

Simulation study of adhoc on-demand distance vector (AODV) routing protocol in manet using SCILAB

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Abstract:

The Mobile Adhoc Network is an infrastructure-less network, which consists of nodes that communicate with each other at any point of time. Due to its mobility, the network is susceptible to various kinds of routing attacks. Consequently, it is a very challenging task for the researchers who is simulating AODV protocol to analyze the effects of the black hole attack with and without presence of single malicious node or cooperative malicious node in the network. This paper presented a study on NARVAL module, how to use NARVAL and simulate the AODV protocol in SCILAB.

Keywords: AODV, Routing Attack, SCILAB, black hole attack.

1 Introduction:

A Mobile Adhoc Network (MANET) is a collection of mobile nodes that can communicate with each other without any fixed infrastructure. Each mobile node can act as a router to find the best path to communicate with other mobile node. The MANET provides a promising technology for civilian and military applications. The word (Adhoc) is a Latin word and it means "for this purpose". Each mobile node in MANET is liberated to move autonomously in any direction, and it changes the links to other nodes frequently [Megha Joshi, 2016]. Future information technology also uses wireless technology for efficient communication and Infrastructure based cellular and mobile networks are limited by its requirement of infrastructure such as allocation of frequencies, base station, etc. To accomplish this kind of requirement of users different methods are given, such as frequency reuse concepts, clustering technique, different frequency allocation/assignment schemes [Ahmad Anzaar et al, 2010].

The main aspects of MANETs are dynamic topology, bandwidth constrained, limited physical security and energy constrained nodes. The MANET uses multi-hop routing to provide connectivity between the nodes. There are many protocols available in MANET. One of the important protocol is Adhoc On Demand Distance Vector (AODV) routing protocol. AODV is chosen since it reduces the routing overhead compared to the other routing protocols [Amandeep et al, 2012]. A major issue in Mobile ad-hoc network is "SECURITY". There are two approaches to protect the mobile ad-hoc networks. First, Reactive approach is seeking to detect security threats and react accordingly. Second, Proactive approach is attempting to prevent an attacker from launching attacks through various cryptographic techniques [vennila G et al, 2014].

The paper is organized as follows: Section-II discuss about the related works done in AODV Routing Protocol, Section-III describes SCILAB Environment, Module Manager-ATOMS, Section-IV discuss about NARVAL Module and how to simulate AODV in SCILAB, Section-V gives the conclusion & future work.

2 Related Works:

Mukesh Kumar garg et al, 2013, estimated the performance of reactive routing protocols such as AODV, DSR and hybrid (ZRP) on the basis of various performance metrics such number of RREQ packets forwarded, number of RREP packets received, number of routes selected, as number of hop count and number of update packets received with respect to increasing the number of nodes in QualNet 5.0.

Ambica Raina et al, 2014, evaluated the performance of AODV and DSR using QualNet 5.0 in terms of throughput, jitter and data received at the server with respect to enhance the number of nodes.

S.Sridhar et al, 2013, proposed the energy based AODV (EN-AODV) integrated QoS metrics for route finding, maintenance and also end-to-end QoS. The QoS parameters such as throughput, PDR and delay are influenced openly. The Energy based AODV protocol (EN-AODV) broadcasts energy and based on which the nodes are sending and receiving rates and sizes of the data to be communicated it validates whether its energy level is preserved or decreased. It calculates the energy levels prior to route establishment. A threshold value is described and if the energy level is greater than the threshold value then the node is considered.

Kanungo, P. et al, 2011, analyzed the performances of AODV, DSR, OLSR and DSDV on the randomly generated traffic pattern. The simulation of OLSR provides better results for high mobility while increasing the number of mobile nodes on the network than other routing protocols such as AODV, DSR, and DSDV. However, the smaller size of networks with a small number of nodes, DSR gives an elevated performance on packet delivery ratio.

S.S.Kaushisk et al,2009, analyzed the performance of DSDV, DSR and AODV routing protocols using NS-2 in terms of the performance metrics such as throughput, normalized network delay load and number of sent packets with the speed of the node as constant and varying network size. The development of the network consists of 550*550 area, node mobility is constant as 15 m/s, simulation time is 300 second and number of mobile nodes varies from 10 to 30. The outcome of the simulation shows that DSR outperforms AODV and DSDV. However, if the number of nodes increases, then the performance of the DSR protocol decreases automatically.

G. Vennila et al, 2014, proposed a technique that uses one cryptographic algorithm RSA and sequence number calculation to eliminate the black hole node. The simulation was carried out using MATLAB. The MATLAB is a simple tool for simulation. The number of nodes from 10 to 50 with 8 malicious nodes has been taken during simulation within the area 1000 X 1000. The performance metrics such as throughput and delay are considered to evaluate the performance of the network with black hole attack and without black hole attack.

3 SCILAB Environment:

The SCILAB is a software for doing numeric computation and also provides enormous toolboxes for doing research in the area of Optimization, Data Analysis, Mobile Ad-hoc network, Vehicular Adhoc Network, Image Processing, Signal Processing, etc. The researchers

can use the ATOMS (AuTomatic mOdules Management for Scilab) toolboxes from the Scilab tool for doing research in their area. The ATOMS is a module manager where it has the repository of external modules such as NARVAL, Signal Processing, Data Analysis, Image Processing etc.

Module manager – ATOMS[Dr. Foued Melakessou,2014]:

The NARVAL(Network Analysis and Routing eVALuation) is an external module which is available in Module manager - ATOMS of SCILAB Workspace. Since it is created at the University of Luxembourg with the Interdisciplinary Centre for Security, Reliability and Trust (SnT). This center performs Interdisciplinary research and graduate education in the area of Security, Reliability and Trustworthy ICT). This module is used to analyze the Network routing protocols and algorithms.

How to use ATOMS :

The ATOMS is a Module manager which is presented on the top of the SCILAB Environment. It depicts an example how to install and load a module.

- Install a module in SCILAB Workspace:
atomsInstall('Module Name');
Example:
atomsInstall('NARVAL');
- Load a module in SCILAB Workspace:
atomsLoad('Module Name');
Example:
atomsLoad('NARVAL');

After successful installation of Module, the module is displayed by default in a list of modules which are available in SCILAB.

NARVAL Toolbox[Dr. Foued Melakessou,2014]:

The NARVAL module has been developed and implemented in the latest version of SCILAB-5.5.0. This toolbox consists of 330 functions are classified into the following sets [Dr. Foued Melakessou,2014]:

NL_F: Function:

This set consists of 29 functions that has all mathematical related functions such as Autocorrelation, Bisection, etc. and also compute the coordinates of the intersection between two lines, Perform a Mysql command from Scilab, etc.

NL_G: Graph

This set consists of 82 functions which permits to construct various kinds of graphs, perform the node degree distribution, etc. The user can easily add, delete the edges and also nodes, etc. The basics of graph operations can be computed (GraphInit, KCore, Local Clustering, Make Graph, Diameter, Distance Partition, Eccentricity, etc.

NL_I: Internet (30 functions)

This set of functions consists of 30 functions that enables to simulate random data communications and new connections are generated in the network during simulation. It performs the displacement of TCP, UDP, MPTCP packet, and also initializes, update a route manager, etc.

NL_M: Mobility (20 functions)

The set consists of 20 functions which can simulate MANET and VANET according to the various kinds of mobility models such as a random direction mobility model, random walk mobility model, random waypoint mobility model, etc.

NL_R: Routing (93 functions)

This set consists of 93 functions which provides a list of routing algorithms that can be applied to MANET/VANET. It has the following Routing Protocols such as AODV, ARC, BFS, Bellman-Ford, DFS, Dijkstra, Flood, Floyd-Warshall, Prim, RPL, etc. The user can also construct new methods and analyze them on different topologies.

NL_S: Security (34 functions)

This set consists of 34 functions which allows to perform the AES, GCD, RSA encryption/decryption algorithms. It also provides an approach called information slicing that is used for secret communications

NL_T: Topology (13 functions)

This set consists of 13 functions which allows to build a variety of topologies. For instance, it has the following algorithms such as Waxman algorithm, Barabasi-Albert algorithm, locality algorithm, etc.

NL_V: Vision (29 functions)

The set is also consists of 29 functions to work on computer vision. It performs the angle, counterclockwise parameter between three points. It also performs the visibility graph of a set of obstacles, etc.

4 AODV Routing Protocol:

The Adhoc On-demand Distance Vector Routing algorithm is an improvement to DSDV protocol. It works on the following three messages [Dr. Foued Melakessou, 2014]:

4.1 RREQ Message

The Route Discovery propagate RREQ to all its neighbor nodes in the network. The format of the RREQ message in SCILAB follows:

$$[M, R] = \text{NL_R_AODVRouteRequest}(G, S, D, T)$$

G: Graph.

S: Source.

D: Destination.

T: Time-to-Live.

M: RREQ packet storage matrix.

R: Route storage matrix.

NL_R_AODVRouteRequest performs the AODV Route Request process from the source node(S) to the destination node(D) inside the network graph G. The set of RREQs (respectively possible routes) is stored in the matrix M (respectively R) with the format [route|arrival|TTL|route length].

4.2 RREP Message

Subsequently, the destination node or intermediate node that knows a path to the destination sends AODV Route Reply to Source node. Hence, the NL_R_AODVRouteReply has the following format:

$$\text{NL_R_AODVRouteReply}(G, S, D, I, R)$$

G: Graph.

S: Source.

D: Destination.

I: Sequence number.

R: Route storage matrix.

NL_R_AODVRouteReply performs the AODV Route Reply process from the Destination node (D) towards the Source node (S) inside the network graph G. The sequence number (I) is assigned to the process in order to differentiate the old and fresh routes.

4.3 RERROR Message:

It sends a RouteError message if any links broken inside the network during the route discovery process. The format of the RouteError message is shown below:

Route Error Message:

$$[N] = \text{NARVAL_R_AodvRerr}(I,N)$$

I: Node.

N: List of unreachable nodes.

NL_R_AODVRouteError adjusts the routing table of the node I, after an error discovery. N gives the list of unreachable nodes. If a Node accepts a RERR packet, it checks the routing table and removes all the routes that has unreachable nodes. There are three different cases available.

- If a data packet is broadcasted from its source node to its destination node with respect to the local decision in each crossed router, a problem occurs if any intermediate node does not know the next node where the packet should be forwarded.
- If a node accepts a RERR, it has to eliminate all entries. In this situation, the node sends a RERR to all its new nodes which are currently inaccessible.
- If a node cannot communicate with other neighbors node (link break), it removes all entries from the routing table and then sends a RERR to all neighbor nodes.

The above protocol can be implemented in SCILAB with the following sequence:

NL_M_Simulation1N2AllAP(R,Rf,Rs,N,Nf,L,VM,T,TM,D,I). Hence, the simulation of AODV protocol is shown in Fig.1

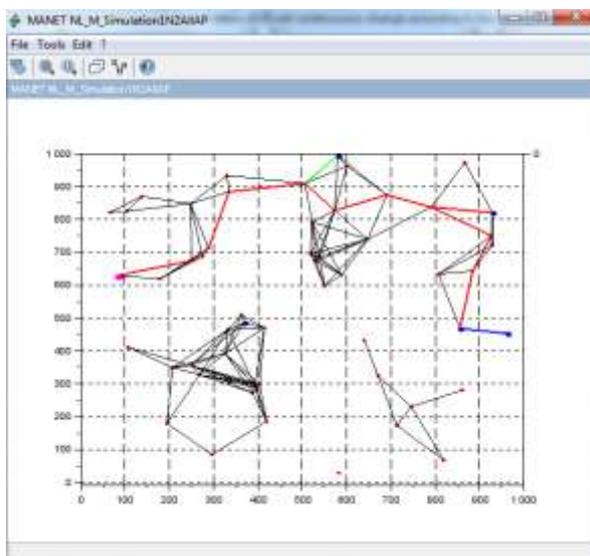


Fig.1.Simulation of AODV Protocol

5 Conclusion:

This paper presented a study on ATOMS-Module Manager, NARVAL Module & its toolbox functions and also how to simulate Adhoc On-Demand Distance Vector (AODV) Routing Protocol using SCILAB which is open source software available at free of cost. It also focuses other toolbox functions which are very useful for the researchers who is doing research in the area of VANET, Optimization, Computer Vision, etc. In future, the AODV Protocol can be implemented using SCILAB & analyze the performance of AODV with respect to Packet Delivery Ratio, Throughput, etc. and also we can analyze the effects of the black hole attack with the presence of single malicious node or cooperative malicious node in the network.

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