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Development of Multi-Hop Clustering Approach for Vehicular Ad-hoc Network

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ABSTRACT: A Vehicular ad-hoc network is a type of mobile ad-hoc network, it's generally from with the group of vehicle nodes without using a any predefined infrastructure or network. All the vehicles are communicated with each other in a wireless transmission; the objective is to provide real time and reliable communication between the all participating vehicles nodes in a network. In this paper we use the multi-hop clustering techniques using with the cluster head selection process for the vehicular ad-hoc network, the cluster head node is selected on the basis of closest speed of node with average speed of node and having a more network life. Here the challenges is to update the cluster head value and selection of nodes is dynamically, All the simulation process done with the network simulator compare with the existing technique, and our proposed method gives better result than the previous techniques, all the results are obtained with some parameters like network overhead, throughput, end to end delay, packet loss rate and packet delivery ratio is discussed in this paper we have enhance the previous work by adding two new parameter percentage of stability and path length with the help QoS matric calculation. The key idea in this paper to proposes an MHC Approach for VANET that considers Quality of Service (QoS) requirements, mobility constraints and the distrust value parameters.

Keywords: Vehicular ad-hoc network, Flat Routing, Optimization, Energy efficiency, life-time, QoS, MHC approach.

Abbreviations: MANET Mobile ad-hoc network, VANET Vehicular ad-hoc network, V2VVehicle to vehicle, V2I Vehicle to infrastructure, DSRC Dedicated short rang communication.

I. INTRODUCTION

In recent years a wireless communication have much more attention for the researchers, the vehicular ad-hoc network is one of them because it's high applicability for the commercial usage. The vehicular ad-hoc network is simulated with the network simulator and using some software for high speed mobile environment such as the wireless access in vehicular environment (WAVE) and the Dedicated Short Range Communication (DSRC) protocol.

Vehicular ad-hoc networks are divided into two forms V2V (vehicular to vehicular) In which vehicle can communicate directly with another vehicle and another types is V2I (vehicle to infrastructure) here vehicles communicate with using some infrastructure unit such as Road Side Unit (RSU) as shown in Fig. 1.

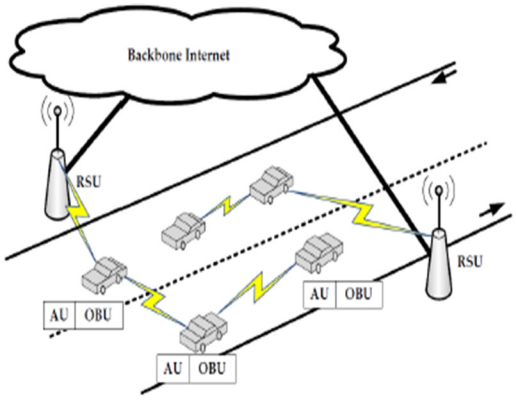

Fig. 1. Illustrative network architecture of a vehicular ad-hoc network.

This can Support many applications such as the road safety, traffic management and infotainment. The data link layer parts i.e. medium access control layer is common medium as responsible to channel utilization in an efficient manner.

The increased movement of participating vehicle nodes in a network as a result of repeatedly imposing the frequently change the topology is very critical task in a wireless communication among the vehicle itself or between the vehicles and the concerned infrastructure as used in a network. However vehicular ad-hoc network comes with several challenging characteristics such as the potentially large scale and high mobility. With the increase in distance the power or required energy for the reliable and good communication is also challenging task for the nodes in a network. The target of vehicular ad-hoc network is achieving higher level of road safety and decreases the number of accidents and manages the overall traffic.

In previous work, they calculated two trusted nodes in the cluster on the basis of highest energy. Malicious node has also highest energy and selected as a trusted node. Then it can forward the data to another attacker and it affects the whole network. They find two nodes in cluster with highest energy and make them cluster head. This CH is only considered as trusted and all the communication had done by these CHs only. When data has to transfer then CH send packet to another cloud's CHs only. By this they eliminate the malicious nodes from the network and make path more secure. In our proposed work, we are finding only one cluster head which is most trusted node in a cluster. So, we are using transmission range with highest energy to calculated cluster head. They have to fulfill both the criteria to eliminate the selection of malicious node.

The rest of the paper is organized as follows section II Discuss the related work, section III Discuss the propose methodology and flow graph, section IV Simulation setup V Discuss about Experimental and finally conclusion and future work.

II. RELATED WORK

The most relevant issues in vehicular ad-hoc network is to provide quality of services and the real time intermittent connectivity between the vehicle nodes, and the high dynamic mobility. The passive multi-hop clustering algorithm is proposed [1] they have followed the cluster head selection mechanism to crate the cluster using passive multi-hop algorithm, here a priority based neighbor following strategy is proposed and find the optimal neighbor by calculating their parameters. A stable routing algorithm proposed [2] author proposed the cluster based mechanism to select the optimal route stability and find the best quality of services in vehicular ad-hoc network, the selected routing algorithm choose the best stable and reliable path between the sender and receiver in the vehicular ad-hoc network. The classification of routing protocol proposed [3] here the author done multi hop structure protocol using the hierarchical, flat and location-based routing protocol, with using all these protocol techniques they compare the different number of parameters. The current challenges and trends presented [4] in this paper author review the different techniques and discuss the about current trends and challenges in the present vehicular ad-hoc network. Here they also present the different hardware mechanism, spectrum, security and other privacy issues. The mobility based and stability-based clustering algorithm is proposed in [5], here the author present clustering model for the especially urban area, where they record each vehicle movement and position with their direction and lifetime estimation. They also calculated with their proposed techniques in average number of cluster and the average number of cluster head life time. The unified framework of clustering approach presents here [6] author present some important points such as the neighbor sampling of the vehicle node, cluster head selection process based on the back-off heads and at the last cluster maintenance based on the backup cluster head process. Also define the matrix for the vehicle node including some parameters such as the vehicle mobility, vehicle position and velocity with the vehicle node life time in a network.
An approach proposed by [13] was employed optimized link state routing this will help us to understand unicast routing protocol for adhoc network. Santa *et al.*, has been modified here to build a more robust method to use in VANET [14]. In OLSR, a set of Multi Points Relay (MPR) nodes is selected by every vehicle, which is used to retransmit the packets. MPR nodes decrease the overhead of flooding message. OLSR is a proactive routing protocol that each node has a route to every other node in the network. However, the overhead of message for retaining the routes is high. Badis and More recent work by Agha [15] have designed QOLSR protocol for ad hoc wireless networks using OLSR. This protocol considers the QoS constraints during the selection of optimal paths. Due to the QOLSR chooses the optimal paths in terms of bandwidth and delay and ignores the mobility of vehicles; it is unable to deal with VANETs. Then, most recent and advance theory proposed by Otrok *et al.,* [16] have introduced the QoS Optimized Link State Routing (QoS-OLSR). This protocol considers the QoS of the vehicles like residual energy and bandwidth during the selection of cluster-head and MRPs. However, it ignores the mobility of vehicles for computing the QoS.

III. PROPOSED METHOD

Intelligent traffic system and monitoring is required for to improve the current traffic monitoring system and road safety features. In previous study author sole the clustering issue using passive multi-hop clustering techniques to improve reliability and stability of nodes in vehicular ad-hoc network. In this section we present the proposed methods for the vehicular ad-hoc network to provide the reliable and stable communication between the vehicle nodes, here we proposed approach i.e. multi hop clustering algorithm using with the cluster head selection process. In the below diagram we mention the proposed MHC (Multi hop clustering Approach) flow chart for the communication between the vehicle nodes. Initially we start the simulator and send the hello message to establish connection for all the participating nodes in a network, after receiving the hello message all nodes reply with their identification number, their location, their distance between the nodes and the destination. The cluster head node is selected if the list is empty then road side unit select the any neighbor node for join the cluster head. The cluster head node is selected on the basis of closest speed of node with average speed of node and having a more network life. Then road side unit informs all the participating nodes to elected as a cluster head node in a network then road side unit find the gateway for the cluster head node and share the information with the neighbor node form the destination, and the finally process end. This paper also calculates the distrust value of every vehicle to keep record of white and black list of vehicle white vehicle are honest vehicle and black are dishonest and malicious which propagate the false message in the network lead to misshape in road and traffic in VANET network. We have added QoS matric to calculate the stability of the network and path length.

A. Calculation of distrust Value

Due to lack of infrastructure and central management, vehicular ad hoc networks are vulnerable to a number of security threats. Vehicles can cooperate with each other and increase security in the network. The following method is utilized for verifying the behaviour of vehicles and isolate malicious vehicles. Flowchart of this method is shown in Fig. 2. To select a cluster-head, distrust values of vehicles should be calculated. It is worth mention that a cluster key is assigned to each cluster-head, which is specified by its certificate authentication (CA). CA acts as a trusted third party and manages cryptography keys, personalities and
certificates of vehicles located in its region. The initial distrust value that is allocated to vehicles when they join to the network is the same for all vehicles. This initial value is set to 1. At first, each vehicle is placed inside the white list and then if its distrust value becomes larger than a threshold value, it moved to the black list. The threshold value δ is a criterion for updating black and white lists [11]. It is computed in each environment as follows:

$\delta = e\varphi \; 0 \leq \varphi \leq Kv\text{-}1$

where Kv is the average number of vehicles in a certain environment and is computed as:

$Kv = [N_{avg} / R_{avg}]$

where R_{avg} and N_{avg} are the typical transmission range and the average number of vehicles, respectively.

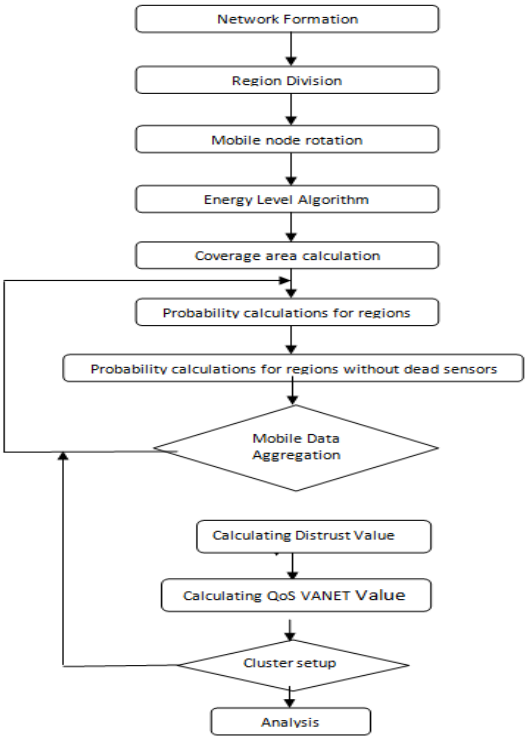

Fig. 2. Proposed flowchart for the cluster head selection process.

B. QoS value:

After calculation the distrust value, we offer to calculate Qos model metric a vehicle can calculate its QoS value using its neighborhood table and obtaining information about the network. QoS value is calculated [11]

$QoS = (B_v \times N_v \times D_{ratio}/v_{ratio})/D_v$

Bv= Available bandwidth

Nv = number of neighbors of vehicle

D_ratio=ratio of Remaining Distance

V_ratio=Ratio of Velocity

After adding these two new concepts in two existing work now we have calculated two new parameter which stable our cluster and it's also calculate the distrust value for keep aside to malicious and dishonest from the network. It is discussed below.

(a) Percentage of stability: The percentage of stability can be calculated by dividing the number of current vehicles in each cluster to the previous number of vehicles in the same cluster before a slot of time. Indeed, stability of cluster is the average lifetime of a cluster in terms of the number of nodes within that cluster. If over 60% of the nodes are in the cluster, the cluster is intended stable.

(b) Path length: This criterion is described as the average number of hops that used to transmit data between the source node and destination node. The path length can be reflected in the
end-to-end delay

IV. SIMULATION SETUP

The performance of our proposed approach is evaluated using simulation implemented with NS-2.35 under Linux Ubuntu 16.04. Ns2 is the most popular simulator for academic research and itis more difficult than other software. It is a discrete event and an object-oriented simulator designed for networking research. Also, it models different network architectures, including Wireless LAN, MANET, VANET and satellite. NS2 is written in C++ with an OTcl (Object Tool Command Language) interpreter. Hence, the proposed approach has been implemented by this programming language. MOVE that is the generator of mobility model is used for vehicular networks. It is based on the Java programming language and builds on SUMO (Simulation of urban mobility) that is a time discrete and open-source microscopic road traffic simulation
package. This traffic simulator applies XML code to represent the network features such as number of vehicles, velocity, duration and topography. The area of simulation selected is the highway of city. We use SUMO 0.12.0 to generate the vehicle traffic and export a part of city map from Open Street Map in the form of XML formatted Osmfiles.

A simulation area of 3000 m × 1000 m is used to simulate by varying the number of vehicles from 10 to 50. Also, the highway topology is applied to simulate the traffic. We assume that all nodes generate a constant bit rate (CBR) peer-to-peer data traffic.

Moreover, the vehicle that drops or duplicates packets and changes the content of the packets is considered as malicious vehicle. The percentage of the malicious vehicles in the network is considered 10% of the whole number of vehicles in the network. Also, we take a 95% confidence interval to obtain more precise simulations. The simulation parameters used for NS2 are given in Table 1.

Table 1.

Parameter	Value
Time of Simulation	400s, 600, 800, 1000s
Dimension	3000 ×1000
Traffic Model	CBR(Constant Bit Rat)
Transmission range	250M
Data Packet Size	512byte
Topology	High Way with Two bands
Protocol	AODV
No of Vehicle	15,30,45,60,75
Vehicle Speed	60 to 120 Km/h
Idle time	Random Value b/w (0,1)
Link band width	1 Mbps
Available Band width	Idle time × Link bandwidth
MAC/PHY	IEEE 802.11p

V. EXPERIMENTAL RESULT

In this section we discuss about our proposed methodology result which is based on the existing techniques and the proposed method i.e. multi-hop clustering (MHC) techniques were simulated with the network simulator 2.34. here the all calculated results were mentioned in the below table and store the value of each parameters and we added two more parameter in the existing work which is percentage of stability and path length calculation .percentage of stability shows cluster head stability which gives the strength to network so the calculated are network overhead, throughput, energy consumption, end to end delay, packet loss, percentage of stability and path length calculation .

Packet delivery ratio: the packet delivery ratio is obtained by dividing the number of packets successfully received by the number of packets originated for a destination [12].

- End-to-end delay: end to end delay refers to the time required to transmit a packet across a network from source to destination [12].

Throughput: the throughput is calculated by dividing the total number of data bits delivered to destination node during the simulation by the total simulation time [12].
Number of packets loss: number of packet loss is defined as the number of packets not received at their destination during the simulation time [12].
Percentage of stability: the percentage of stability can be calculated by dividing the number of current vehicles in each cluster to the previous number of vehicles in the same cluster before a slot of time. Indeed, stability of cluster is the average lifetime of a cluster in terms of the number of nodes within that cluster. If over 60% of the nodes are in the cluster, the cluster is intended stable.
Path length: this criterion is described as the average number of hops that used to transmit data between the source node and destination node. The path length can be reflected in the
We have discussed many parameters here and many of them is discussed in previous work and two of them are calculated in this paper and we have compared this parameter with VANET QoS-OLSR, the cluster-based QoS-OLSR and the classical QOLSR is illustrated them are discusses.
The results were directly compared with previously reported finding and compared between the proportion of stability of MHC approach in VANET and different protocols is shown in Fig 3. This figure represents that in comparison to other protocol the percentage of stability of MHC approach -VANET is increased by approx. More than 10%. This is because our proposed protocol uses the distrust value and the proportional distance and velocity to calculate the QoS value per vehicle. It guarantees that cluster-heads and gateways are selected with proper velocity and significant distance to traverse and avoids the repeated disconnections.

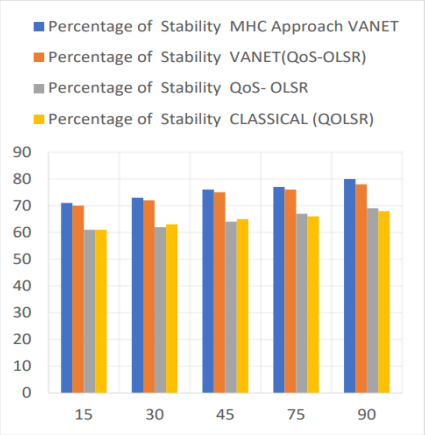

Fig. 3. Compression Percentage of Stability.

This result demonstrates the potential superiority approach over previous establish methods Fig. 4 compares the number of packet loss obtained by different protocols. Due to the proposed protocol increases the percentage of packets transferred, the number of packet loss of MHC approach VANET is lower than other investigated protocols about 6%. represents the average number of hops yielded using the investigated protocols. This figure demonstrates that the number of hops in MHC-approach is about 3% less than other examined protocols. This is due to the fact that this protocol calculates the QoS function and select the nodes that has the highest value of QoS as gateway.

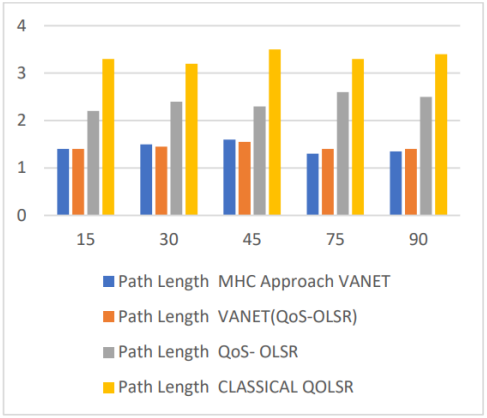

Fig. 4. Compression of Path Length.

VI. CONCLUSION

The main conclusions of this work are drawn together and presented in this section. This paper presents the new multi-hop based advanced clustering techniques for the efficient routing and stability of the nodes in a network. The proposed techniques also used optimization techniques for the various parameters to record and calculate the value of node. Our simulated result shows better results than previous techniques with the parameters such as Percentage of stability and Path length. In future research we use some evolutionary techniques and some hybrid model for the improvement in clustering issue and trust node-based calculation in network.

VII. FUTURE WORK

In future work we may also use trust node-based calculation for the authenticity of the node in the vehicular ad-hoc network, and also used some advanced classification techniques to enhance the performance of the network.

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REFERENCES

[1]. Zhang, D., Ge, H., Zhang, T., Cui, Y. Y., Liu, X., & Mao, G. (2018). New multi-hop clustering algorithm for vehicular ad hoc networks. *IEEE Transactions on Intelligent Transportation Systems*, *20*(4), 1517-1530.
[2]. Mu'azu, A. A., Tang, L. J., Hasbullah, H., & Lawal, I. A. (2015). A cluster-based stable routing algorithm for vehicular ad hoc network. In *2015 International Symposium on Mathematical Sciences and Computing Research (iSMSC)*, 286-291.
[3]. Rani, S., & Ahmed, S. H. (2016). Multi-hop Network Structure Routing Protocols. In *Multi-hop Routing in Wireless Sensor Networks* (pp. 45-58). Springer, Singapore.
[4]. Rasheed, A., Gillani, S., Ajmal, S., & Qayyum, A. (2017). Vehicular ad hoc network (VANET): A survey, challenges, and applications. In *Vehicular Ad-Hoc Networks for Smart Cities* (pp. 39-51). Springer, Singapore.

[5]. Ren, M., Khoukhi, L., Labiod, H., Zhang, J., & Veque, V. (2016). A new mobility-based clustering algorithm for vehicular ad hoc networks (VANETs). In *NOMS 2016-2016 IEEE/IFIP Network Operations and Management Symposium* (pp. 1203-1208). IEEE.
[6]. Ren, M., Zhang, J., Khoukhi, L., Labiod, H., & Vèque, V. (2017). A unified framework of clustering approach in vehicular ad hoc networks. *IEEE Transactions on intelligent transportation systems*, *19*(5), 1401-1414.
[7]. Rossi, G. V., Fan, Z., Chin, W. H., & Leung, K. K. (2017). Stable clustering for ad-hoc vehicle networking. In *2017 ieee wireless communications and networking conference (wcnc)* (pp. 1-6). IEEE.
[8]. Shanmugasundaram, G., Thiyagarajan, P., Tharani, S., & Rajavandhini, R. (2017). A Multilevel Clustering Using Multi-hop and Multihead in VANET. In *Proceedings of the International Conference on Data Engineering and Communication Technology*, 171-178.
[9]. Singh, A., & Kaur, M. (2015). A novel clustering scheme in vehicular ad hoc network. *International Journal of Applied Information Systems (IJAIS), 10*(3), 1-5.
[10]. Sugumar, R., Rengarajan, A., & Jayakumar, C. (2018). Trust based authentication technique for cluster based vehicular ad hoc networks (VANET). *Wireless Networks*, *24*(2), 373-382.
[11]. Fatemidokht, H., & Rafsanjani, M. K. (2020). QMM-VANET: An efficient clustering algorithm based on QoS and monitoring of malicious vehicles in vehicular ad hoc networks. *Journal of Systems and Software*, 110561.
[12]. Ankit Temurnikar, Pushpneel Verma, Jay Trilok, Choudhary. Securing Vehicular Adhoc Network Against Malicious Vehicle Using Advanced Clustering Technique. Paper Under Proceeding " IDEA 19-20 IEEE conference RGPV Bhopal.
[13]. Clausen, T., Hansen, G., Christensen, L., & Behrmann, G. (2001). The optimized link state routing protocol, evaluation through experiments and simulation. In *IEEE symposium on wireless personal mobile communications,* 1-6
[14]. Santa, J., Tsukada, M., Ernst, T., Mehani, O., & Gomez-Skarmeta, A. F. (2009). Assessment of VANET multi-hop routing over an experimental platform. *International Journal of Internet Protocol Technology*, *4*(3), 158-172.
[15]. Badis, H., & Agha, K. (2005). QOLSR, QoS routing for ad hoc wireless networks using OLSR, *European Transactions on Telecommunications, 16,* 427–442.
[16]. Otrok, H., Mourad, A., Robert, J. M., Moati, N., & Sanadiki, H. (2011). A cluster-based model for QoS-OLSR protocol. In *2011 7th International Wireless Communications and Mobile Computing Conference,* 1099-1104.

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