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Analysis of Clustering Algorithm in Securing VANETs

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Abstract:

Security of wired and wireless networks is the most challengeable in today's computer world. Computer and the development of network technology and its application cause the decrease in the Security of the system. It improves the attention of the people because once the data has been destroyed; it is a tedious process to recollect the lost data which causes the interrupt in the network and the performance. The main goal of VANET is to disseminate safety messages from Source to destination without negotiating security. The nodes in VANET is rich in mobility henceforth, there are many challenges to route the packets to their final destination. VANETs are themselves vulnerable against attacks that can directlylead to the corruption of networks and then possibly provoke big losses of time, money, and even liveshowever; malicious vehicle may trace the message which causes vulnerability to other vehicles. Clustering is one solution to improve the security against malicious vehicles. In this work, a security mechanism has been incorporated by analysis of clustering Algorithm such as MMV(Monitoring Malicious Vehicle) algorithm and CSMV(Clustering Surveillance Malicious Vehicle)algorithm.

Keywords: Malicious, Clustering, Security, Routing

I. INTRODUCTION

Vehicular communication is an important field for transportation systems. Vehicular ad hoc networks (VANETs) are the suitable networks that can be used for transportation systems.VANET is based on short-range wireless communication among vehicles. The main objective of VANETis to disseminate safetytraffic messages among vehicles, such as accident warning,traffic congestion,etc. Vehicular Ad hoc Networks (VANET) play an important role in Intelligent Transportation Systems (ITS) by providing critical information about roads and traffic condition, sending safety messages, and providing entertainment for passengers. In VANETs, vehicles can connect to each other for many purposes such as exchanging safety and infotainment messages. A special characteristic of VANET nodes, compared to nodes of other ad hoc networks such as MANET, is the abundant on-board processing resources of the vehicles which make them suitable platforms for processing complex algorithms for various applications. This can be adopted by Doppler-based cooperative positioning Dedicated Short-Range Communication (DSRC) signals [1].

VANETs have been used in various applications such as safety and infotainment which need high stable topology, optimized solutions for clustering in VANETs are required. Efficient communication among the vehicles on the road without scalability and hidden terminal problems is another motivation to proposing clustering solutions in VANETs. But on the other hand, there are number of challenges that need well designed solutions for clustering of vehicles. In the usage of cluster structures, the stability of clusters is a critical point [2]. In dynamic environments such as VANETs, the unavoidable cluster reconfigurations and the changing of cluster heads affect the stability. Hence, not only the vehicular movement, vehicle density and vehicle speed should be considered for stable and dynamic clustering in VANETs, but also cluster formation in minimum time, maintenance of moving cluster with reduced overheads and cluster reconfiguration, should be addressed.

Clustering is a technique to form grouping of nodes and cangreatly improves network performance. It allows the formation of a virtual communicationbackbone that supports efficient data delivery in VANETs and also improves theconsumption of scarce resources such as bandwidth. Hence, not only the vehicular movement,vehicle density and vehicle speed should be considered for stable and dynamicclustering in VANETs, but also cluster formation in minimum time, maintenance ofmoving cluster with reduced overheads and cluster reconfiguration, should be addressedduring designing dynamic clustering algorithms. The clustering technique hasbeen well studied in Mobile Ad-hoc Networks (MANETs) in recent years. According tothe characteristics of VANETs, such as high speed, frequently changes of topology, scaleof the network, *etc*., the traditional clustering schemes are not suitable for VANETs.Therefore, new clustering schemes should be designed specifically based on VANETcharacteristics.

Generally, two different approaches for the clustering of vehicles are defined inVANET: First, static clustering based on Vehicle-to-Infrastructure (V2I) communicationthat Road Side Units (RSUs) play the role of static cluster heads. As mentioned above, since VANETs have been used in various applications such assafety and infotainment which needs high stable topology, optimized solutions for clusteringin VANETs are required.

This paper is organized as follows. Section 2 discusses the related work. In section 3, some of the clustering techniques are analyzed. The proposed algorithm is explained in section 4, section 5 gives the comparison of the proposed with the existing. Finally section 6 concludes the paper.

II. RELATED WORK

In order to avoid the malicious vehicle from the network. It is necessary to select the cluster head. Cluster head had been selected by various methods such as: Highest-degree heuristic [2], Lowest-ID heuristic [3], and weighted clustering algorithm (WCA) [4]. WCA gets the advantages of other algorithms, where it considers the degree of a vehicle, average speed, and distance as input parameters. One disadvantage of WCA is its high re-affiliation frequency when network changes very fast.

Some Algorithms are widely used for maintaining the connectivity. The neighbor-based approach is based on maintaining the number of neighbors that can be reached by a vehicle within certain thresholds by adjusting transmission power [5]. This approach is simple but does not guarantee connectivity. In [6], it has been showed that the network connectivity can be guaranteed if there exists at least one neighbor in each cone of a certain angle centered at the vehicle.

In order to select the Cluster Heads, several techniques and algorithms have been proposed such as Weighted Clustering Algorithm (WCA). Higher the mobility of vehicles may increase the network topology which reduces the stability of cluster formation. Cluster head is selected based on vehicular dynamics and driver intentions are used in algorithm known as Clustering for Open Inter vehicle communication Networks (COIN).

There areseveralproposedalgorithms for security purposes and detectingattackernodesinVANET [7].For the purpose of training a network, Genetic Algorithm can be employed to represent a Cluster Head Level (CHL). It determines the score of each vehicle which is inside the cluster in order to become a cluster head.

III. VARIOUS SCHEMES OF CLUSTER

Most of the existing VANET clustering algorithms are derived from the MANET clustering schemes. These algorithms do not consider the mobility characteristics of VANET. For efficient clustering stable clustering is required.

A. Mobility Based Clustering Schemes

Protocols under this category consider mobilitycharacteristic of vehicles as one of the parameters forselecting clusters and cluster heads in the network.The other characteristics of a vehicle are position,direction, speed, etc. The mobility based clusteringtechniques can be further classified into two typesdepending on the direction taken by the vehicles onroad. They are direction based clustering schemes andnon-direction based clustering schemes.

B. Direction Based Clustering Schemes

Some of the direction based clustering schemes focuson direction of vehicle for selecting effective clustersfor the vehicular network. However, some of theseschemes focus on direction of vehicle or lane forselecting clusters or cluster heads for the respectivenetwork. So according to these differences thedirection based clustering schemes can be furtherclassified into two types: Lane based clusteringschemes and Vehicle based clustering schemes.

C. Lane Based Clustering Schemes

The lane based clustering schemes consider thedirection of traffic on road as one of the parameters forcalculating efficient and comparatively stable clustersin VANET. The advantages of a stable clusteringscheme are that it reduces the overhead of re clusteringwhich results in an efficient network topology. Clusterhead changes and cluster reconfigurations cannot beavoided in varying networks like VANET. This affectsthe stability of the network. For more stable clusters inthe network there needs to be fewer cluster headchanges. To achieve less number of cluster headchanges, cluster members should select a node amongthe cluster members which can meet all therequirements of being a cluster head for a relativelylong period of time than rest of them.

IV. PROPOSED CLUSTERING SURVEILLANCE MALICIOUS VEHICLE (CSMV) ALGORITHM

In existing they use the vehicular clustering based on weighted clustering algorithm (VWCA) they propose the VWCA algorithm to optimize the cluster-head election procedure so that a more stable network can be obtained. In clustering methods, clusters should not be elected very large or very small. In VWCA, there are two techniques have been used to determine transmission range and distrust value.Each vehicle announces itself as a cluster-head by putting its own address and ID in a beacon to be broadcast. After receiving beacons from its neighbors, each vehicle has complete information from its current neighbors, and it can make decision whether to change its current cluster status or not. Entropy model [8] has been used in VWCA. For this purpose, vehicles execute VWCA in order to select their clusterheads. For each vehicle, a neighborhood list should be determined. For this purpose, each vehicle broadcast a message in network.The original weight formula [9]is updated insuch a way that the average moving speed of vehicles is replaced by the entropy of local networks, where the ‘‘local network’’ term denotes the neighborhood list of vehicles.

VANETs should be encouraged to have a high co-ordination between the Vehicles. Here the High coordination between the vehicles andhigh security is important. To maintain the good coordination among the trusted vehicles the following Algorithm is proposed. The flowchart for the proposed algorithm is given in figure1.

Step 1: Determination of the neighborhood list

Every vehicle should determine by its neighborhood list. When it sends an acknowledgement message from one vehicle to other, it stores the position, ID, speed, negative value and one life time.

Step 2: Cluster keys Distribution

The distrust Value should be considered for each Cluster Heads. Each Cluster Head has its Cluster key as CA. The cluster key of the clusters are maintained by its CA. When one of the cluster nodes remains Cluster-head for long time,

then it can be refreshed by its CA. Various algorithms [10],[11] have been widely used for channeling the message between the Cluster Head (CH) and Cluster key(CA).

Step 3: Allocation of Initial distrust values

Every vehicle in the network is allocated with the distrust value as 1.0 when it joins to the VANET. Then the vehicle broadcast its initial distrust value to the neighborhood vehicle to make an acknowledgement and locate in the white list. The vehicles may move to the black list when the distrust value is greater than threshold valueσ.

Step4: Determining the threshold value σ

The average number of vehicle within the transmission range should be calculated to determine the threshold value. Three values can be obtained as morning, noon and night based on the vehicular density.

Step 5: Monitoring the distrust vehicles

The vehicle which is the Cluster-head is the trustiest vehicle in the network. Monitoring is the process of tracking the information about the behavior of the vehicle. The vehicle which monitors its neighborhood vehicle is known as **'*Verifier.***

Step 6: Determining the vehicles priority based on distrust values

Initially, the entire vehicles in the network have the distrust value of 1.0 and placed in the white list. Once the verifier monitors the vehicle, the malicious vehicle can be isolated and placed in the black list. This black list contains the vehicles which is greater than the initial distrust value.

Step7: Modification of distrust value

Initial distrust value can be changed when the vehicle performs as a source vehicle or relaying vehicle. This changed distrust value is broadcasted to the neighboring vehicle. when the verifier monitors the vehicle which is higher than distrust value should be reported to the CA as malicious vehicle.

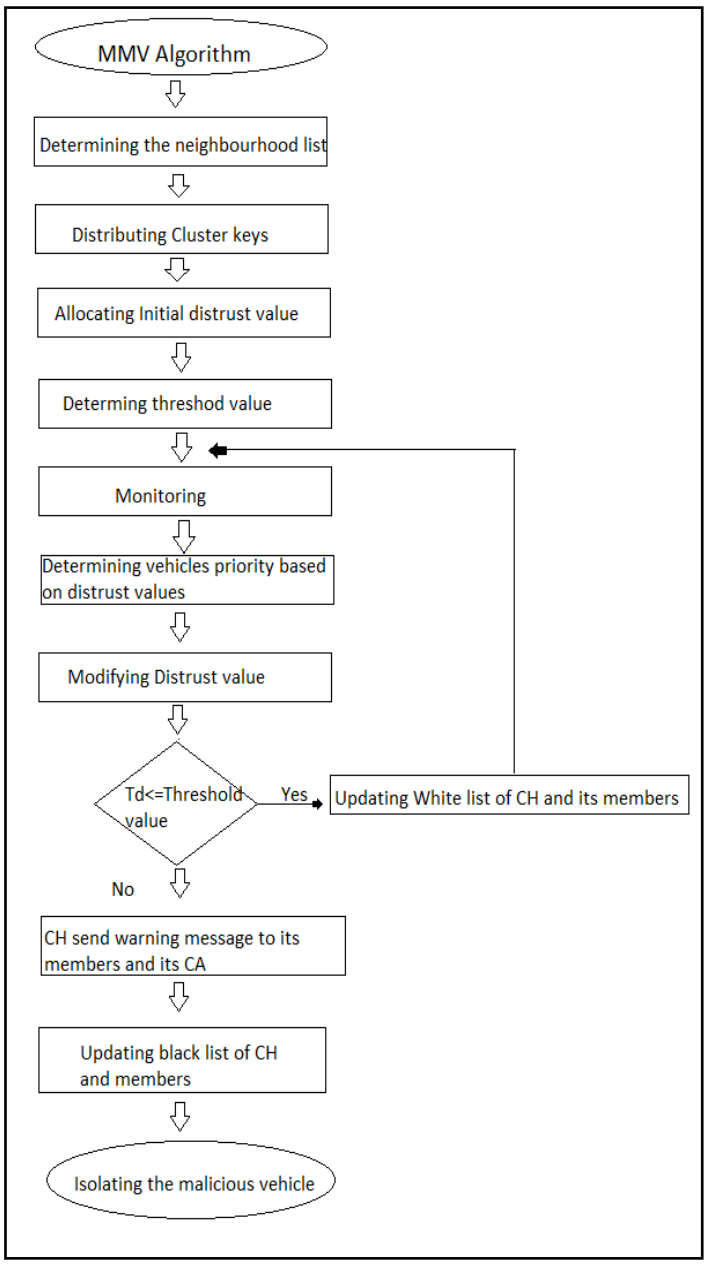

Figure1. Flowchart of CSMV Algorithm

The condition to place the vehicle in the back list and white list as follows:

1. When Td ≤ σ, the ID of the vehicle should be kept in the white list and new distrust value is transmitted to other neighbor vehicles. The verifier monitors ID, process and abnormal behavior of the vehicle and sends in the acknowledgement message.
2. When Td ≥ σ,the ID of the vehicle is place in the balck list and the Cluster-head sends a warning message to its member of the vehicle about this distrust vehicle. Cluster-head also reports the ID of this distrust vehicle to the CA as a warning message. Then, CA moves this malicious vehicle into the black list and send the warning message to the cluster-head and other members not to allow this malicious vehicle. The algorithm to do move the black list is given below.

Inputs: $q_{i,t}$, $W_{i,t}$
Output: $q_{i+1,t}$

Begin
if ($W_{i,t} \geq \delta_{s,t}$ & $q_{i,t}$ == Secure) **then**
  $q_{i+1,t}$= Secure
end if
if ($W_{i,t} \geq \delta_{s,t}$ & $q_{i,t}$ == Vulnerable) **then**
  $q_{i+1,t}$= Secure
end if
if ($W_{i,t} \geq \delta_{s,t}$ & $q_{i,t}$ == Unsecure) **then**
  $q_{i+1,t}$= Vulnerable
end if
End

V. COMPARISON OF ALGORITHMS PERFORMANCES

The performance of VWCA and the proposed CMMV are evaluated by simulation implemented with NS2. We consider the network model introduced in Section 3. The VANET network has been simulated with 10–350 vehicles and based on Table 3. Note that the number of vehicles is variable in our simulations. Moreover, the position of vehicles is selected randomly.Moreover, we consider that malicious nodes may change the content of packets, forge the data, and drop the packets. In the following, our measurements are based on the averaging of the results obtained from 10 simulation runs. The simulation of the proposed protocol is given in figure 2. The following is the definition of the performance metrics we shall evaluate in the following subsections:

Average number of clusters: average number of clusters byaveraging system observations per ten seconds.

Average number of CMs: average number of CMs in acluster by averaging system observations per ten seconds.

Average cluster lifetime: average lifetime of a cluster.

Average idle time: average time duration for a noderemaining as a UN in the system.

Average resident time: average time duration for a CM tostay in the same cluster.

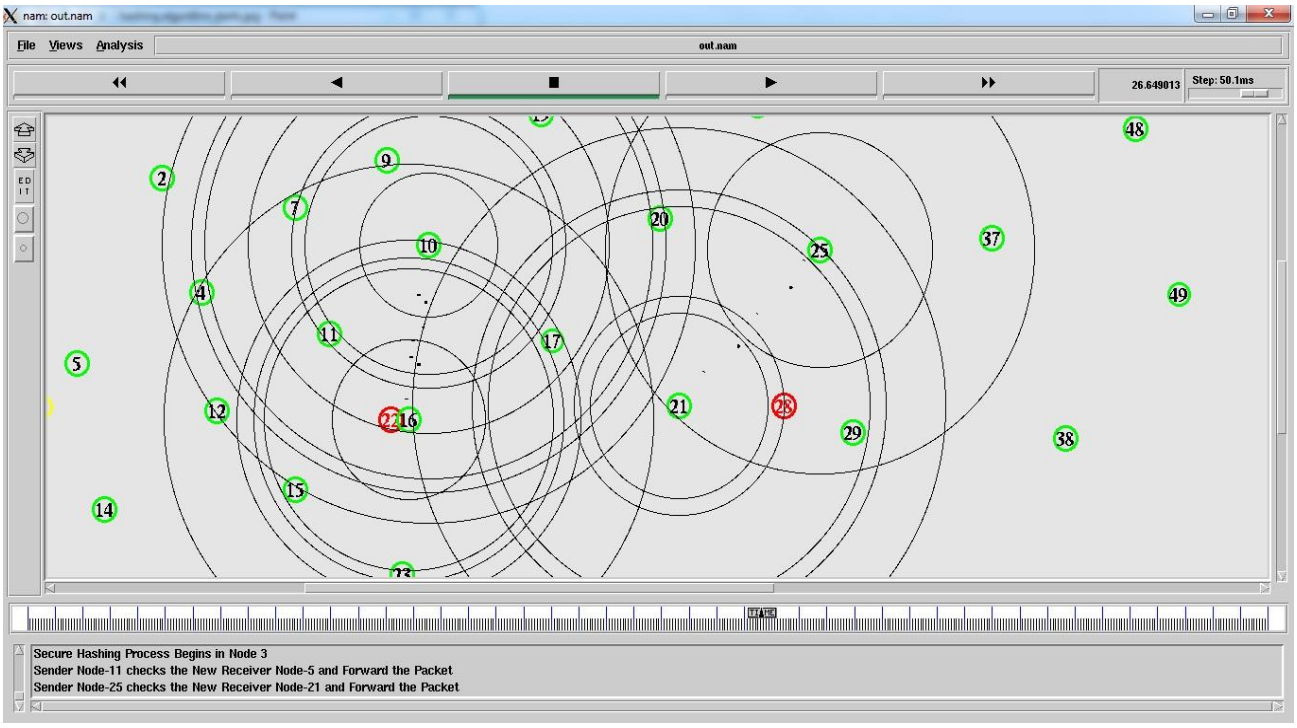

Figure 2. Proposed Algorithm to detect malicious vehicle

The performance comparison of the existing and proposed algorithm is given in figure 3.

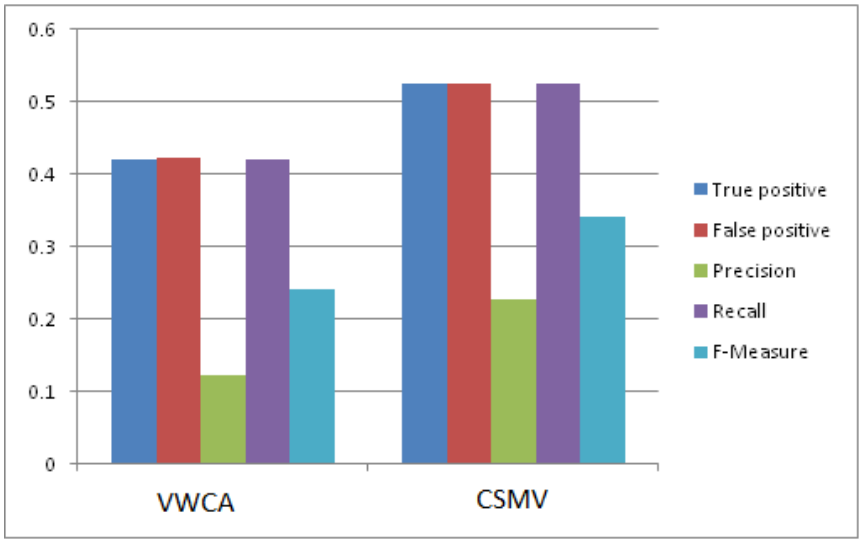

Figure 3.Performance comparison of existing and proposed algorithms

VI. SUMMARY AND CONCLUSIONS

The Connection of Network is an important criterion in the case of VANET and security of Vehicular ad hoc network is tremendously increasing day to day by the adoption of transportation system. The challenges of VANET security still remains to be solved for the highly secured VANET infrastructures.

Proposed Clustering Surveillance of Malicious Vehicles (CSMV) Algorithm has generated the distrust value among the trusted and distrusted vehicles. It includes a strategy for a vehicle to prioritize based on their relevance.This shows that the proposed scheme not only can disseminate messages efficientlyand rapidly but also to detect the malicious vehicles and act against them using specific methods

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