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Detection and Prevention of Malicious Vehicles with Bacterial Foraging Optimization in VANETs

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Abstract: *A Vehicular Ad-Hoc Network consists of the no. of vehicles. One of the major drawback of VANETs is trafficking. There may be some malicious vehicles that enter into the network and destroy the performance of the network. The problem of my research work is to prevent the data packets to move to the nodes that are malicious in the network with the help of bacterial foraging optimization algorithm. If the sender wants to send data to destination it will check its distance from destination. If there is no direct path, then it will find the path from coverage set and after that transmission of data packet is checked. It there is loss in packets then, BFO algorithm is used.*

Keywords: *Vehicular Ad Hoc Network, Bacterial Foraging Optimization, Privacy, Message authentication.*

I. INTRODUCTION

Ad Hoc network is the structure-less system. It does not depend upon the pre-existing infrastructure. One node sends the data to other node dynamically on the basis of network connectivity. Vehicular Ad Hoc Network is the collection of vehicles that connect with one another through DSRC. The communication between VANET may be V2V or V2I unit. The basic problem faced by VANETs is security [11]. When some malicious vehicle enters into the network, then many type of attacks may occur like Eavesdropping, Sybil attack, malware, black hole attack etc. In this paper, to prevent the vehicles from malicious vehicles we introduced Bacterial Foraging Optimization in VANETs. There are various security and verification methods used. These methods are all used to prevent the intrusion. Identity based batch verification scheme is introduced [3]. It can improve the performance of the system by verifying number of message-signature at once instead of verifying one message-signature after the other. It helps in fast verification of the messages, less time is utilized for this process thus, system performance is improved [1]. In Cooperative Message authentication method, the user cooperatively authenticates a group of message-signature without the involvement of third party. This increases the performance of the network.

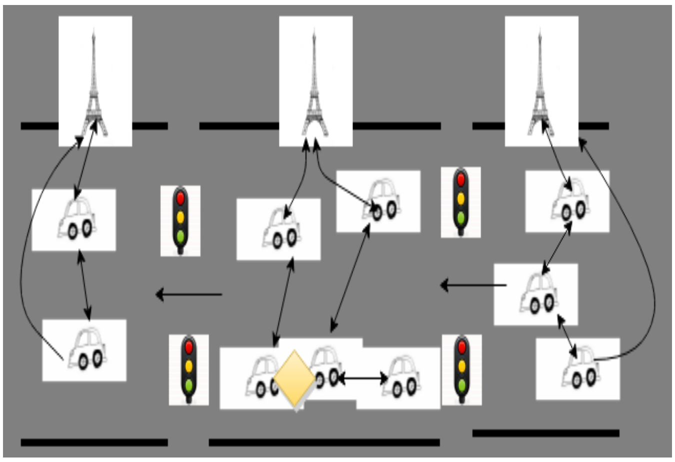

Figure 1: Basic VANET Structure

In this paper, cooperative message authentication protocol is used by the vehicles to authenticate the message without TA (Trusted Authority) and BFO is used to decrease the rate of packet loss, routing overhead, error rate and increase the throughput.

II. BACTERIAL FORAGING OPTIMIZATION

Passino [2] discovered this new technique. It is technique of the nature inspired optimization algorithm. When bacteria search for food, then the movement is done with the set of tensile flagella. Flagella is the threadlike structure that enables many bacteria to move from one place to another.Flagella has two basic operations. When the flagella of the bacteria are revolved in the right-handed direction, each flagellum stretches the cell. Each flagella moves independently.This algorithm mainly consists of following steps:

- **Chemotaxis:** This process imitates the movement of bacteria via swimming and tumbling. Sometimes, it can swim for a period of time in same direction or it may tumble. With counter clockwise direction, bacterium moves in the straight line. With clockwise, the flagellum moves in different direction.
- **Swarming:** The cells when gets energetic with the high level of succinate release aspartate, which helps them to get aggregate into groups and density of the bacteria increases.
- **Reproduction:** The bacteria with low level of nutrients, least health will finally die while other bacteria with the good health split into two bacteria.
- **Elimination and Dispersal:** Sometimes there is the sudden change in the environment due to various reasons like raise in temperature. This may kill the group of bacteria that are currently in that part which is rich in nutrients.

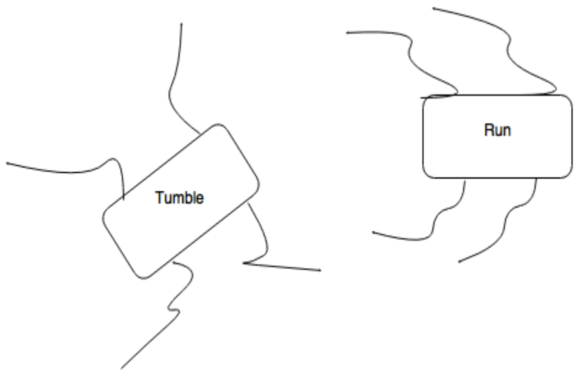

Figure 2: BFO

III. PROPOSED MODEL

Various parameters are used to evaluate the performance of the network. These parameters are used to evaluate the performance of the vehicles in the network.

- **Throughput:**Throughput is defined as the rate of successful delivery of the messages in the network.
- **Error Rate:**The error rate is defined as the number of bit errors per unit time. It is basically expressed in percentage. It is calculated as the number of bit errors divided by the total number of bits transferred during a specified time interval.
- **Packet Delivery Ratio:** The packer delivery ratio is the ratio of the total number of packets delivered to the destination compared to the total number of packets sent by the sender.
- **Routing Overhead***:* Routing overhead means routing of the packets does not take place efficiently in the network.

IV. Simulation Model

1. Initialize the network with 1000*1000mwith n number of vehicles and k number of intruders and packet-size 10,000.

2. A source and destination has been verified and some intruders have been placed.

3. If the distance>0, then Distance=1 and

direction is towards right otherwise Direction=0 and direction is towards left.

4. Calculating the uncovered neighbor sets of n and load the coverage-set. Calculate the data transferred between the nodes and find out whether there is any packet loss in the network. If there is packet loss, BFO is called.

3. Bacterial Foraging Optimization algorithm is applied.

Step 1: Initialize parameters:

Y, F, A_c, A_s, A_{re}, A_{ed}, B_{ed}, S(t).

Y: search space dimensions
F: total bacterial
A_c: no. of chemotactic steps
A_s: length of swim
A_{re}: no. of reproduction steps
A_{ed}: no. of elimination-dispersion steps
B_{ed}: probability of elimination- dispersion
S(t): step size taken in the random direction specified by the tumble.
Step 2: w=w+1 is the Elimination Dispersion loop

Step 3: d=d+1 is the Reproduction loop

Step 4: h=h+1 is the Chemotaxis loop

[a] For t bacteria, start the chemotactic step where t=1, 2, ………. F.
[b] Computation of the fitness function J (t, h, d,w) as follows:
[c] Suppose
$J(t,h,d,w)=J(t,h,d,w)+Jcc(\theta(h,d,w),Y(h,d,w))$
[d] Suppose $J_{last}=(t,h,d,w)$
[e] Tumble: create a vector randomly $\Delta(t) \in R^Y$ where $\Delta_x(t),\ x=1,2,....,Y$
[f] Move: Let
$\theta^t(h+1,d,w)=\theta^t(h,d,w)+S(t)(\Delta(t)\backslash\sqrt{\Delta^T(t)}\Delta(t))$
[g] Compute $J(h+1,d,w)$ suppose:
$J(t,h+1,d,w)=J(t,h,d,w)+Jcc(\theta^t(h+1,d,w),Y(h+1,d,w))$
[h] Swim
- Let x=0
- While $x<As$
- Let x=x+1

[j] If $J(t,h+1,d,w)<J_{last}$ (if doing better), let $J_{last}=J(t,h+1,d,w)$

[k] $\theta^t(h+1,d,w)=\theta^t(h,d,w)+S(t)(\Delta(t)\backslash\sqrt{\Delta^T(t)\Delta(t)})$

Use this Θ^t (h+1, d, w) to compute next $J(t,h+1,d,w)$ as we did in g.

Else

Let $x=As$

[l] Go to next bacteria t+1

Step 5: If $h<A_c$, go to step 4
Step 6: Reproduction

$J_{health}(t)=\Sigma_{h=h+1}(t,h,d,w)$

Sorting of bacteria in the ascending cost J_{health} is done.

The bacteria having high cost will be killed and the remaining bacteria with the optimized value splits.

Step 7: If $d<A_{ed}$, go to step 3
Step 8: Elimination-dispersal: For t = 1, 2…F with probability B_{ed}, elimination and dispersion of bacteria occurs. If the bacteria are eliminated, dispersion of other bacteria randomly on the optimization domain takes place.

If $w<A_{ed}$, then go to step 2
Else end
Evaluate the parameters like throughput, packet delivery ratio, error rate, routing overhead
.

V. FLOW CHART

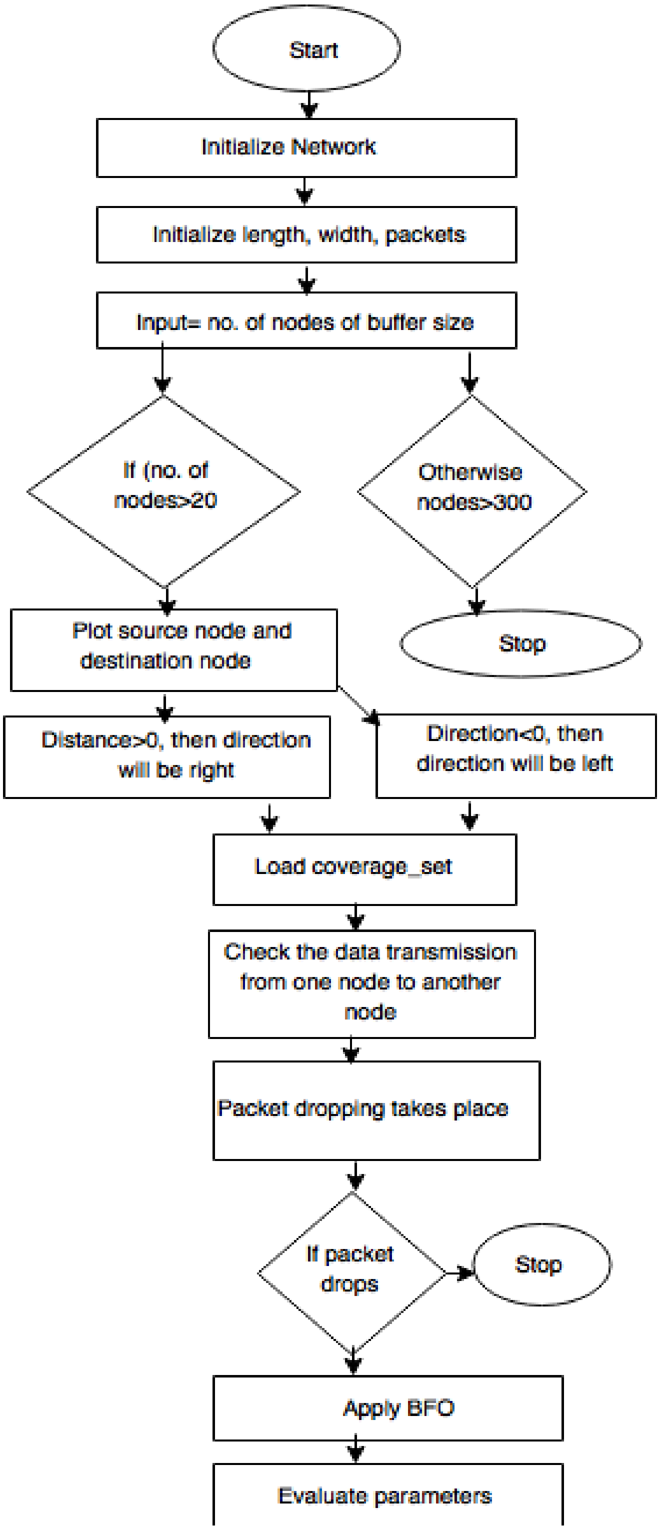

Figure. 3: Proposed Flow Chart

V. RESULTS

When we execute, the user input window is displayed. The user inputs the number of nodes, the buffer size and the size of the packet. Here nodes refer to the vehicles in VANET scenario. Buffer size is the temporary data storage when the data moves from one location to another location. The data is stored in buffer while moving from the input device to the output device. In computer, the data is stored temporarily in buffer when it moves between different processes. Buffer can be used when the rate at which data is received is different from that rate at which it is processed. Packet size is size of the packet that is transferred between the vehicles. After entering the input, the new result windows are displayed as follows:

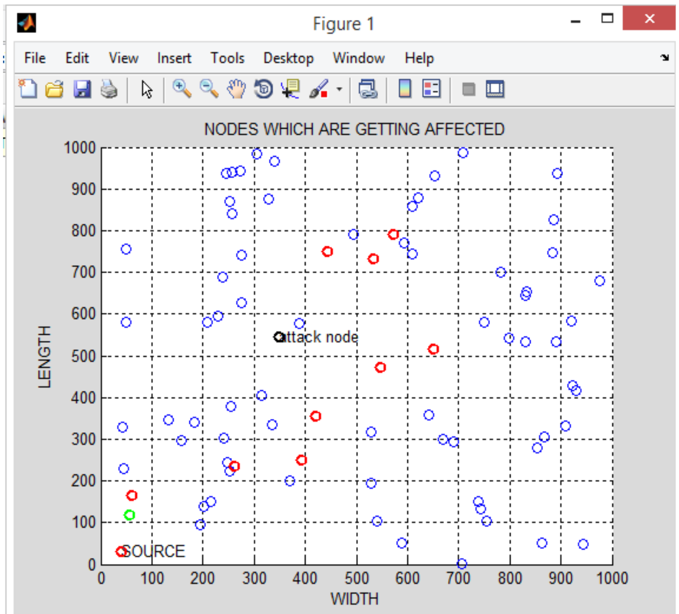

Figure 4: Input Window

In figure 4, there are three nodes. One is a source node, the green is the destination node and the red is the attacker who attacks in the network. Other red nodes show that they are affected by the attacker.

The sender finds out whether the destination is in its range. If the destination is in its range sender send the data directly to the destination. Otherwise the sender will find out the node nearest to the destination with the help of coverage set.

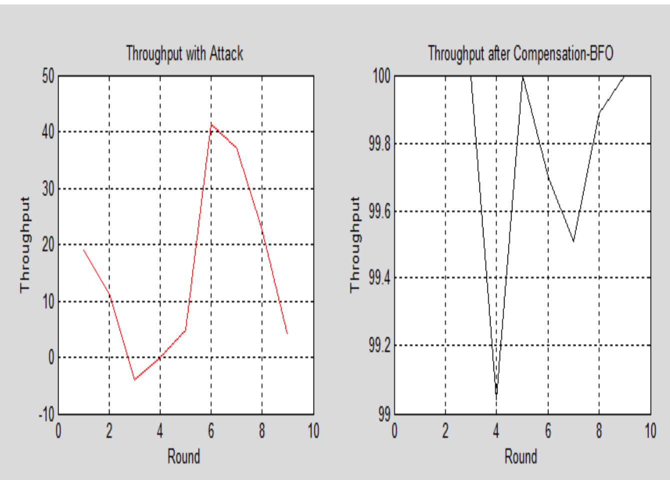

Figure 5: Throughput

If the throughput is high, then the performance of the network as also good. If the throughput decreases, the performance of the network also decreases. Throughput is defined as the rate of successful delivery of the messages in the network. In Figure 5, the throughput with attack is maximum up to 40 bytes but when the BFO algorithm is applied it goes maximum up to 100 bytes. After round 6, the throughput decreases when the attack has taken place but after compensation, the throughput increases after round 6.

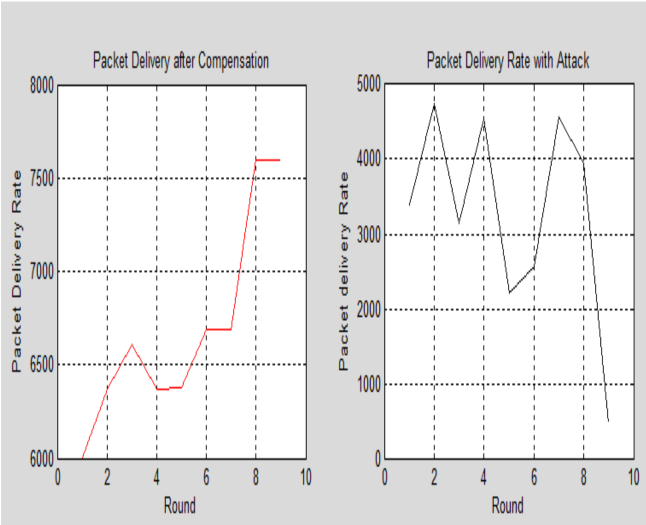

Figure 6: Packet Delivery Ratio

When the packet delivery rate is large, the performance of the network is also high. After round 8, the packet delivery ratio decreases gradually when attack has taken place but when we apply BFO on this network the packet delivery ratio increases. The packet delivery ratio goes maximum up to 4700 after attack and it goes maximum to 7500 with BFO.

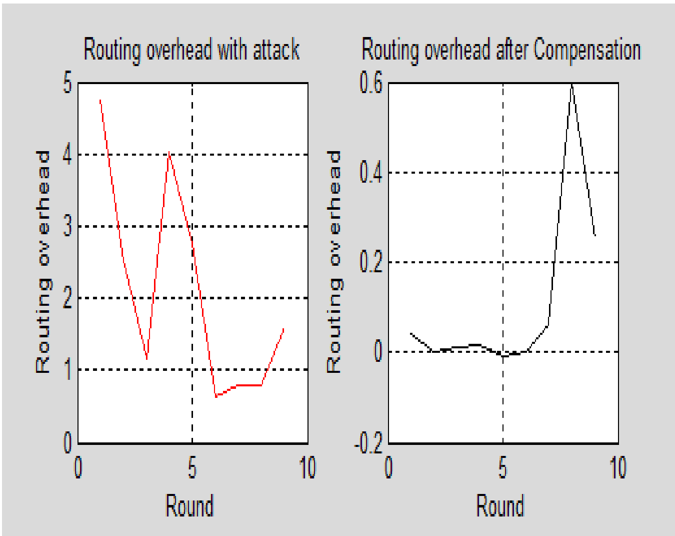

Figure 7: Routing Overhead

Routing overhead means routing of the packets does not take place efficiently in the network. Routing overhead is any error that occurs when messages for the maintenance ofthe route are sent from sender to receiver in the network.In Figure 7, the routing overhead is approx. 3 but after compensation it is negligible. After applying BFO, the routing overhead goes maximum up to 0.6. Routing overhead may occur due to the error while the packets moves in the network. This may occur when the malicious vehicles enter the network.

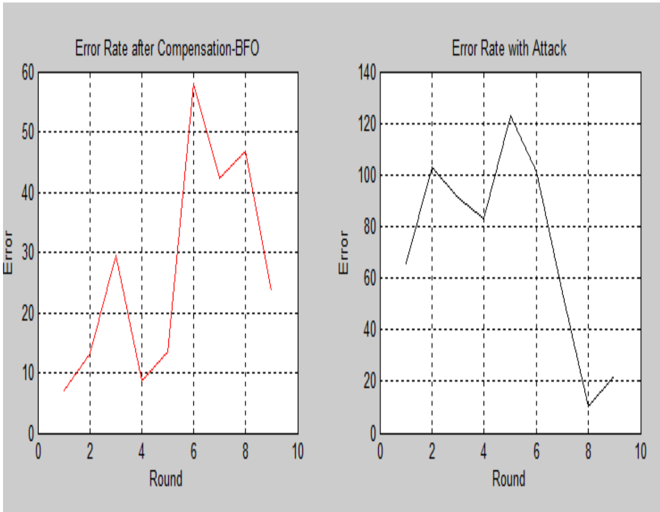

Figure 8: Error Rate

Bit error rate may be affected by the noise, synchronization of bit's problem, multipath fading. Figure 8 shows that the error rate goes maximum up to 60 after applying BFO algorithm. At round 6, the error rate is 100 but after compensation the error rate goes to 60.

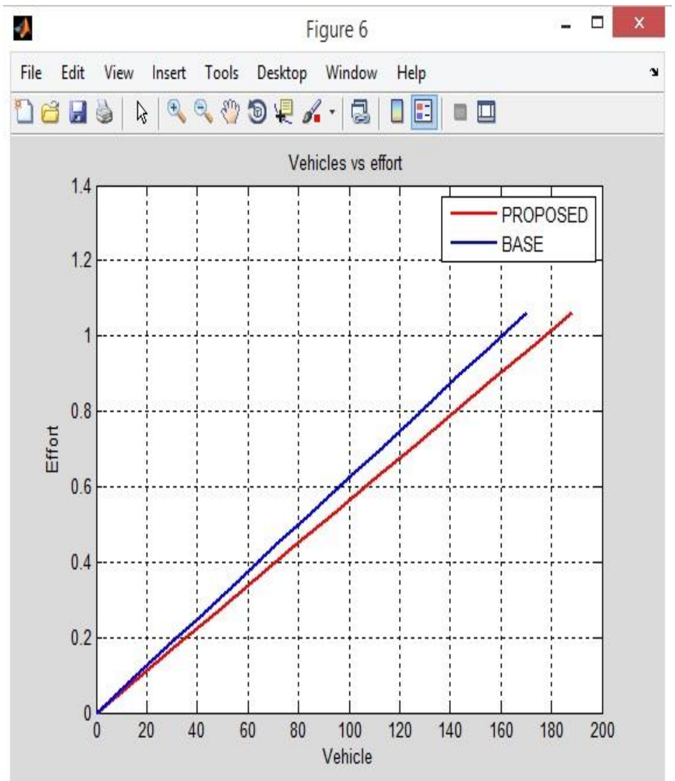

Figure 9: Vehicles vs Effort

In Figure 8, efforts are the authentication of messages by the vehicles to decrease the overhead. When vehicles are 100, the effort are approx. .63 but in proposed model efforts done by vehicles are 0.58. This shows that the proposed model shows better results as compared to [1].

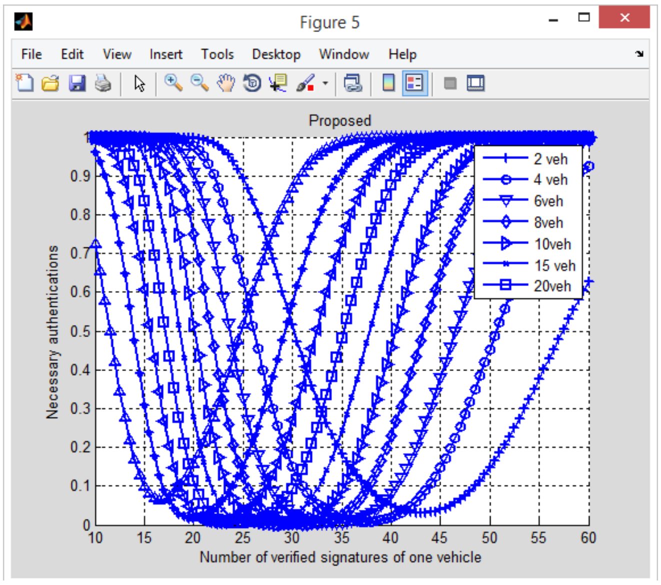

Figure 10: Authentication vs Vehicles

Figure 10 shows the graph between necessary authentication and number of verified signatures of one vehicle. When the number of vehicles increases, the necessary authentication done by single vehicle decreases. In this graph, message authentication is done without the involvement of TA (Trusted Authority). Cryptography plays an important role in authentication of the messages.

V. CONCLUSION AND FUTURE SCOPE

A vehicular ad hoc network has been presented with n number of nodesk number of malicious vehicles and m number of messages. The role of Bacterial Foraging Optimization in this case is to prevent the affected nodes from any more damage which could occur due to malicious nodes. A fitness function has been designed to evaluate the performance of the nodes on the basis of the speed of the nodes. The robustness of the system has been found to be low when bacterial foraging optimization has been applied. Parameters like throughput, packet delivery ratio has been found to be growing significantly good enough to say that the proposed algorithm fits in the solution.

The current research work has opened up. A lot of gates for further research workers. It would be interesting to see the effect of several kind of attacks with the same prevention algorithm like black hole

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attack, gray hole attack. The upcoming research may also try their hands in increasing the speed of the nodes as the current speed is only a maximum of 10km/hr.

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