The Journal of Digital Policy & Management 2013 Oct; 11(10): 379-385

도심환경에서의 자율 군집적인 각도 기반 라우팅 프로토콜

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A Self-Organizing Angle-based Routing Protocol for Urban Environments

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요 약 Mobile Ad Hoc Network(MANET)은 잦은 경로 단절과 경로 재설정으로 인한 지연 때문에 차량환경에 적용이 쉽지 않다. 이런 문제를 해결하기 위하여 VANET(Vehicular Ad Hoc Network) 알고리즘이 제안되었으며, 이들 중에서 위치 정보 기반의 라우팅 프로토콜이 유용한 것으로 알려져 있다. 도심환경에서는 차량의 잦은 이동과 함께 높은 건물들로 인한 전파 방해로 빈번한 네트워크 단절을 일으키지만 현재의 VANET은 이러한 도심환경을 고려하지 않기 때문에 토폴로지의 단절이 빈번히 일어난다. 본 논문에서는 도심환경 내에서 노드들의 이동방향을 측정한 후 캐쉬 테이블을 통하여 비교하여 교차로를 탐색하는 방법을 개선하고, 전송 홉 수를 최대한 줄여 전송효율을 높이는 라우팅 알고리즘을 제시한다.

주제어 : 차량 애드혹 네트워크, 라우팅, GPS, 도심환경, 교차로 탐지

Abstract MANET is not suitable to be applied to vehicle environments because of frequent path loss and path re-routing. To solve these problem, It is known that location-based routing protocol VANET is efficient. But, the VANET algorithm does not consider urban environments due to frequent vehicle movement and jamming by tall building. In this paper, we propose an efficient routing protocol to improve transfer efficiency and reduce transfer hop count. in urban networks.

Key Words : VANET, Routing, GPS, Urban Environments, Junction Detecting

1. Introduction

Ad-hoc networks in recent years, the VANET (Vehicular Ad-hoc Network) in the automotive-related research has brought a lot of attention.

*본 연구는 미래창조과학부 및 한국산업기술평가관리원의 산업융합원천기술개발사업(SW・컴퓨팅)의 일환으로 수행하였음. [10041145, 자율군집을 지원하는 웰빙형 정보기기 내장 소프트웨어 플랫폼 개발]
*본 연구는 2011년도 정부(교육과학기술부)의 재원으로 한국연구재단의 지원을 받아 수행된 연구임
*본 연구는 지식경제부 및 정보통신산업진흥원의IT/SW 창의연구과정의 연구 결과로 수행되었음
*본 연구는 BK21+ 사업의 일환으로 수행하였음
Received 14 August 2013, Revised 26 September 2013
Accepted 20 October 2013
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ISSN: 1738-1916

The VANET provide safety for passenger such as dangerous situations on the road and traffic congestion, also it provide convenience service, such as data sharing service for the convenience of passengers can be supported [1].

Existing mobile network, Mobile Ad hoc Network (MANET) routing algorithm, frequently disconnected and long delay caused by re-routing is difficult [2]. To solve this problem of MANET algorithms for VANET was proposed[3-5], Position-based routing protocols are known to be useful. In urban environment, network is frequently disconnected, due to the frequent interference such as moving vehicles and buildings. However, many VANET routing algorithm does not consider urban environments as to frequent disconnection of the topology. This paper is proposed to solve these problems, the decrease of the number of hops to transmit in urban environments, how to improve the accuracy of the junction detection. The data transmission rate increases to reduce the number of hops in the urban environment to transfer data using the junction [6]. Therefore, it is proposed that the sender select a node at the longest distance from the sender on junctions.

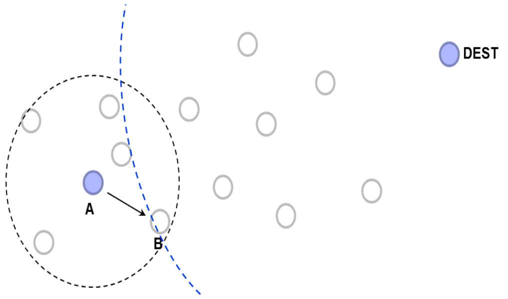
In the urban environment when the nodes send to the data using the junction, Accuracy of junction detection is important. Existing methods, if the density is low of the nodes at the junction, which reduces the accuracy of the junction detection. In this paper proposed that how to improve the accuracy of junction detection. We improve the accuracy of the junction detection using a temporary cache, regardless of the node density

2. Related works

Movement of vehicle in VANETs is generally restricted in just two-way movements agonistic along roads and streets. So routing methods use the location information acquire from map and GPS. This factor takes support from the many articles which compare topology-based routing protocols with position-based routing protocols in urban environment. Thus, the position-based routing protocol has been ascertained as a more prospective routing paradigm of VANET [1]. This chapter account for the position-based routing protocols for VANET.

2.1 GPSR(Greedy Perimeter Stateless Routing)

GPSR(Greedy Perimeter Stateless Routing)[7]is very famous routing protocol in VANET. It is used to two routing mechanism, greedy routing and face routing. The face routing is helpful that get out of the local minimum. It works best in a highway scenario with distributed nodes. This protocol is used to perform simulations in [8] and its results were compared to DSR[9]. GPSR has a several problems due to greedy routing and planarization graph. First, it's not adapted to city scenario, second, packets travel a longer path with higher delay, third mobility may also induce routing loops for face routing, and last, packets get forwarded to wrong direction.



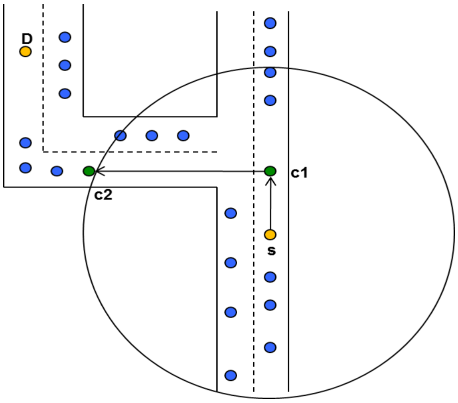
[Fig. 1] Greedy Forwarding

2.2 GPCR(Greedy Perimeter Coordinator Routing)

GPCR(Greedy Perimeter Coordinator Routing)[5]is proposed another solution that without use to street map and infrastructure. GPCR is adapted to city scenario. This routing protocol is used to two mechanism, restricted greedy routing and repair strategy. The restricted greedy routing algorithm is followed while the nodes are on the street. The junctions are the places where the routing decisions are taken. Thus a packet should be forwarded to a node on the junction. It is better than forward across the junction. Also, this protocol uses a repair strategy to get out of the local minimum, the neighbor node is nonexistent which is closer to the destination than the intermediate node. The GPCR is higher delivery rate than GPSR with larger average number of hop and reduce the latency.

3. THE ALGORITHM

In this section, the distance between the sender and the neighbor, and angle-based routing algorithm is proposed. Also the detection of the junction methods to improve the accuracy of the new junction detection method is proposed by using a temporary cache.



[Fig. 2] Restricted Greedy forwarding

All nodes have GPS information and the destination information is assumed to know the position of the information.

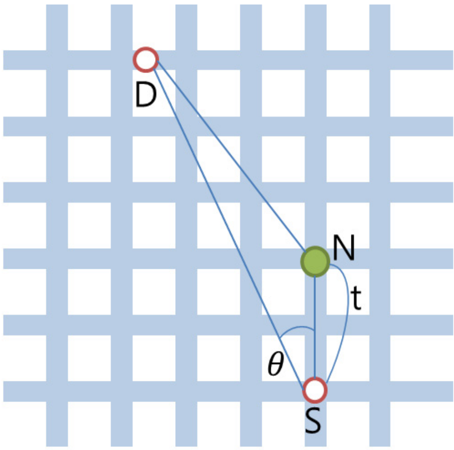
3.1 Path selection of the sender

In urban environments, if the transmission path of a packet specify the sender when a transmission rate of packet is decreased due to frequent topology disconnection. In this paper, instead of selecting all the paths to the destination from the source, each intermediate node selects the path. If the sender has a packet to send to the destination, the sender chooses the path by the angle and distance to the neighbors.

It can find a shortest path between the sender and neighbor. [Fig. 3] is shown for VANET environment in New York City Manhattan-style in a regular grid. It show that transfer from the sender to the destination by the intermediate nodes. Through the position information of the sender and the destination and the neighbors can be calculated the angle (1).

The distance between each node using the Pythagorean Theorem can be calculated.

$$\theta = \frac{\overline{DS}^2 + \overline{SN}^2 - \overline{DN}^2}{2\overline{DS}\,\overline{SN}} \qquad (1)$$



[Fig. 3] Selection of next node

After calculation of the angle among the neighbors, sender chooses the node of the minimum value of the Θ. Because choice of smaller value of the Θ is chose of shortest path to the destination. If the value of the Θ of neighbor is bigger than 90°, It means that the next forwarding direction can be toward the back from the currently node, but the smallest value of Θ is selected among the neighboring nodes. If there are neighbor nodes that have the same angle to select the shortest path to choose the next node using a distance from sender to neighbor nodes.

```
The number of junction nodes = N
// At the junction of neighbor nodes only.
next_node.Θ   <- 360 // Initialization of next_node
LOOP  i = 1 ··· N
IF   next_node.Θ > W[i] .Θ : next_node <- W[i]
// W is junction   node.
ELSE IF   next_node.Θ = W[i] .Θ :
     IF getdis(sender,next_node) <   getdis(sender,W[i]) :
          next_node <- W[i]
ELSE return
```

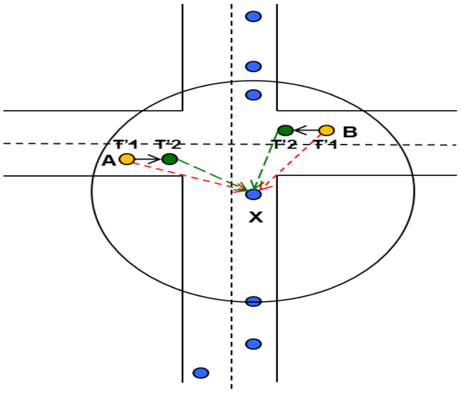
[Fig. 4] Pseudo code indication that sender selects next node

The following pseudo code in [Fig. 4] indicates the method given above. If neighbor nodes have same angle, sender is compared of the distance. The sender chooses the long distance from the sender to neighbor node.

3.2 Junction detect method

In urban environments to increase data transfer rate using the intersection method is useful for route selection. Therefore method of junction detection be able to increase accuracy, actual data transmission rate is increased. Also It has the advantage to reduce transmission delay. This chapter is proposed about method of junction detection to improve the accuracy. The method of Junction detection is used to the temporary cached in order to increase the accuracy. Through the temporary cache temporarily saved the direction of movement of the vehicle, Actual vehicle direction of movement is detected.

Vehicles in actual urban environments due to factors such as traffic lights at junctions that stop short period, the direction of movement of the vehicle can detect. [Fig. 5] When the node X is entry to the junction to received beacon signal from each neighbor node, it shows that the detection of the direction of movement of the neighbor node. The sender is received to periodic beacon signal that is stored in temporary cache for location of the vehicle, after depending on time changes, through the direction of movement of vehicles is judged on junction.



[Fig. 5] Vehicle movement at the junction

<Table 1> T=0 Cache Table

Node	X	Y	IN direction
A	80	110	-
B	130	125	-

<Table 1> is shown to information of temporary cache table when the node X is first entry in the junction. Neighbor A, B for the first time in the beacon signal is received and stored in the cache Table. Since first time of received beacon signal, the received node does not know the direction of movement of each node, so puts a blank on direction table.

<Table 2> is shown to information of temporary cache table when the node X is received to next beacon signal on the junction. The cache table is changed due to the moving of Neighbor node A and B. In the direction of movement base on the node X. That is when t = 0 is receiving beacon signals from the new

node, T = 1 at the time the node x is detecting the direction of movement of the node, so the node X determine itself about located on the junction. If node X determines that the node X is located on the junction, it broadcast of information to the neighbor nodes. These methods is able to detect the junction as minimum number of nodes, it takes advantage of accuracy without affecting node density. Also, that can reduce the delay in urban environment.

〈Table 2〉 T=1 Cache Table

Node	X	Y	IN direction
A	90	110	W
B	120	125	E

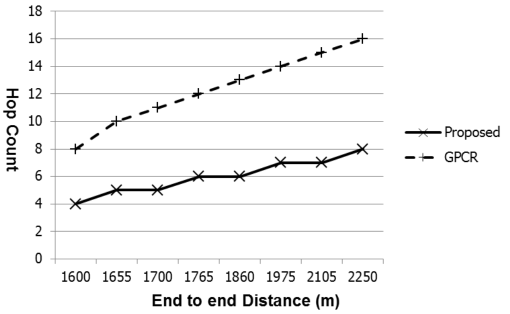
4. SIMULATON RESULTS

〈Table 3〉 simulation parameter

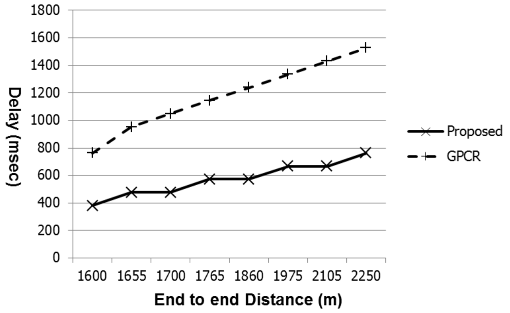
Parameters	Value
MAC	802.11b
Field	2000m * 2000m
Street	8 * 8
Node	100 - 300
Transmission Range	250m - 2000m
Packet size	1Mbyte
Number of packets	1000

Simulation environment such as Manhattan in New York is used [10], it consists of the block that is the size of 200m and the map size is 2000m * 2000m. Junction of the horizontal, vertical, respectively, was set to eight. The Vehicle had to variably increased and reduced from 100 to 300. In the simulation the transmission range of each node was set to the default 500m. According to simulations by varying the transmission range may be increased.

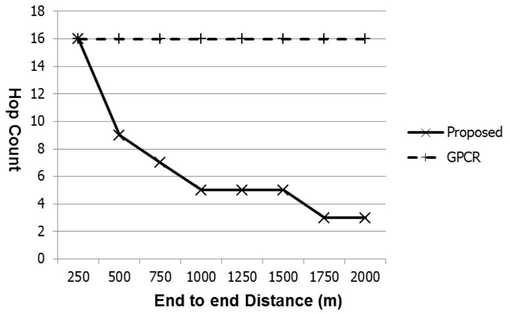
The simulation result was measured about the number of hops and end-to-end transmission delay. Also, the transmission range of node increased to 250-2000m to measure experiment. Evaluate the simulation results compared with GPCR, Proposed algorithm was confirmed about reduce of the delay time and number of hop. Decrease the number of hops, each transmission node sends to destination through the intermediate node at the farthest junction. It shows that decrease of number of hops. Also, it confirmed about reduce of the transmission delay time as reduce of number of hops. This reduction of the transmission delay is due to decrease of number of hops.



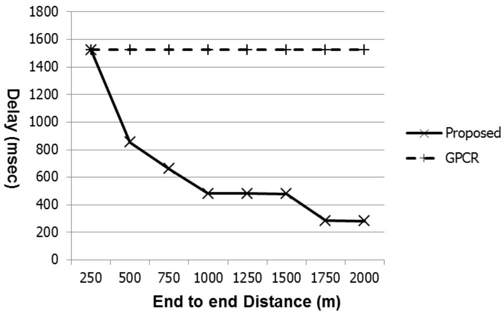
[Fig. 6] Average number of hops(Range : 500m)



[Fig. 7] Average number of delay(Range : 500m)



[Fig. 8] Average number of hops(Range : 250 - 2000m)



[Fig. 9] Average packet delay(Range : 250m - 2000m)

5. CONCLUSIONS

We presented a new position-based routing protocol for urban environments. In our scheme, the sender forwards its data to the destination through the farthest neighbor node located at a junction to reduce the number of hops to the destination. The farthest neighbor is determined by calculating the angle to its neighbor located at the junction. Simulation results showed that our routing protocol can provide a better performance than the previous well-known VANET routing protocols such as GPCR in terms of the number of hop counts and transmission delay.

ACKNOWLEDGMENTS

* This work was supported by the IT R&D program of MISP/KEIT. [10041145, Self-Organized Software platform(SoSp) for Welfare Devices]
* This work was supported by National Research Foundation of Korea Grant funded by the Korean Government.
* This work was supported by the MKE, Korea, under IT/SW Creative research program supervised by the NIPA.
* This work was supported by the Brain Korea 21+ Program.

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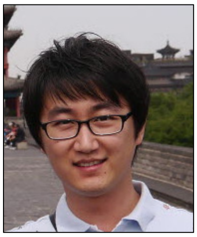

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