Analysis of Junction based Routing algorithm for VANETs

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Abstract—In this research paper the focus will be on the Junction-based Multipath Source Routing. It is a geographic routing protocol, in the sense that it exploits the location of the nodes and also of the street junctions, known via digital street maps. The main idea is that it maintains concurrently two paths from the source to the destination as a series of junctions the packets should pass through, and not as a series of nodes-relays. JMSR injects the routing information inside each packet, according to the source routing paradigm, so that every node on the path is aware of the route the packets should follow. In this paper the ananlysis of this algorithm is done, merits and demerits of the algorithm are derived.

Keywords: VANETs, routing, multipath, junction-based, JMSR.

I. INTRODUCTION

Vehicular Ad Hoc Networks (VANETs) have been proposed as a technology that will enable connectivity of users on-the-move and also implement Intelligent Transportation Systems (ITS). The latter is a technology that refers to smart transportation information collection and dissemination, such as cooperative traffic monitoring, collision prevention and real-time detour computation [3].

In VANETs, nodes cannot freely move around an area or surface; their movements are restricted within the roads formed around obstacles such as buildings. These obstacles have also a great effect in the transmitted wireless signals, causing large distortions to them. A side-effect of this is the partial predictability of nodes'movements. Another interesting characteristic is the large scaleof the network, as VANETs may comprise hundreds or thousands of nodes that may be too close together or too far away. Finally, in VANETs the nodes'power consumption is not a critical design parameter [2].

The vast majority of routing protocol for VANETs so far, such as Greedy Perimeter Coordinator Routing, Geographic Source Routing or Connectivity-Aware Routi-
ting [8], use only one single route from the source to destination. GPSR handles each packet separately. Some of its variations, like GPCR-MA , exploit the use of additional information, like electronic maps and traffic, in order to improve GPSR's performance.

The author [1] has presented a new routing protocol not based on MANET protocols variations, but based on the characteristics of urban environments from the very beginning. Junction-based Multipath Source Routing is a geographic routing protocol, in the sense that it exploits the location of the nodes and also of the street junctions, known via digital street maps. It maintains concurrently two paths from the source to the destination as a series of junctions the packets should pass through, and not as a series of nodes-relays. JMSR injects the routing information inside each packet, according to the source routing paradigm, so that every node on the path is aware of the route the packets should follow.

II. JUNCTION BASED MULTIPATH SOURCE ROUTING ALGORITHM [1]

They have assumed that each node is equipped with a GPS receiver, thus always knowing its position. Furthermore, each node has a digital map of the city streets (some commercial vehicles are already equipped with such systems). Hello packets (including position information) are used so that each node is aware of the number and position of its neighbors. Finally, they assume that the vehicles' density is relatively high, as in urban environments during rush hours.

JMSR is characterised as junction-based because it is a geographic or position-based routing protocol, where the junctions' positions are of much higher importance than the positions of the nodes themselves. Using the location information of the junctions instead of the nodes' has some attractive advantages: on one hand they avoid routing loops and local maxima/minima, while on the other hand nodes' movements have much less influence on routing decisions and paths are much more reliable in that sense. Packet forwarding is handled by the nodes within the junctions. All nodes in the junctions are potential forwarders and the selection is done randomly.

Multiple paths have been proposed in order to distribute the traffic load to a wider area, such that better performance can be achieved. JMSR is a multipathprotocol, however, multipath refers to paths comprising series of junctions and not series of nodes, as usual. Hence, JMSR's paths are not only link and node disjoint, but also they have a significant probability to be interference-disjoint too, since buildings prevent communication among nodes on either side of them; JMSR exploits this fact.

Finally, JMSR adopts the source routingconcept. Each data packet carries forwarding information, injected in the packet by the source node. Unlike other source routing protocols, the injected information refers not to the nodes but to the junctions a packet should visit. Thus, we need no routing packets to maintain routes. Finally, more freedom is provided to forwarding nodes for more appropriate next hop selection, since they have better knowledge of their neighbourhood than the source node, given the high node mobility.

A. *Routing mechanism in jmsr*

In JMSR, the source node is responsible for determining the routes towards the destination. Taking into account its own position, the destination's position and the junctions in the area between and around these two nodes, the source node calculates two routes towards the destination. Each route is composed of a sequence of junctions. After calculating the two routes (the exact method will be discussed later), the source node, appends to the header of each data packet the coordinates of the junctions of the route the packet should follow. In this way, every forwarding nodes will be aware of the geographical area that they should search for the appropriate next hop. Then, the source node behaves as a forwarding node: it searches among its neighbours for one that resides in the first junction and sends the packet to it.

Since JMSR uses two paths, the next data packet is routed via the other path. In this way, the traffic load is distributed between the two routes.

When an intermediate node receives a data packet, it looks at the packet's header to determine the location of the next junction on the path. Then, it searches for an available node at that junction, and forwards the packet to it. If no next junction is found, it means that the destination is supposed to be the next hop (and also its neighbour), so it just passes the packet to it. The selection of the next hop node inside the specified junction follows no specific rule; the choice is random. In case no node is found to reside in the junction, the packet is dropped. At this initial version of the algorithm, They have adopted no recovery mechanism. Nevertheless, in a crowded city center this case is practically rare, as most vehicles are stuck in junctions, due to city traffic lights or signs.

The size of the map's area that we will transform into a graph, where the source is going to search for routes, is crucial. They have used the rectangular area of the map defined by the two furthest points among the source node, the destination node, the junctions between them and the neighbouring junctions of the source and destination node. In this way we avoid losing routes that overcome some peculiarities in the topology and provide the shortest path algorithm with more available routes, thus increasing the probability of finding interference-disjoint paths. The update of the routes takes place each time we receive an update regarding the position of the destination node.

III. PROBLEM STATEMENT

JMSR[1] is a geographic routing protocol, in the sense that it exploits the location of the nodes and also of the street junctions, known via digital street maps. It maintains concurrently two paths from the source to the destination as a series of junctions the packets should pass through, and not as a series of nodes-relays. JMSR injects the routing information inside each packet, according to the source routing paradigm, so that every node on the path is aware of the route the packets should follow. When an intermediate node receives a data packet, it looks at the packet's header to determine the location of the next junction on the path. Then, it searches for an available node at that junction, and forwards the packet to it. If no next junction is found, it means that the destination is supposed to be the next hop (and also its neighbour), so it just passes the packet to it. The selection of the next hop node inside the specified junction follows no specific rule; the choice is random. In case no node is found to reside in the junction, the packet is dropped. In the algorithm they have not adopted any recovery mechanism to recover that dropped packet.When an intermediate node receives a data packet, it looks at the packet's header to determine the location of the next junction on the path. Then, it searches for an available node at that junction, and forwards the packet to it. If no next junction is found, it means that the destination is supposed to be the next hop (and also its neighbour), so it just passes the packet to it. The selection of the next hop node inside the specified junction follows no specific rule; the choice is random[5]. As shown in Fig 1, in case no node is found to reside in tha junction, the packet is dropped. In the algorithm they have not adopted any recovery mechanism to recover that dropped packet.

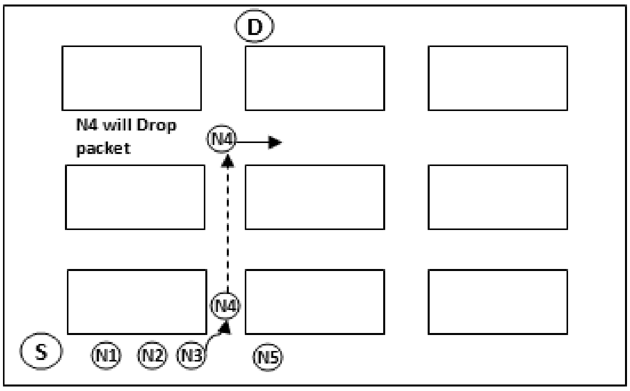

Fig. 1: Packet dropped at junction

IV. PERFORMANCE EVALUATION

The NS2 is used for the performance evaluation. We modelled the city environment as a rectangular area with horizontal and vertical streets. The dimensions of the modelled area is 1000m×500m and the node density is 600nodes/km^2.

PARAMETER		2	5	10	15
AVG DELAY(us)	4 HOPS	0.25	0.24	0.14	0.11
	6 HOPS	0.43	0.24	0.2	0.19
PDR(kbps)	4 HOPS	0.83	0.82	0.76	0.73
	6 HOPS	0.78	0.75	0.72	0.68

Table 1: experimental parameters

We have taken two experimental parameters: The Packet Delivery Ratio (PDR), defined as the ratio of the data packets delivered to the destinations to the total data packets generated by the CBR sources, andAverage end-toend delay, which is the average time that the received packets needed to reach the destinations.

Here we have taken 4 hops and 6 hops for single source to destination scenario.

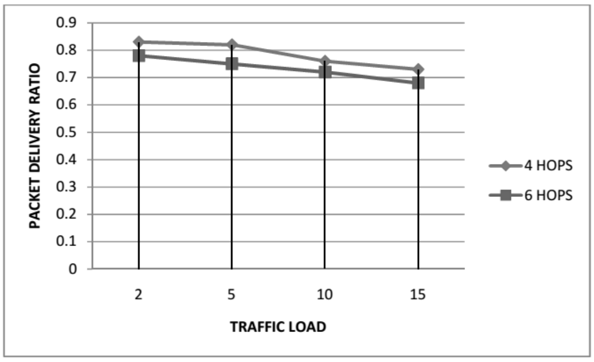

Fig. 2: Simulation result: PDR vs Traffic Load

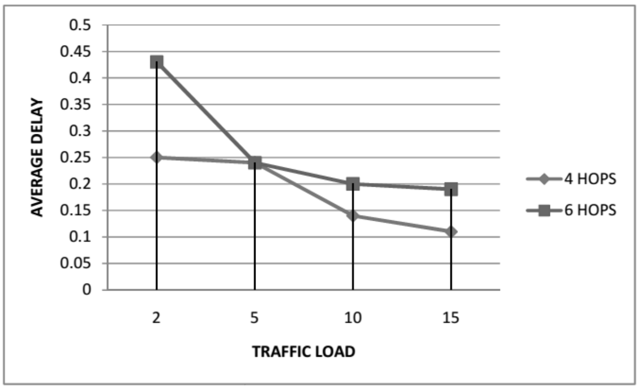

Fig. 3: Simulation result: Average delay vs Traffic load

From the simulation result we can conclude that as the number of hops increases the PDR decreases and average delay decreases. For higher traffic load the multipath performance better for multi hops.

V. CONCLUSION

In this paper, the comprehensive study of the Junction based multipath source routing algorithm is done. From the analysis it is proven that JMSR is useful when the traffic load is high and number of hops are medium to high. So the multipath is beneficial in city area where traffic load is high compare to the single path. The disadvantage of this algorithm is that if the packet is dropped at junction then there is no way of recovering the packet so the recovery mechanism should be implemented.

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