodes also act as a router and takes part in routing. As nodes are mobile, routing become the most important and challenging task in MANET [19].

A mobile ad-hoc network (MANET) is a self-configuring infrastructure less network of mobile devices connected by wireless. Ad hoc is Latin and means "for this purpose". Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently. Each must forward traffic unrelated to its own use, and therefore be a router. The primary challenge in building a MANET is equipping each device to continuously maintain the information required to properly route traffic. Such networks may operate by themselves or may be connected to the larger Internet [12].

Types of MANET

- Vehicular Ad-hoc Networks (VANETs) are used for communication among vehicles and between vehicles and roadside equipment.

- Internet Based Mobile Ad-hoc Networks (iMANET) are ad-hoc networks that link mobile nodes and fixed Internet-gateway nodes. In such type of networks normal ad-hoc routing algorithms don't apply directly [12].

VEHICULAR AD-HOC NETWORK (VANET)

A vehicular ad hoc network (VANET) is a technology which utilizes moving cars as nodes in a network to generate a mobile network. VANET revolve every participating car into a wireless router or node rather than moving in arbitrary fashion, vehicles tend to move in a coordinated fashion. VANET offers several benefits to management of any size. IEEE 802.11p standard is integrated in vehicular communication. The communication area which is related with the scope of this approach is a proceeding and stimulating application of an ad-hoc network where vehicles are separate as nodes. This area has certain guaranteed aspects and activities to be granted, which are largely related with the security, convenience and entertainment topics. Vehicular ad hoc networks (VANETs) represent a rapidly emerging and challenging class of mobile ad hoc networks (MANETs). In such networks, each node operates not only as a host but also as a router; promote packets for other mobile nodes [3]. Communication between vehicles by means of wireless technology has a large potential to improve traffic safety and travel comfort for drivers and passengers [4].

Applications of VANET

The primary goal of VANET is to improve safety on road. To achieve this, the vehicles act as sensor and exchange messages to different vehicles, these messages include information like speed of vehicle, situation of road, Traffic density. This enables the drivers and authorities to react early to any dangerous situations like accidents and traffic jams. But the recent researches in the field of VANET have discovered many applications and technologies.

Type 1

Application Assistance for Safe Navigation: This application manages different critical aspects of traffic safety, which are follows

- Application for avoiding collision through distance calculation between two vehicles it can use sudden braking system.
- Application for detection of hazardous and dangerous driving conditions. This conditions can be damaged road, blocked road, if road is covered with blizzard or mud.
- Application for emergency call services after an accident occurs here the vehicle can automatically call to authority if an accident occurs.
- Applications for detecting rough drivers, which are disobeying traffic rules like crossing speed limit, talking in phone while driving, driving in the wrong side of the road.

Type 2

Application for Traffic Regulation and Internet Connectivity: This application manages different critical aspects of traffic regulation as well as internet connectivity, which are follows:

- Application for Advanced Navigation Assistance (ANA) such a car park formation, real time vehicle congestion information, expected weather condition for driving etc.

- Internet connection services can be provided to vehicle added for travel comfort and improved productivity. This can be done by data transfer between vehicle and road side unit.
- Chatting services between users of the same root, This can improve driving safety i.e. one driver can send immediate warning message to other driver, and Application for advertisement of local/nearest service stations, nearest hotel, shops, mall.

VANET and Convenience

There are several ways VANET could aid riders in areas of convenience and comfort. For commuters who line up and drive, VANET could help drivers keep path of arriving trains, roller or buses. This also will be a part of the protocol that is selected: it must be programmable for individual drivers. Probably an extensive use of VANETs is in avoiding traffic congestion. The first car that confrontation a traffic jam will let others know so the jam can be avoided [1].

Special Characteristics of VANET

High Dynamic Topology: VANET have very high dynamic topology. The communication links between node changes very rapidly communication between two nodes remains for very less time. We can explain through example if two vehicles moving away from each other with a speed of 25m/sec and if the transmission range is about 250m, then the link will be only for 5 seconds (250m/ 50ms-1). So this how highly dynamic topology is present in VANET.

Frequent Disconnected Network: From the above characteristic we can see that connection between two or more vehicles remains for 5 second. To maintain the continuous connectivity vehicles needs another connection nearby immediately. But if failure occurs vehicles can connect with Road Side Unit (RSU). Frequent disconnected network mainly occur where vehicle density is very low like rural area.

Mobility Modeling and Prediction: The above two features for connectivity needs the knowledge of position of vehicles and their movements but it is very difficult to predict since vehicle can move randomly and it does not have a pattern. So mobility model node prediction which based on the study of predefined road roadway model and vehicle speeds is use.

Communication Environment: The mobility model highly varies in different environment form rural area as compare to urban area, from highways to that of urban environment. So mobility modeling and vehicle movement prediction and routing algorithm should adapt to these changes. For highways mobility models are very easy because vehicle movement is one dimensional. But in case of urban environment there are many vehicle present with different obstacle like building are present it makes communication application very complex in VANET.

Hard Delay Constraints: Safety aspect like accident, sudden break and emergency call of VANET application depends upon the delivery time of data. It cannot compromise for data delay in this type of application. Therefore hard delay constrain is more important in VANET than high data rate.

Interaction with on-Board Sensors: The on-bard sensors are present in the vehicle. These sensors are used to find vehicle location, vehicle speed and vehicle action these information's are then used for effective communication between vehicles.

VANET ROUTING PROTOCOL

VANET routing protocol is a convention or standard that controls how node achieve route packets between enumerate devices in a mobile ad hoc network. In ad-hoc networks, nodes are not familiar with the topology of their networks. The basic idea is that a new node may announce its presence and should listen for announcements broadcast by its neighbors. Each node learns about nodes nearby and how to reach them.

Ad Hoc on Demand Distance Vector (AODV)

In AODV, the network is silent until a connection needed. At that point the network node that needs a connection broadcasts a request for connection. Other AODV nodes forward this message, and record the node that they heard it from, creating an explosion of temporary routes back to the needy node [14]. When a node receives such a message and already has a route to the desired node, it sends a message backward through a temporary route to the requesting node. The needy node begins using the route that has the least number of hops through other nodes. Unused entries in the routing tables are recycled after a time.

When a link fails, a routing error is passed back to a transmitting node, and the process repeats. Much of the complexity of the protocol is to lower the number of messages to conserve the capacity of the network. For example, each request for a route has a sequence number. Nodes use this sequence number so that they do not repeat route requests that they have already passed on. Another such feature is that the route requests have a "time to live" number that limits how many times they can be retransmitted. Another such feature is that if a route request fails, another route request may not be sent until twice as much time has passed as the timeout of the previous route request [13].

Dynamic Source Routing (DSR)

DSR is an efficient routing protocol that allows independent wireless mobile nodes to self-organize into an ad hoc network. The protocol specifies two main operations, route discovery and route maintenance, which allow nodes to learn and track routes to arbitrary destinations in the network [22].

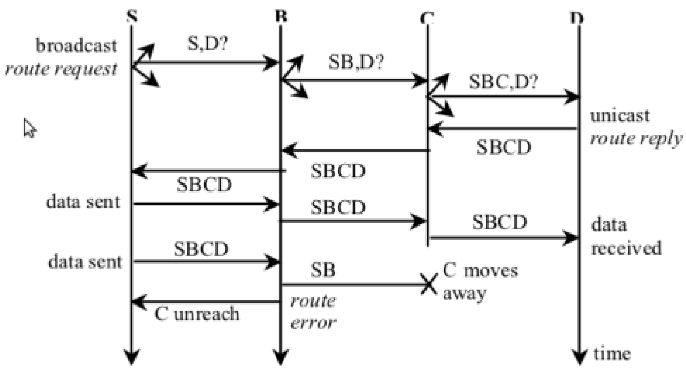

Figure 1: DSR Protocol Operation [19]

Route Discovery: The operation of the protocol is illustrated in figure 1 Time increases in the downward direction in the figure 1. The initial phase is route discovery, in which a node S wishing to send a packet to a destination node D broadcasts a Route Request (RREQ) message for D to the network. This message is contained in an IP packet that includes a DSR header preceding the transport protocol packet. The header includes the type of message, as well as the path taken by the packet so far. Initially, the path just contains S. This message propagates to the immediate neighbors of S, including B. In turn, each neighbor appends itself to the path recorded in the header and then propagates the RREQ to each of its own neighbors, such as C in the figure. This process repeats until the RREQ reaches D. D then issues a Route Reply (RREP) message, which travels back to S along the reverse of the recorded path. S then caches the route for future use, specifying the full route to D in subsequent data packets [19]. When S receives more than one RREP for a given destination, it chooses the first route that it receives in order to minimize the time for route discovery to take place. With minor modifications, the implementation can choose a route based on other metrics, such as previously observed throughput or packet loss rate for each node along the path [19].

Route Maintenance: Route maintenance is the mechanism by which S detects during transmission if its route to D has become invalid, typically due to an intermediate node in the path failing or moving out of communication range. Path validity is monitored on a per-hop basis, with each node along the path using an acknowledgement mechanism to ensure that a packet was received by its downstream neighbor. This acknowledgement mechanism may be provided by the underlying layer 2 protocol (such as IEEE 802.11p), or else a node may infer acknowledgement from overhearing its downstream neighbor relay the packet (for example, B concludes that C successfully received a packet after overhearing C transmit the packet to D).

If neither of these mechanisms is available, DSR can rely on its own acknowledgement scheme, in which a node sends an Acknowledgment Request message to its downstream neighbor and awaits a corresponding Acknowledgment Reply message [19]. Regardless of the mechanism used, if a node does not receive an acknowledgement from a downstream neighbor, it assumes that neighbor is unreachable and marks invalid all routes in its cache that contain that neighbor. The node then issues a Route Error (RERR) message to all upstream nodes that have recently used the invalidated routes. The upstream nodes can then attempt to use other routes in their route caches, or they can invoke route discovery again to find new routes that do not include the failed node [19].

IMPLEMENTATION AND RESULTS

In this paper firstly created scenario file for IEEE 802.11p standard which has to be used along with TCL Script than created a TCL script consist of various routing protocols these are AODV and DSR in VANET scenario or topology in this paper it consist of 44 movable nodes with two ray ground model and various speed of i.e. 20, 40 & 60m/sec, performance has been calculated on the basis of Residual energy and Routing overhead with different environment. Implementation consists of typical installation process of ns-2 complexity of topography creation and a detailed understanding of AWK scripts, and total environment size taken is of 2 KM.

Simulation Parameters

Table 1: Simulation Scenario

Simulation TOOL	Network Simulator-2.35
IEEE Scenario	VANET(802.11p)
Mobility Model	Two Ray Ground
No. Of Nodes	44
Node Movement speed	20,40,60 m/sec.
Traffic Type	TCP
Antenna	Omni Directional Antenna
MAC Layer	IEEE 802.11p
Routing Protocols	AODV, DSR

Table 1: Contd.,

Queue Limit	50 packets
Simulation Area(in meter)	2000*2000
Queue type	Droptail, CMU Priqueue
Channel	Wireless Channel
Simulation Time	10,20,30,40,50 sec.

Residual Energy: It is the total amount of energy Consumed by the Nodes during the completion of Communication or simulation for ex. If a node is having 100% energy initially and having 70% energy after the simulation than the energy consumption by that node is 30%. The unit of it will be in Joules.

Residual Energy for the Node Mobility of 20m/Sec: Table 2 shows the Residual Energy under routing protocols i.e. AODV and DSR for the mobility of 20m/sec.

Table 2: Residual Energy for the Node Mobility of 20m/Sec

	AODV	DSR
10sec	99.906	99.992
20sec	95.157	96.279
30sec	91.654	95.653
40sec	89.037	92.865
50sec	85.438	90.704

Residual Energy for the Node Mobility of 40m/Sec: Table 3 shows the Residual Energy under routing protocols i.e. AODV and DSR for the mobility of 40m/sec.

Table 3: Residual Energy for the Node Mobility of 40m/Sec

	AODV	DSR
10sec	99.947	99.978
20sec	96.856	97.370
30sec	93.090	95.935
40sec	89.167	93.127
50sec	85.662	90.770

Residual Energy for the Node Mobility of 60m/Sec: Table 4 shows the Residual Energy under routing protocols i.e. AODV and DSR for the mobility of 60m/sec.

Table 4: Residual Energy for the Node Mobility of 60m/Sec

	AODV	DSR
10sec	99.999	99.999
20sec	96.638	96.871
30sec	92.692	94.051
40sec	88.082	92.575
50sec	86.775	91.316

Analysis of Residual Energy: Residual Energy is the remaining energy of the nodes after the whole communication process is done. Residual Energy of DSR routing protocol is very less as compare to AODV refer table 2, 3, 4.

Routing Overhead: This is the ratio of overhead bytes to the delivered data bytes. The transmission at each hop along the route is counted as one transmission in the calculation of this metric. The routing overhead of a simulation run is calculated as the number of routing bytes generated by the routing agent of all the nodes in the simulation run. This metric has a high value in secure protocols due to the hash value or signature stored in the packet.

Routing Overhead for the Node Mobility of 20m/Sec: Table 5 shows the Routing Overhead under routing protocols i.e. AODV and DSR for the mobility of 20m/sec.

Table 5: Routing Overhead for the Node Mobility of 20m/Sec

	AODV	DSR
10sec	0.703	1.168
20sec	0.417	0.388
30sec	0.429	0.249
40sec	0.367	0.221
50sec	0.395	0.222

Routing Overhead for the Node Mobility of 40m/Sec: Table 6 shows the Routing Overhead under routing protocols i.e. AODV and DSR for the mobility of 40m/sec.

Table 6: Routing Overhead for the Node Mobility of 40m/Sec

	AODV	DSR
10sec	0.302	0.342
20sec	0.340	0.300
30sec	0.305	0.226
40sec	0.282	0.212
50sec	0.317	0.195

Routing Overhead for the Node Mobility of 60m/Sec: Table 7 shows the Routing Overhead under routing protocols i.e. AODV and DSR for the mobility of 60m/sec.

Table 7: Routing Overhead for the Node Mobility of 60m/Sec

	AODV	DSR
10sec	0.244	0.223
20sec	0.363	0.252
30sec	0.358	0.220
40sec	0.341	0.191
50sec	0.322	0.175

Analysis of Routing Overhead: From Above table of Routing Overhead for AODV and DSR routing protocols for various mobile scenarios it is clear that DSR routing protocol is having minimum routing overhead as compare to AODV refer table 5, 6, 7.

CONCLUSIONS

Work Started from VANET scenario and concluded that the Routing overhead for all the cases of mobility DSR is having minimal overhead and minimal energy consumption as compare to AODV protocol. The Vehicular environment is being used with various mobility of Vehicular node.

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