International Journal of Applied Engineering Research ISSN 0973-4562 Volume 12, Number 18 (2017) pp. 7884-7890

A new Strategy for Performance Enhancement of DSR in Vehicular Ad-Hoc Network

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Abstract

Vehicular ad-hoc network (VANET) is a type of ad-hoc network in which the speed/movement of the nodes is very high as compared to MANET. Also topology of the nodes changes rapidly. As a result, the communication breakages between nodes are a normal thing. This problem causes high data loss and delay. Many routing protocols are used in MANET, like DSR and AODV. These protocols (DSR, AODV) are reactive routing protocols. They puts their best performance in MANET, but there are many problems (in respect of performance) while you will apply these protocols in VANET. Because in VANET, speed of nodes is very high and link breakage chances are more. To enhance the performance of DSR in VANET, we have proposed a new strategy during next hop selection process in DSR. In this strategy, we have considered three input parameters named speed, position, and direction. In terms of moving models, we have selected MANHATTAN moving model. In our proposed work, it is assumed that no traffic jam, no red light, no energy/power problems.

In the network environment of VANET, DSR will not work well. It is necessary to enhance DSR for VANET. Besides number of hops parameter, we have considered here some other important parameter like speed, direction, and position of moving nodes. In our proposed strategy, these parameters work as input parameters. Here, in this research work, we want to enhance DSR and make it usable for VANET with high performance. Direction parameter is considered as most important parameter for selected next hop. Other second important parameter is position.

In this paper, this new strategy named DSR-D is compatible to improve the performance of routing and reduces the loss of packets during communication. Here, we will apply this strategy into two steps.

Keywords: VANET; direction; MANET; Manhattan model; DSR.

INTRODUCTION

VANET is a subclass of MANET. Here, nodes participating in VANET are moving at very high speed and during this time period, communication has to be taken place.

Network topology changes very rapidly/regularly. Two types of communication may take place in VANET:

1. Vehicle to vehicle.

2. Vehicle to road side unit.

In this paper, we introduce a Manhattan moving model based DSR routing protocol performance for VANET.

DSR is most appropriate routing protocol for vehicular ad-hoc network due to its self-organizing and maintenance features.

VANET having a highly dynamic topology, hence there is a typical/tedious task to maintain a reliable path between source and the destination.

Certain mobility models are used in MANET ad-hoc network.

Moving vehicles/nodes are considered as they are equipped with sensors and GPS (Global Positioning Systems).

Location information is obtained from GPS system and speed from speedometer.

Sensors and GPS systems are helpful in routing decisions. They play an important role during routing.

DSR (Johnson, 1996) uses source routing.(source indicates in a data packet is the sequence of intermediate nodes on the routing path).

DSR: DSR is a reactive routing protocol, it activates only when it is necessary for a node to communicate with another node. It considers mainly the active route. Hence, it reduces the network congestion. In route discovery process, DSR broadcasts RREQ with a unique id from source. The destination node receives the data packet and broadcast a RREP packet back to source with unique id. During the route discovery phase, DSR floods into the network for the route search and this route discovery process completes only when the required route is found.

We can categorize the VANET network architecture into three parts:

1. WLAN/Cellular
2. Ad-hoc
3. Hybrid

In VANET, there is no centralized system which can dictate the communication. VANET is a self –manageable, self-organizable ad-hoc network. Here, link breakage chances are more.

Generally, data transmission is less reliable and less optimal as compared to MANET.

Speed of moving vehicle (nodes) more.

Characteristics of VANET

a. Predictable mobility.
b. High mobility and rapid changing topology.
c. Geographic position available.
d. Variable network density.
e. High computational ability.

Streets structures are fixed and vehicles have to follow the traffic rules (street signals, visitor's signs etc).

Many things in VANET, rapidly changes such as traffic, topology, network size, links etc.

In VANET, it is considered that each vehicle have its GPS system. GPS system gives position details for navigation purposes.

Network density (number of nodes in the network) is not fixed. It is variable.

VANET network keeps latest big computational power.

Some important factors in VANET

Street layouts: streets make moving vehicles to following a well-defined path. Streets can have either single/double or multiple lanes and can allow either one -way or two-way.

Block Size: an area surrounded by the streets in a city may be considered as block. If the block size is large, there are chances of more intersections, which in turn reflect the frequency with which a vehicle takes a break. Large block sizes make the network more complex and sensitive which directly affects the performance of the VANET.

Traffic Control mechanisms: the traffic control mechanisms directly effects on the speed of vehicles. Also topology of the network changes randomly at intersections. Reduction of average, speed means more static nodes and slower rates of route changes in the network. Also clustering process adversely effects on the performance of the VANET network.

Interdependent Vehicular Motion: speed of one moving vehicle is the main factor for changing the movement of other surrounding vehicles. For example, a moving node would try to maintain a minimum distance from the one in front of it, increase or decrease its speed, and may change to another lane.

Average Speed: speed limit, acceleration/de-acceleration, topology of the map directory affect the average speed of vehicles. The map having more intersection, then average speed of the vehicles in that map will low. But in a map having fewer intersections, then average speed of vehicles will be high.

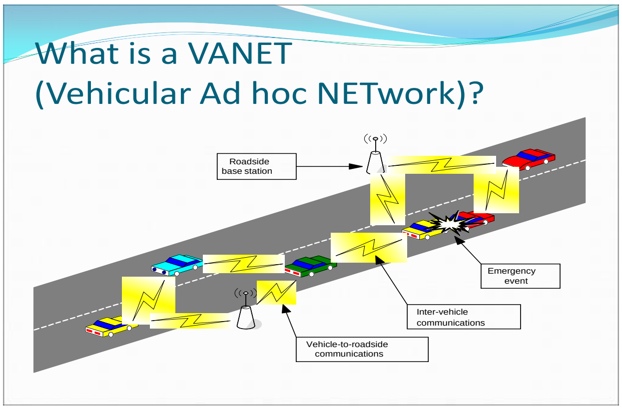

Figure 1: VANET Architecture

LITERATURE SURVEY

In [1] AODV routing protocol is enhanced. Using three mobility parameters (speed, direction, position) and Manhattan Mobility model, a new strategy is proposed in this research work. Step by step, two algorithms are applied during next hop selection routing process. Maximum and minimum speed of vehicles is considered. Every vehicle has to follow these criteria. For simulation purposes, GlomoSim simulator has been used. Link expiration time (LET), broken links and route length are the parameters which are used as simulator parameters.

Khalid Zahadiet. Al [2] proposed a new mechanism for enhancing the performance of dynamic source routing. Link breakage prediction is used to enhance the DSR. Advanced link breakage prediction will be able to construct a new route which avoids this soon to be broken link. When a node found that the received signal strength indicator (RSSI) value of the received data packets from its previous hop is still decreasing after some successive measurements, the node will realize that the link between it and its previous hop will have a link breakage soon.

In [3] Ramesh et. Al elaborated the taxonomy of various routing protocols in vehicular ad-hoc networks. VANET routing protocols can be classified into reactive routing, pro-active routing, and hybrid routing AODV, AOMDV, and TORA are examples of reactive routing (on demand routing).

An improvement over AODV, a protocol IMAODV (Improved Multicast-AODV) is designed in [4]. Basic routing strategy of DSR (Dynamic Source Routing) and multicast ad-hoc on-demand distance vector (MAODV) is applied in IMAODV. Proposed work is partitioned into route discovery and route maintenance mechanism. For simulation, MATLab is used here.

In its initially stage; network is partitioned into sub networks. Here proposed IMAODV works for multicast routing technique.

Kavneetkauret. al [5] proposed an optimized technique for enhancing the performance of AODV(Ad-hoc on demand distance vector). To find the shortest path between source and distance, ant colony routing technique is proposed here for AODV. Ant colony routing strategy is used in place of Dijsktra's algorithm for next hop selection process. The proposed approach is evaluated using MATLab tool u2013a. The evaluation work is done on the basis of packet delivery, ratio (PDR), control overhead ratio (COR), end-to-end delay, and link failures.

The overall performance of DSR is enhanced using ACO (Ant Colony Optimization) in [6]. Here DSR is evaluated using ant colony optimization algorithm with some quality parameters. By using ACO algorithm, DSR can find many optimal paths during next hop selection process. For simulation, NS-2 simulator is used.

In [7], for real time city VANET, a position based routing technique is proposed. Here, mainly position parameter is considered as main parameter for next hop selection. Direction and position is obtained by global positioning system (GPS). Sumo server is used during Omnet simulation with the help of mobility manager (MM). You can monitor on the change in direction and position of vehicles. The proposed technique is applied to reduce the network overhead by controlling over flooding of packets, route lifetime to obtain more realistic solution for real traffic problem. In this work, finding the position of moving vehicle (node) is considered as more challenging task, because speed in VANET is very high.

In wireless sensor network (WSN), TSP (Travelling Sales Person Problem) with proposed network model is approached in [8]. Dual-objective strategy based travelling sales person problem is explained here. TSP problem is solved with the help of evolutionary algorithm (EA) approach. To test the feasibility of the proposed work was run in C language. A research work is elaborated in [9] for topology control and topology maintenance for wireless sensor network. Topology maintenance is a big work for every type wireless ad-hoc network. Various protocols/algorithms such as A3, A3-Coverage (A3-Cov), Simple Tree, Just Tree etc. have come into existence. In this work, a detailed study of these protocols/algorithms has been explained in details. Also a comparative analysis has been done here. Types of metrics used in these algorithms are also mentioned in this work.

Manhattan model for Vanet

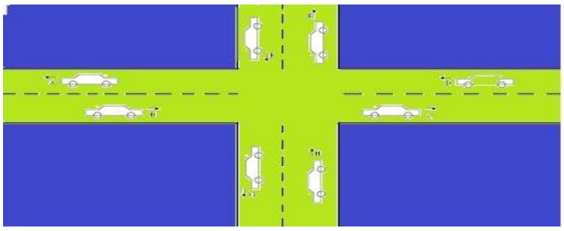

Figure.2: Manhattan Model

- No. of horizontal and vertical streets co-exists
- Mobile nodes are following the lanes of the streets
- Each street having no. of lanes in both directions
- Lanes are not supposed to overlap
- Vertical and horizontal streets can cross-over at the intersection
- Moving vehicle/nodes can move ahead, turn left or turn right on the intersection
- Direction of a lane has +ve value 1, then the lane on the opposite direction must have –ve value -1.
- Here for moving nodes on the streets there is min &max value (V_{min}, V_{max})
- For calculating next speed of moving node, acceleration & current speed of vehicle/node are input parameters
    1. If $C_s>S_{max}$ then $C_s=S_{max}$
    2. If $C_s<S_{min}$ then $C_s=S_{min}$

If current speed of node is greater than the maximum allowed velocity for its lane, current speed decreases to S_{max}. Otherwise if current speed of node is less than minimum allowed velocity for its lane, current speed increases to S_{min}.

PROPOSED MECHANISM

In our proposed mechanism, three parameters i.e. direction, speed, and position are used as input parameters.

Input parameters

Direction, Speed, Position

- Direction and Position inputs are calculated using Global Position System (GPS)
- Speed is calculating using *Speedometer*
- Each moving node is supposed to have *Sensor*

Moving situations

a. Source node S & destination node D move in same direction

b. S & D move in opposite direction

c. S & D are orthogonal

We consider here only a) & b) conditions

Intermediate node selection conditions as next hop

- It moves in some direction with source and/destination
- Intermediate node I_{node} location is b/w source & destination

```
Bool Next_Hop (node,source, destination)
// Step 1:
{
Ds=Get_Direction (Source);
Dd=Get_Direction (destination);
Dn=Get_Direction(node);
if((Dn==Ds) ‖ (Dn==Dd))
//Step 2:
{
Ps=Get_Position(Source);
Pd=Get_Position(destination);
Pn=Get_Position(node);
If ((Ps<=Pn<=Pd) ‖ (Pd<=Pn<=Ps))
Return TRUE;
Else Return False;
}
Else Return False;
}
Else Return False;
}
```

Algo no.1 next hop selection

- In this Algo the conditions for next hop selection for Intermediate node I_{node} are applied.
- Get_Direction () &Get_Position () functions get the node's direction &position respectively.

Algo no. 2

- If intermediate moving node is not find out b/w S &D in that case we have to apply another algo i.e. ALGO NO. 2
- Put lower bound for the no. of discovered route (NR)

Case I: If there are no. of nodes that have both condition of position & direction and results satisfy the lower bound of NR, then algo comes to next step.

Case II: If case I fails then go to next step.

In next step, position parameters are not considered.

Intermediate Node that has same direction with source and/or destination, can be selected as next hop for the route.

ALGO 2 applies these steps.

```
Attempt 0; //Counter
//Step 1:
If ((Dn==Ds) ‖ (Dn==Dd)) &&
((Pd<=Pn<=Ps) ‖ (Ps<=Pn<=Pd))
{
Send_RREQ_Packet (node);
NR++;
}
Else
Attempt ++
If (attempt<2)
{
Wait(w_t);
//Go to Step 1;
Else if (NR<Min_Route_threshold)
```

International Journal of Applied Engineering Research ISSN 0973-4562 Volume 12, Number 18 (2017) pp. 7884-7890


```
//Step 2
If ((Dn==Ds) || (Dn==Dd))
{
Send_RREQ_Packet(node);
NR++;
}
```

ALGORITHM NO. 2

SIMULATION RESULTS

Table 1:. Simulation parameters

Simulation Software	GlomoSim
Area	1000×1000 m
SimTime	700s
Horizontal streets	3
Vertical streets	3
Intersections	9
No. of Lines/Streets	2
Mobility Model	Manhattan
Max Speed	20 m/s
Acceleration	5 m/s^2
No. of Nodes	40
MAC Protocol	802.11
Transmission Range	250 meters
Packet size	5000 bytes
No. of packets	10000
Min route threshold	5 routes

Simulation Parametrs

- ✓ *LET (Link Expiration Time)*
- ✓ *Broken Links*
- ✓ *Route Length*

Results:

Figure 3(Broken link vs density) indicates number of broken links with respect the original DSR. This results presents that our approached method enhances thechange network density. Here, we have compared our proposed method DSR-D with original one i.e. DSR routing protocol more percentage in average, it means that links which selected with respect to nodes directions and positions are more reliable.

The figure 4 (broken link vs speed), DSR-D acts smoothly behavior on the variable speed of a node. In DSR, number of link breakage increase faster than DSR-D at high speeds.

Our results (figure 5, route length vs density, and figure 6, (route length vs speed) indicates our enhanced results with respect to increments of nodes and their speeds.

Results shown in figure 7(RET vs density), increasing the number of nodes to decrease route expiration time (RET). This figure 7, presents that DSR-D has more stability than original DSR.

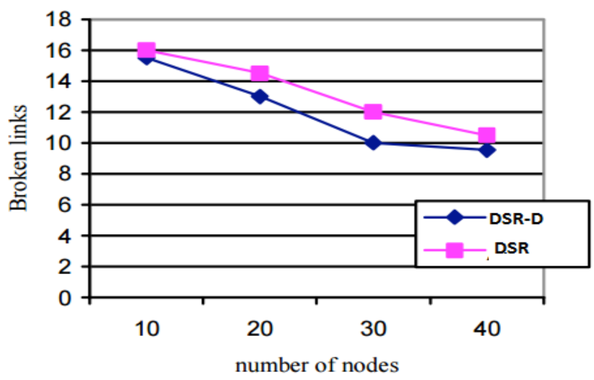

Figure 3: Broken link vs Density

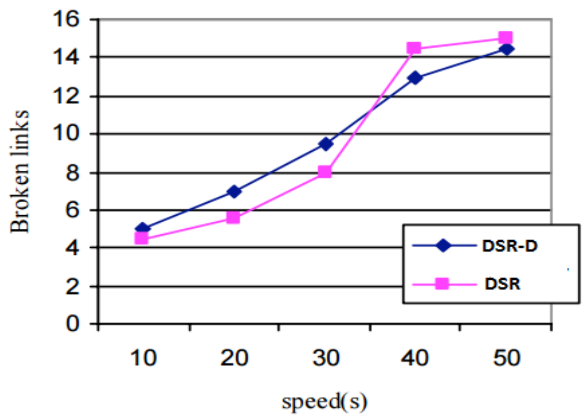

Figure 4: Broken link vs Speed

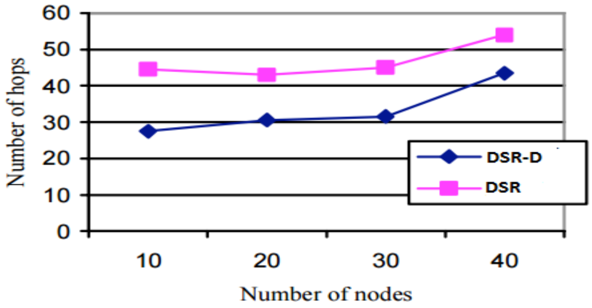

Figure 5: Route length vs Density

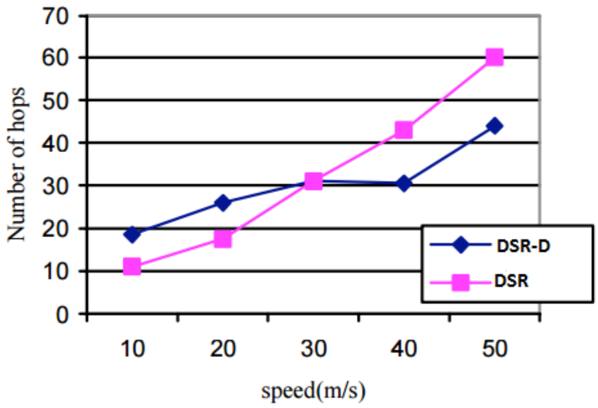

Figure 6: Route length vs Speed

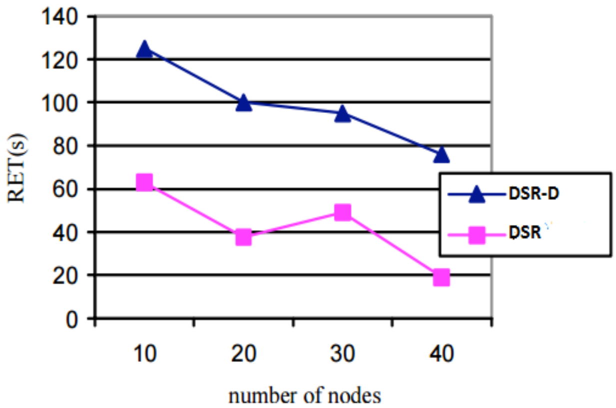

Figure 7: RET vs Density

CONCLUSION

In this work, a new routing enhanced protocol DSR-D is proposed. DSR-D enhances the total efficiency issues on DSR routing protocol. It solves the routing problems while establishing a route connection in VANET. Here, three parameters (position and direction) are considered during next hop selection in routing process. Route discovery step is totally depends upon these three parameters. The simulation result shows that link stability of DSR-D is better than DSR and also number of discovered route are less (that's why overhead of each route in DSR-D is less).

- DDSR works wells in various traffic situations
- Works well at higher speeds of nodes/vehicles
- Overall overhead of DDSR is less than DSR
- No. of discovered routes are less that's why overhead is less overall

In our future work, we can consider more moving parameters, several VANET effecting factors for routing in VANET.

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