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Abstract **-** In this paper we exploit the position based routing for VANET. We take the benefit of BMFR protocol to reduce the number of hops. Further we take advantage of AMAR for optimizing the path with the help of speed and direction in addition to position of neighbours. Finally to resolve the conflict between two competitive nodes we use an attribute named probability to prevent the packet to be forwarded in wrong direction.

I. INTRODUCTION

Vehicular Ad hoc Networks (VANETs) belong to wireless communication networks. VANET is the emerging area of MANETs in which vehicles act as the mobile nodes within the network. VANET is the wireless network in which communication takes place through wireless links mounted on each node (vehicle) [1]. Each node within VANET acts as both, the participant and router of the network as the nodes communicate through other intermediate node that lies within their own transmission range. VANET is a self-organizing network. Since it does not rely on any fixed network infrastructure, it is known as ad-hoc network. Although some fixed nodes act as the roadside units to facilitate the vehicular networks for serving geographical data or a gateway to internet etc. [2]. Higher node mobility, speed and rapid pattern movement are the main characteristics of VANET. This also causes rapid changes in network topology [3]. The basic target of VANET is to increase safety of road users and comfort of passengers.

VANET is a special type of MANET in which vehicles act as nodes. Unlike MANET, vehicles move on predefined roads, vehicles velocity depends on the speed signs and in addition these vehicles also have to follow traffic signs and traffic signals [4]. There are many challenges in VANET that are needed to be solved in order to provide reliable services. Stable & reliable routing in VANET is one of the major issues.

Traditional topology-based routing protocols, such as DSR [5], DSDV [6] and AODV [7], maintain routing information about the available or the used paths in the network which may occupy a significant part of the bandwidth. Moreover, the route instability and frequent topology changes in VANET increase the overhead for path repairs and consequently degrades the routing performances. Therefore, these routing protocols are not suitable for VANETs. Position-based routing is known to be very suitable with respect to the mobility and speed of the nodes in VANET. It is also scalable for large network size. However, applying position-based routing to VANET may also not solve problems. For example, Greedy Perimeter Stateless Routing (GPSR) [8], one of the most well-known position-based protocols in literature, works best in a free open space scenario with evenly distributed nodes. In this protocol, a purely local decision is made by each node to forward data to the neighbor that is closest to the destination. This process is repeated until the packet is delivered. Unfortunately it is not always possible. A packet could not be forwarded if its current forwarder node does not have a neighbor geographically closer to the destination than itself. This problem, known as local maximum [8], occurs often in road intersections because position information does not always point to the right direction leading to a wrong forwarding decision. The absence of mobility prediction also prevents a packet to be forwarded to destination successfully. Due to these problems, the position-based routing needs some improvements to match the requirements of VANET.

In this paper, we are using the knowledge of mobility prediction by taking advantage of Adaptive Movement Aware Routing (AMAR) [9]. We are also taking benefits of Border-node based Most Forward within Radius routing (B-MFR) [10] which uses the concept of border-node within the sender's communication range to minimize the number of hops between source and destination.

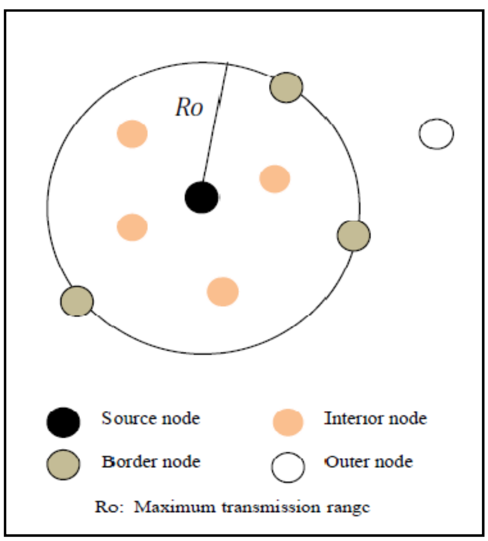
II. RELATED WORK

It is assumed that all the nodes know their position, speed and direction using any navigation system e.g. GPS. It is also assumed that the transmission range of a node is fixed. All the nodes that are within the transmission range of source node are its one hop neighbor. It is assumed that the source node has information about its neighboring nodes. Source node obtains this information through the periodic exchange of beacons or HELLO packets with its neighbors. Beacons [11] include the position of the node, its speed, direction of motion and current time as shown in fig.1

Information in HELLO Packet				
ID	**Location**	**Speed**	**Current Time**	**Direction**

Fig.1 HELLO Packet

Neighboring nodes are divided into two groups [12] - interior nodes and border nodes. All the neighbors that lie inside the circle of its transmission range are interior nodes and the nodes that lie on the circle are border nodes [13]. The nodes that lie outside the circle are known as outer nodes. The distance of the source node to the border node is exactly equal to the maximum transmission range of the source node i.e. Ro.



Border-node based most forward within radius routing protocol (B-MFR)

After getting the list of its one hop neighbor, the source need to decide the next forwarding node to deliver the packet to destination.

For this decision, border node is the best candidate in [10]. The border node is selected as the next forwarding node since the border node is the only neighbor node which is maximum away from the source node and nearest to the destination. By projecting all the border nodes on the straight line connecting the source and destination, [10] selects the one which is maximum towards the destination.

In fig.3 [10], border nodes A and B are projected on the line segment SD connecting source and destination. From projection it is clear that the border node A is closer to the destination as compared to border node B. Therefore among all the border nodes, node A is selected as a next forwarding node.

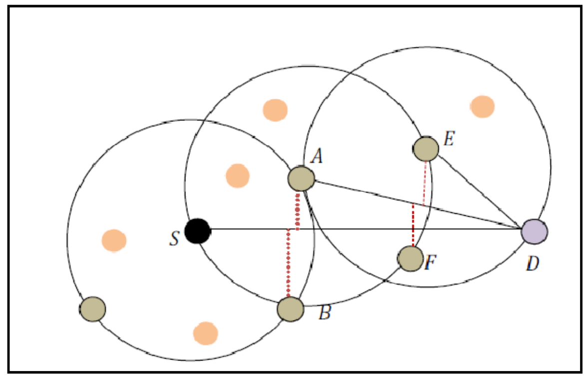


Fig.3 B-MFR forwarding method

Similarly node A will select the border node E as a next forwarding node since it is closer to the destination as compared to border node F. This greedy approach will continue until the destination node is in the transmission range of current forwarding node. In fig. 3, destination node D is in the transmission range of node E. So the node E will deliver the packet to node D and the process will be terminated. But sometimes situation arises when it is difficult to select which should be next forwarding node out of all the border nodes.

Problem in BMFR

There is some problem in above mentioned protocol. For example in fig.4, border nodes A and B are projected on the line segment SD joining source S and destination D.

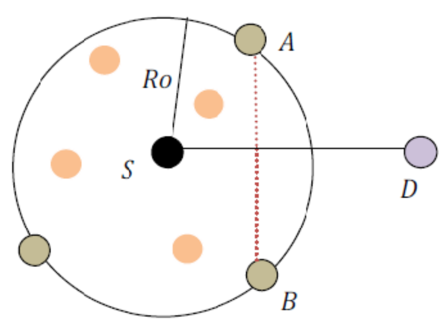


Fig.4 Problem in BMFR

Both nodes are projected to the same point on SD. Both are at the same distance from source and destination. That means, there is a conflict between nodes A and B. The decision for the next forwarding node becomes very difficult.

To resolve this conflict we take the benefit of AMAR [9] (Adaptive Movement Aware Routing Protocol).

Adaptive Movement Aware Routing (AMAR)

The AMAR [9] protocol can be used to solve the above described problem of BMFR. This protocol makes use of additional information about vehicle movement to select an appropriate packet's next-hop that ensures the data delivery. In this scheme, a border node is selected out of the two conflicting nodes by making use of mobility awareness i.e. by using some parameters like speed and direction. Based on the position, speed and direction, weighted score *Wi* for border bode *i* is calculated as follows:

$$Wi = \alpha Pm + \beta Dm + \gamma Sm$$

where α, β and γ are the weight of the three used metrics *Pm, Dm, Sm* representing the position, the direction and the speed factors respectively with $\alpha + \beta + \gamma = 1$.

A sorted list of next hop candidates can be defined ased on the computed score Wi: the node with the highest weighted score among all the border nodes of the current forwarder will be selected as the best candidate for next forwarding node. It also improves the data delivery.

Problem in AMAR

AMAR protocol solves the problem of BMFR but there is still some problem in it. Suppose that ***i*** and ***j*** are two border nodes and ***Wi*** and ***Wj*** are their respective calculated weighted score. If the weighted score of two border nodes ***i*** and ***j*** i.e. ***Wi*** and ***Wj*** are equal, again a dilemma will occur. Now to resolve this conflict, we use an attribute named probability.

Novel Solution

On the basis our study, we assign probability to the node that changes its direction on the intersection as ***Pc*** and to the node that does not change its direction on the intersection as ***Pnc*** where ***Pc*** is higher than ***Pnc***. It is assumed that all the nodes have a digital map. The source node or the current forwarding node will look on the route of both the conflicting nodes. Now the current forwarding node will take into account the probability factor and discard the node having an intersection in its route since it may change its direction and leading the packet to be forwarded in the wrong direction. Finally the packet is forwarded to the other node i.e. to the node that does not have an intersection in it route in order to accomplish successful delivery to the destination.

In table 1, complete algorithm of Border-node based Movement Aware Routing Protocol (BMAR) is shown.

TABLE 1. ALGORITHM OF PROPOSED PROTOCOL

Notations:

CFN: current forwarding node
NCN: Set of neighbors of current forwarding node
SCN: List of selected candidate nodes
SNN: selected next node
Ro: Max communication range

Algorithm:

1) CFN = S /* S is original source node
2) Check if the destination is in the communication range of CFN then exit.
3) SNN = Null
4) Compute Euclidian distance of all nodes in NCN from source node CFN
5) For all Ni € NCN, $i \leftarrow 1$ to n
   { $if\ (distance\ of\ Ni\ from\ CFN == Ro)$
   Add Ni to SCN
   }
6) For each Ni in SCN do
   Compute the weighted score *Wi*
7) Sort the SCN according to *Wi* (highest value first)
8) { $if\ (Wi == Wi + 1)$
   Use probability factor and eliminate the node from SCN having intersection in its route.
9) SNN← head of SCN
10) $if\ (SNN \neq Null)$
   Forward the packet to SNN
   Else
   Store the packet until its validity time expires
11) $if\ (SNN == Null)$
   Repeat 4 - 10
   Else
   { CFN = SNN /* Next neighbor node is selected as source
   Repeat 2 - 10 }
12) End

REFERENCES

[1] Manvi, S.S., Kakkasageri, M.S., Mahapurush, C.V., "Performance Analysis of AODV, DSR, and Swarm Intelligence Routing Protocols In Vehicular Ad hoc Network Environment", In International conference on future Computer and Communication, April. 2009.

[2] Bernsen, J. Manivannan, D., "Routing Protocols for Vehicular Ad Hoc Networks That Ensure Quality of Service", In the fourth international confernce on Wireless and Mobile Communications., Aug. 2008.

[3] Wex, P. Breuer, J. Held, A. Leinmuller, T. Delgrossi, L., "Trust Issues for Vehicular Ad Hoc Networks" IEEE,VTC Spring 2008, May.2008.

[4] T. Taleb, E. Sakhaee, A. Jamalipour, K. Hashimoto, N. Kato, and Y. Nemoto, "A stable routing protocol to support its services in vanet networks", IEEE Transactions on Vehicular Technology, November 2007.

[5] D. B. Johnson and D. A. Maltz, "Dynamic source routing in ad hoc wireless networks," Mobile Computing, 1996.

[6] C.E. Perkins and P. Bhagwat, "Highly dynamic destination sequenced distance-vector routing (DSDV)," in Proceedings of ACM SIGCOMM'94 Conference on Communications Architectures, Protocols and Applications, 1994.

[7] C. E. Perkins and E. M. Royer, "Ad hoc on-demand distance vector routing," in Proc.2nd IEEE Workshop on Mobile Computing Systems and Applications, New Orleans, LA, USA, February 1999

[8] B. Karp and H. T. Kung, "GPSR: Greedy Perimeter Stateless Routing for Wireless Networks", Proc. ACM/IEEE MobiCom, Boston, USA, Aug. 2000.

[9] N. Brahmi, M. Boussedjra, J. Mouzna, M. Bayart, "Adaptive Movement Aware Routing for Vehicular Ad Hoc Networks", IWCMC'09, 2009.

[10] Ram Shringar Raw, D K Lobiyal, "B-MFR Routing Protocol for Vehicular Ad hoc Networks", 2010 International Conference on Networking and Information Technology, 2010.

[11] Ram Shringar Raw, Sanjoy Das, "Performance Comparison of Position-Based Routing Protocols in V2V Communication", International Journal of Engineering Science and Technology, 2011.

[12] M. Zhang, R S. Wolff, "A Border Node Based Routing Protocol for Partially Connected Vehicular Ad Hoc Networks", Journal of Communications, February 2010.

[13] R. S. Raw, S. Kumar, S. Das, "An Efficient Position-Based Routing Protocol for Vehicular Ad hoc Network in City Traffic Scenarios," RISTEP-2010, NIT Srinagar, India, 2010