Multi-Adaptive Networks Structure for VANET

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Abstract—This paper aim to introduce the new idea of VANET networks structure as multi-adaptive. That provided the structure of the VANET networks changed dynamically with the traffic. By separated the overall traffic into the sub network using the direction and the speed of the vehicles. The result shown the hierarchy of the networks can be reduced the number of links between all nodes. The other benefit is the sub networks can be move along the road, which made the robustness sustainable.

Keywords-Multi-Adaptive; Network Mobility; Network Structure; VANET

I. INTRODUCTION

As the Vehicular Ad Hoc Network (VANET) applications are the state of the art of the development technology. There are many protocols from the forum tried to implement into the traffic system. The limited condition of using some application from the Mobile Ad Hoc Network (MANET) is the network mobility or NEMO for the short word [1].

The network mobility in VANET were define in 4 categories there are survey models, event driven models, software oriented models and synthetic models. [2-4] The most used are the synthetic models by using the mathematic equation to simulated the develop the mobility models closed to the realistic environment such as MObility model generator for VEhicular networks (MOVE), Simulation of Urban MObility (SUMO) and STreet RAdom Waypoint (STRAW).

This paper aim to shown the advantage of the multi-adaptive networks structure in network mobility witch suitable for VANET. As we were purposed the new idea of multi-adaptive networks structure which study the behavior of the network mobility along the intersection.

II. RELATED WORK

The ideas of VANET started with using the protocols of MANET. But the differences between the nodes behavior as the mobility is the limited of using the MANET protocols directly [5-8]. The VANET protocols usually based on the network mobility since the nodes are moving rapidly. The new generation of VANET application is design especially base on the mobility behavior, which difference between each area [9-11].

Routing performance is the main problem of the implementing VANET. Due to the random and rapidly move of the nodes. The study of realistic mobility models were to increased the routing performance. Network mobility models tried to keep the nodes connection under the high random mobility to get the sustainable network connection and low routing path.

The existing methods of VANET routing protocol involved the position based into the MANET routing protocol. That can be get rid the high mobility of nodes. The developments were study about the topology changing as the nodes moving. The multi-adaptive idea was interested in moving the topologies together with the nodes moving to maintain the network structure.

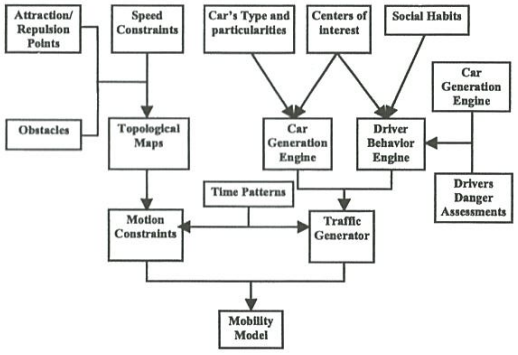

Figure 1. Mobility models. [2]

III. FRAMEWORK DEFINITION

A. *Multi-Adaptive Routing Protocols for VANET*

Firstly, we purpose the model of routing protocols for VANET as multi-adaptive routing protocols (MAR) witch using the multi-adaptive networks structure to reduce the network mobility as shown in Fig.2.

B. *Multi-Adaptive Networks Structure*

The meaning of multi-adaptive in this model is the changing of the network structure along with the movement of the nodes or vehicular. Although the nodes are moving along the street, but the useful of this model is for the high traffic such as the intersection in the city area.

The multi-adaptive networks structure aim into the intersection as the Manhattan with these conditions:

- Speed intervals separate into 6 ranges as 0 km/hr, 1-20 km/hr, 21-40 km/hr, 41-60 km/hr, 61-75 km/hr and 76-90 km/hr.
- Nodes directions separate into 6 directions as go north, go south, go east, go west, stop and leave.

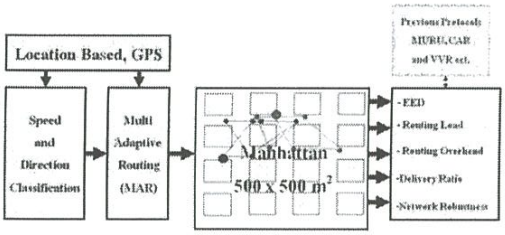

Figure 2. The multi-adaptive routing protocols model.

Fig. 3 shown the multi-adaptive networks structure. The number of sub-networks increased with the number of node move into the street, the speed of nodes and the direction of nodes. Since the sub-networks can be moved along the traffic and overlap each other. Each node change into another sub-networks depend on the condition of node.

From speed intervals and node direction can be consider the number of sub-networks into 36 statuses as shown in table I.

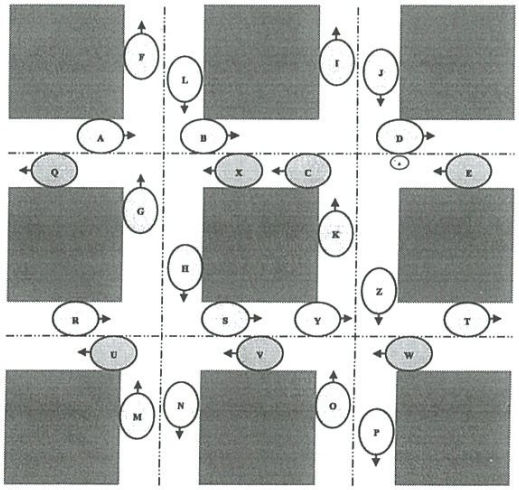

Figure 3. The multi-adaptive networks structure.

TABLE I. THE STATUS OF SUB-NETWORKS

Status	Number of interval	Number of direction	Status	Number of interval	Number of direction
1	1	1	19	4	1
2	1	2	20	4	2
3	1	3	21	4	3
4	1	4	22	4	4
5	1	5	23	4	5
6	1	6	24	4	6
7	2	1	25	5	1
8	2	2	26	5	2
9	2	3	27	5	3
10	2	4	28	5	4
11	2	5	29	5	5
12	2	6	30	5	6
13	3	1	31	6	1
14	3	2	32	6	2
15	3	3	33	6	3
16	3	4	34	6	4
17	3	5	35	6	5
18	3	6	36	6	6

IV. RESULTS AND DISCUSSIONS

As the results the numbers of nodes in the networks reduced as the sub-networks and the speed of node reduced by the moving of sub-networks, as in

$$MS\_N \leq MI * MD \quad (1)$$

Where MS_N is the maximum number of sub-networks
MI is the maximum interval
MD is the maximum direction

The number of nodes versus the number of sub-networks which proportionally each other. As equation (1) this model as the maximum number of sub-networks equal to 6 * 6 = 36 although the number of nodes greater than 36 nodes.

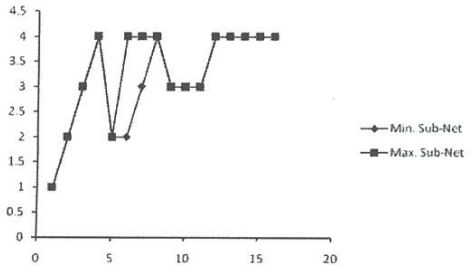

Figure 4. The arrival of 4 nodes in the network.

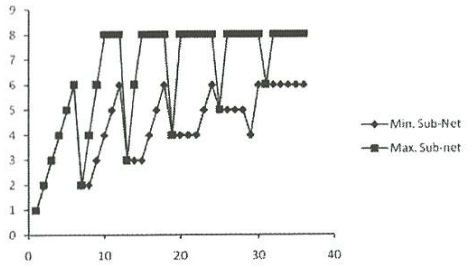

Figure 5. The arrival of 8 nodes in the network.

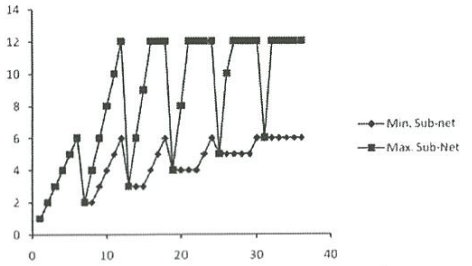

Figure 6. The arrival of 12 nodes in the network.

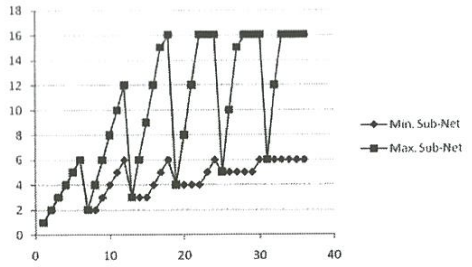

Figure 7. The arrival of 16 nodes in the network.

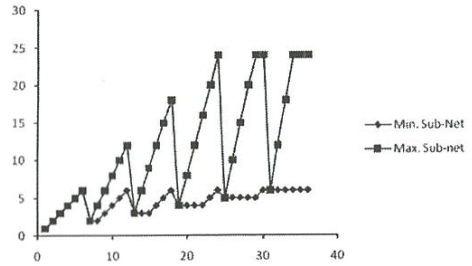

Figure 8. The arrival of 24 nodes in the network.

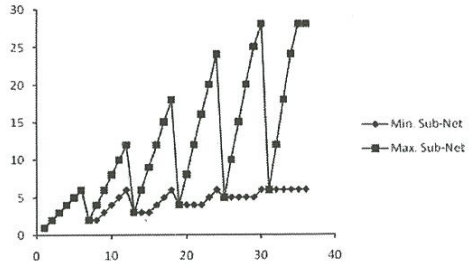

Figure 9. The arrival of 28 nodes in the network.

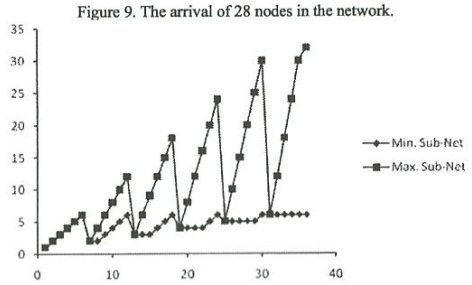

Figure 10. The arrival of 32 nodes in the network.

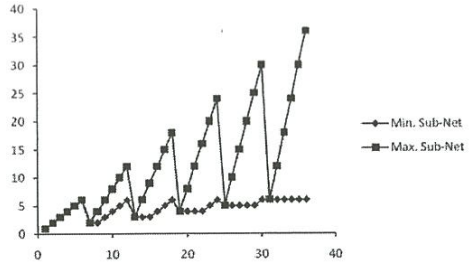

Figure 11. The arrival of 36 nodes in the network.

From Fig. 4 – 11 shown the number of sub-network occurred as the number of nodes arrival. The minimum of sub-networks pattern are steady. While the Maximum of sub-networks are dynamic change as the equation (1), which we can limit the network structure by the traffic policy.

V. Conclusions and Future Work

The conclusions multi-adaptive networks structure scheme can be control the maximum number of sub-networks. Although the traffic policies useful to manage the utilities of vehicular ad hoc network. The direction and the speed of the vehicles can be control the maximum number of sub-networks. The number of networks reduced the routing reduced. By this scheme can be reduced the

speed of nodes because the sub-networks look like moving together with each node.

This paper shows the networks structure management for VANET, which is the number of nodes and the speed of nodes are the limited of implementation many VANET protocols. The multi-adaptive networks structure can be used to design the VANET protocols such as the routing protocol as our further work.

As mention the existing VANET NEMO models concern with the high mobility of nodes. The comparison with the existing methods was shown the advantage of the robustness of network topology that can be used in the high mobility situation.

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