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Ant Colony based Optimized Authentication Mechanism for Vehicular Ad Hoc Networks

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***Abstract* – Vehicular ad-hoc networks (VANETs) have started to receive increasing interest recently due to their potential to be used in trace and safety applications in the upcoming years. Recently authentication schemes were to lower communication overhead, preserve node anonymity, isolation of misbehaving nodes, and non-repudiation. Research directions are aimed at implementing a Trust Validation Model to reduce the vulnerability window on infrastructure-less scenarios, which includes exploring reputation based systems, and more efficient revocation information distribution mechanisms. In this paper an ant colony base optimized trusted authentication scheme has been proposed. Which lead lower bandwidth overhead and higher packet delivery ratio.**

***Keywords* – Adhoc Network, ANET, Network Authendication, Network Security, Ant Colony Algorithm.**

I. INTRODUCTION

Vehicular Ad hoc Networks (VANETs) is an assuring approach to provide safety to the vehicular nodes. The demand of VANETs is increasing day by day because it has great potential to improve traffic efficiency and road safety. In vehicular network, vehicles are connected but they can move freely and no wired connectivity is required. Here each car moves independently by self-organizing and self-managing information in a distributed fashion. VANETs provide many services such as related to Real-time traffic, Post-Crash Notification, Electronic Toll Collection, Parking Availability and Fuel Saving. The nodes move in the dynamic network covering the range of 100 to 300 meters to connect to each other and form wireless network. [1] Although Vehicular communication network provides many facilities to their users, but each are constrained by many factors like mobile vehicles have a limited broadcast range and limited storage capacity.[2] Except these common problems in wireless networks, one unique feature of a vehicular communication network is the high mobility of vehicles. The communication between the vehicles is at greater risk because the broadcasting of messages is restricted by wireless channel and dynamic mobility of vehicles. To make communication possible every application requires connectivity of vehicles in the network. The connectivity disruption occurs when a node is not in the radio range of any other node. Due to the high mobility of VANET, a node enters and leaves the radio range of any other nodes frequently. So, to maintaining the connectivity among vehicles is thus the primary goal to achieve. To maintain the connectivity, one of the solutions proposed for scaling down networks with large numbers of nodes is clustering. Clustering is a more efficient scheme for mobile ad hoc networks [3] [4], sensor ad hoc networks [5] [6], and for vehicular ad hoc networks [7] [8]. Clustering is a technique by which nodes are collected in a group. The method of grouping nodes such as mobile devices, vehicles, etc. are organized by applying some rules and it splits the network into interconnected substructures called clusters. [9] Each cluster contains at least one cluster head and two or more cluster members. The nodes in a cluster are organized based on some similarity or special characteristics between them. As a result, less topology changes occur as compared to the whole network. Moreover, managing the cluster is easier than managing the whole network.

I. RELATED WORK

There have some recent works that promised to improve the Energy Consumption and Security for increasing the routing protocol's performance. Basically a common concepts are used that encryption/decryption technique and network coding, that proves the secure data transmission in less number of transmission in network. They defined that, each node in network have some attributes (like identity, threshold), based on these attributes data can transmit from one node to their neighbour node. It include the allowable overhearing of control messages from adjacent nodes and limiting the local repair for a small topological range of the link break therefore alternative routes to the sink node can be found quickly with optimum routing overheads. A range of threshold values for changing network scenarios, specifically for different network load conditions. Clearly demonstrate that a decision making process for **energy saving and security** technique that is flexible and adaptive for different network load conditions, and lead to obtain a performance improvement.

W.Grzegorz et al. [10] presented a new clustering algorithm for Vehicular Ad-Hoc Networks (VANETs).The main goal is to avoid re-clustering when groups of nodes move in the different direction. The idea is based on periodically sending hello messages between the vehicles and estimating the connection time of two moving nodes. When a fresh value is computed, it is possible to avoid re clustering when two nodes comes in connection over a

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short period of time. The cluster head election is done when the node does not accept the node which have higher weight than the weight of its current cluster head.

R Y Zaydoun et al. [11] established a new multi-metric cluster head (CH) election technique. This technique is done by each vehicle to predict their suitability value. Hence, the elected cluster head is connected with its members for the longest period of time. Hence, nodes with higher connectivity degree, keeping closer distances to their neighbors and closer speed to the average speed of their neighbors is more qualified for winning the CH role. *B. Ramakrishnan et al. [12]* Proposed the clustering approach that splits the VANET area into a number of clusters. Every cluster contains a cluster head. The cluster head can be either RSU or any other vehicle which must have good database storage and accessing abilities. For a new cluster head election a scheme is used to select a capable vehicle as a cluster head, it ensures that the cluster head has not frequently crossed the cluster head. If the boundary crossed by the node frequently then the cluster head selection often elects a new cluster head.

M S. Thamarai et al. [13] introduced a cluster based vehicle model for vehicle communication in which clustering technique is performed by taking parameters such as vehicle density, speed and position of each vehicle to reduce the delay overhead. The cluster head is elected based on speed and position of the vehicles. In cluster head switching scheme if any incoming new vehicle speed is greater than the cluster head than incoming vehicle is elected as the cluster head.

M.Hari Prasad et al. [14] proposed a new technique to construct stable clusters to perform cluster based routing (CBR) and improved the performance of VANETs. To form stable clusters, it gathers the nodes based on the position and direction information. The node elected as cluster head is determined by its suitability value u, which is computed on the basis of mobility information of its neighborhood. The nodes will have higher probability to elect as a cluster head, if it has higher no. of stable neighbors, closer distances to their neighbors and closer speed to the average speed that means they have higher suitability value.

M. S. Kakkasageri et al. [15] proposed a multi agent mechanism to form dynamic and stable clusters in VANETs by taking each vehicle direction, speed, connectivity degree to other vehicles and mobility pattern. The vehicle which has connected with more vehicles and less average speed is eligible for being a cluster head.

L. Ahmed et al. [16] Introduced a clustering technique for connectivity maintenance in VANET with the concept of virtual mobile clustering The vehicles exchange their Hello messages to provide information such as their id, status, longest list of neighbors and velocity. The main idea of cluster head election mechanism is based on the velocity vector of the vehicles moving in the same direction.

III. Proposed Solution

Mobility and energy consumption are complex issue in the ad hoc network, due to high and frequent mobility network partitioning like issues are arises. Therefore, that is router's responsibility to arrange the path and save energy in ad hoc network. So, here required to find a search technique, by which efficiently the new path discovered due to path break and/or link failure and consumes less energy. Thus here a clustering technique, i.e., k-means clustering and a cryptographic scheme, i.e., p-coding are used in proposed method, over the conventional routing techniques.

IV. Algorithm of Proposed Method

N^i_{VANIT}
$= Vachile\ adhoc\ network\ having\ i\ \ mobile\ node$
List[node, id] = list contain node and their id maintain by each node of network
M
$= \{X_i | X_i \text{ is } i^{th} \text{ mobile node } \epsilon\ N^i_{VANIT}\}, Set\ of\ Mobile\ node$
NN^{Xi}
$= \{Y_i | Y_i \text{ is } i^{th} \text{ neighbour node of } X_{ith} \text{ mobile node } \epsilon\ N^i_{MANIT}\ \}$
Algorithm {
Step 1:- Source node ($\mathbf{X_S}$) call AODV and broadcast RRP to all there $\mathbf{NN^{Xs}}$ path towards their desired destination ($\mathbf{X_D}$)
Step 2:- Every $\mathbf{NN^{Xs}}$ uni-cast Route reply packet (RRP) to X_S with their energy level. Where each node attached their node ID
"$Ri^{Xd}_{Xs} = X_s, Y_1^{id}, Y^{id}_{1+1}, Y^{id}_{1+1+1}, ,,,, X_d$"
Step 3:- for every route Ri^{Xd}_{Xs}
$Ri^{Xd}_{Xs} = X_s, Y_1^{id}, Y^{id}_{1+1}, Y^{id}_{1+1+1}, ,,,, X_d$
Step 4:- Xs verify each node id and drop the route having lower resident energy node by using List [Node, id]
Step 4:- Lower resident energy node (N^{LE})search their neighbor node having energy above middle resident energy node as N^{ME} by using List [Node, id]
Step 5:- Lower resident energy node (N^{LE}) swap their coordinate their neighbor node having energy above middle resident energy node as N^{ME} by using List [Node, id]
Step 6:- Xs select route and generate optimized code data packet.
$Di^{Xd}_{Xs} =$ "X_d"
$gerenrate\ p-code\ for\ that$
$P(Di^{Xd}_{Xs}) = * \#\#\#\#\%\hat{}\$$ "
Step 7:- Send $P(Di^{Xd}_{Xs})\ through\ selected\ \ route$
Xd apply inverse $P(Di^{Xd}_{Xs})$
inverse $P(Di^{Xd}_{Xs}) =$ "X_d" }

V. Simulation Environment

To implement the concept, the aodv.cc file has been modified. When the simulation starts function named

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"command" is invoked. All the modification related to the wormhole is done in this function. Functionality to create wormhole nodes by reading the node ID from the file is added in this function. The Tcl script calls this function to create wormhole in the simulation. Tcl also calls the attacking and detecting time, from its related file that is reside in the "command" function.

Table 1: Simulation Parameters

Parameters	**Values**	
Number of Nodes	Vary from 40 to 100	
Area	40	600*300
	50	600*300
	100	1000*800
	140	2000*1500
	170	2000*1500
Traffic	CBR	
Simulation Duration	100 Mili Seconds	
Packet Transmission Rate	1024 kbps	
Carrier sense threshold Used In Normal Nodes	200 Meter	

In order to analyze the proposed technique for wormhole detection number of simulation experiments have been performed by using NS-2 by using 50 mobile nodes with AODV protocol for routing. Table 5.1 show the parameters used in the simulation experiments. The proposed approach is tested with wormhole using a rectangular scenario of 600 × 300 m square area; CBR (Constant bit rate) traffic is used to generate UDP packets for the simulation. In the simulation, start on 0ms and end on the 100ms. There are different packets sizes are used in the NS-2, for this simulation 1024KB packet is used.

- **Implementation of MANET using AODV Protocol:** In this network scenario we implement a network using AODV routing protocol over variable number of nodes in network.
- **Implement K-Means & Optimized Coding and Measure Their Performance:** Here we implement and modify the network protocol and implement K-means clustering and Optimized Coding in traditional AODV protocol.

VI. RESULTS ANALYSIS

This chapter of the document provides the performance analysis of the proposed routing protocol with respect to the AODV routing protocol. For performance analysis we use more than one performance parameters.

Header Overhead

Each packet needs extra bytes of data which is saved in packet header. It can reduce the overall transmission speed of data. The lower the value of overheads makes higher the performance of protocol. Form fig. 1 describes the overhead or header packets that vary between nodes 20. This x-graph represents the trusted method (old method) by red line and Ant Optimized Coding (proposed method) represents by green line.

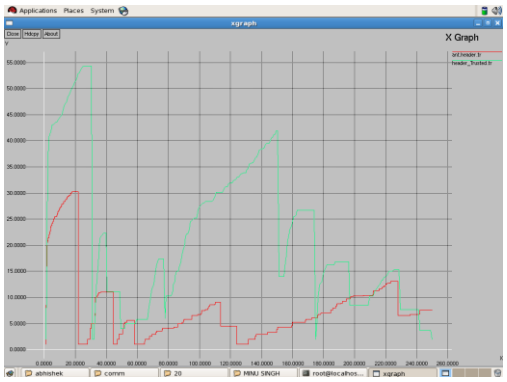

Fig.1. X-Graph of Header Packet Size For 20 Nodes

This X-graph compares header packets or overheads between old method, i.e., Trusted method and proposed method, i.e., ant colony Optimized Coding method for 20 nodes.

Bandwidth Requirement

Average bandwidth is the amount of average bandwidth which used in whole data transmission. More the time delay consumes more bandwidth for data transmission. The energy used in transmission one bit is found by using its power value.

Bandwidth = data rate * time

Where data rate is in bit/sec and time is in seconds.

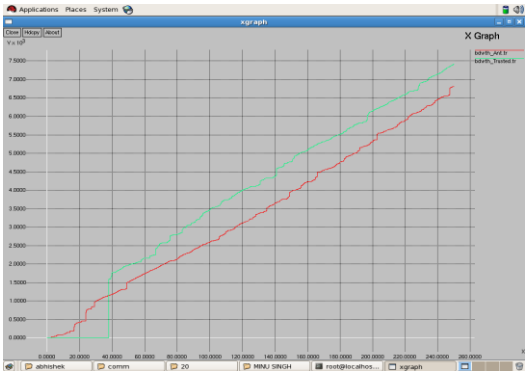

Fig.2. X-Graph of Bandwidth Requirement For 20 Nodes

Here above fig. 2 shows the average bandwidth consumption between trusted method and ant colony optimized coding method. In x-graph, red line shows the trusted method and green line shows the ant colony optimized coding method. From above figure 2, it is clear that the trusted method consumes more bandwidth than proposed method ant colony optimized coding.

End-To-End Delay

This refers to the time taken for a packet to be transmitted across a network from source to destination.

$$D_{\text{end 2end}} = N\left[D_{\text{trans}} + D_{\text{prop}} + D_{\text{proc}}\right]$$

$D_{\text{end 2end}}$ = end-to-end delay

D_{trans} = transmission delay

D_{prop} = propagation delay

D_{proc} = processing delay

Where: $N = \text{number of links}(\text{Number of routers} + 1)$

The end-to-end delay is a combination of transmission delay, propagation delay, and processing delay and

parameter of routing protocol and proposed method using the 10scenarios and gets the result for every scenario and compares the result finally red line shows the Trusted based AODV performance and green line shows the proposed work performance in milliseconds table below where showing the proposed method end-to-end delay is large but proposed work provide the optimum path that no discard/ link break while data transmission.

The above given graph results shows the end-to-end delay of network simulation where red lines shows the performance of ant colony Optimized Coding based delay and green line shows the AODV routing protocol delay.
This X-graph compares the time delay of Trusted method and proposed method.

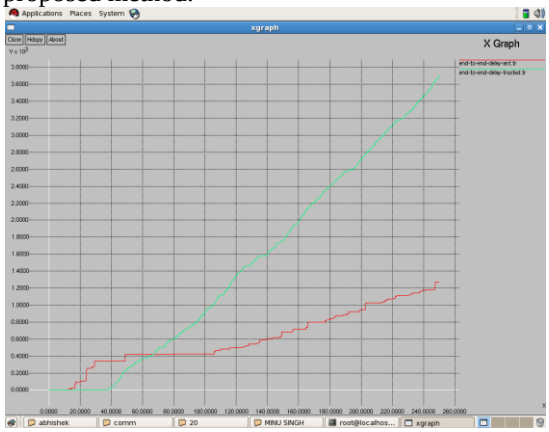

Fig.3. X-Graph Of end to end time delay For 20 Nodes

VII. CONCLUSION

In the proposed study work described in above section provides the design and implementation of a K-Means and Optimized Coding based routing protocol. To identify the need of protocol we study various techniques by which we get the problem domain and the solution domain. To design the protocol we study the techniques of cryptography and clustering with AODV routing protocol and find the place where required to make change and implementation of this routing protocol performed using C++ scripts which is listed at end of the document. Our proposed work is based on the energy consumption and security. The study of the proposed work is completed yet and the performance evaluation is completed after that we found the proposed K-means clustering and Optimized Coding method based routing protocol provide high performance QoS parameters and adoptable for use. But in future their performance can increase by using more suitable clustering algorithms or variation of K-means algorithms. So, in near future we stick with the same concept and we will try to implement this concept with more adaptable clustering algorithm that can reduce more energy.

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