True Time based Simulation for AODV in MANET

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Abstract: AODV routing protocol has been extensively used for data transfer in MANET's due to high mobility of the nodes and wireless technology. There are several problems associated in the network. It is essential procedure for MANET network to design and optimize. We proposed True Time simulator for MANET's in MATLAB/simulink. We use computational intelligent technique, paths to capture networks dynamic behavior and in-node behavior. The simulation result show True Time could accomplish MANET'S simulation and displayed node energy under several conditions.

Keywords: AODV, MANET, True Time, Node energy, MATLAB/simulink.

Introduction

Need for ad hoc wireless communication has increased with more use of portable devices knows as Mobile ad hoc network (MANET). MANET consists of independent nodes that can communicate to each other through radio waves. MANET is an infrastructure less network in which nodes move arbitrarily [1][2]. Due to this mobility nature of the nodes they themselves act as router. The primary challenge in building MANET is to establish path between the communicating nodes. This type of network has power constraints since they depend on limited battery resources.

MANETS are self organizing and self configuring multi hop wireless networks where the structure of the network changes dynamically because of mobility of the nodes, broadcast nature of the network frequent network reconfiguration. Continuous change in position and connection consumes more energy. Therefore it is necessary to save energy to maintain the life time of the network in order to enhance the life time of nodes [3][4][5]. There are several simulator used for MANET network research such as NS-2, OPNET, OMNET++, TOSSIM etc. NS-2 is widely used simulation tool. Table 1 gives some elements of the dependability for each simulator [1].

The rest of this paper is organized as follows. Section I describes Ad-Hoc on-Demand Distance Vector routing protocol used for simulation. Section II introduces True time Kernel toolbox of MATLAB/Simulink. Section III gives implementation and Simulation Model details. Section IV describes the result analysis and conclusion is drawn in section V.

Ad-Hoc On-Demand Distance Vector

The Ad-Hoc On-Demand Distance Vector (AODV) is a reactive routing protocol. The protocol is used to discover the route when source and destination nodes cannot communicate directly i.e on-demand. The source node generates route request packet (RREQ) and broadcast to its neighbor nodes. The neighbor nodes checks its routing table for the destination node, if found sends route reply packet (RREP) for path establishment between source and destination node else it further broad cast to RREQ to its neighbor. This process is continued until RREQ reaches destination node. The destination node generates RREP and unicast in the reverse path. Thus path is established [6].

True Time blocks

Lund university, Sweden developed a co-simulation tool TrueTime (TT) in MATLAB/simulink. This provides a simulation environment for network control. TrueTime could be used to simulate computation within the nodes and dynamic behavior of the network. [7][8][9]

A group of simulink blocks are provided in TrueTime library (figure1). In simulation we have used TrueTime kernel (figure2), TrueTime battery and TrueTime Wireless Network (figure3).

Table 1: Elements of dependability: ganularity and mobility[1]

Name	Granularity	Metropolitan mobility
ns-2	Finest	Support
DIANEmu	Application- level	No
Glomosim	Fine	Support
GTNets	Fine	No
J-Sim	Fine	Support
Jane	Application-level	Native
NAB	Medium	Native
OMNet++	Medium	No
OPNet	Fine	Support
QualNet	Finer	Support
SWANS	Medium	-

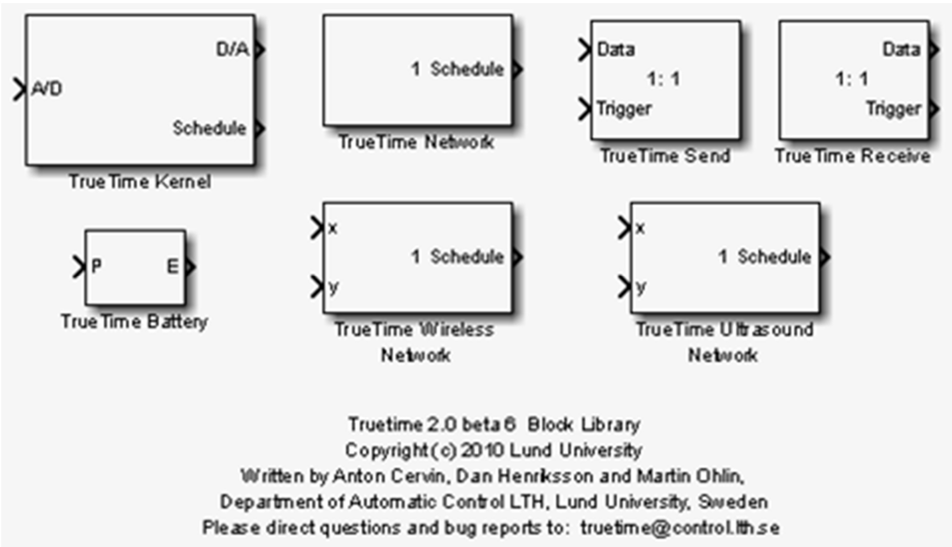

Figure1: TrueTime Block Library

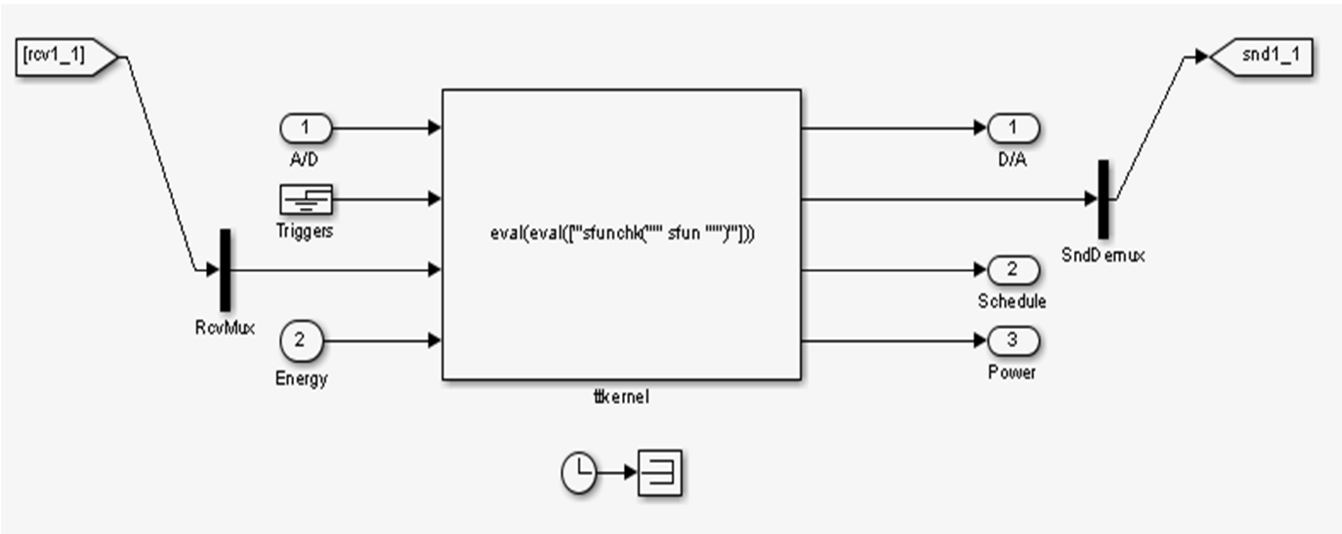

Figure 2: Internal structure of a TrueTime Kernel

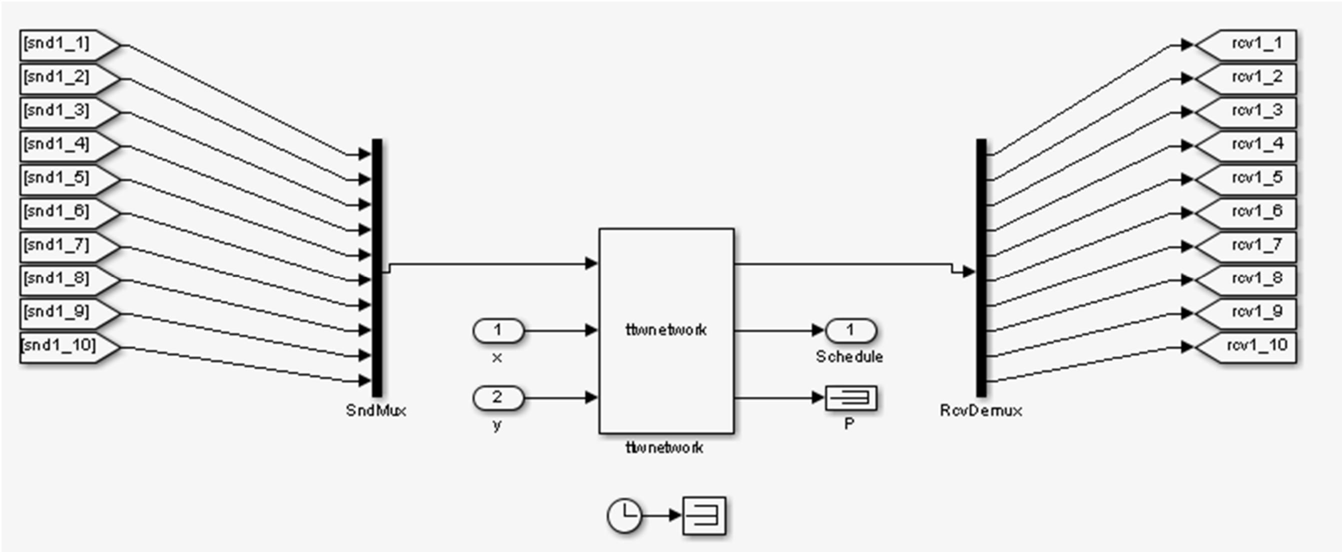

Figure 3: Internal structure of a TrueTime Wireless Network

Implementation and Simulation Model

The following parameters were considered for simulation (Table 2). Each node position was randomly given in the area of 400m*400m and each node was assigned with energy of 20J. Figure4 shows internal structure of one such node. Figure5 shows overall AODV implementation using TrueTime blocks.

Table 2: Simulation parameters

Transmission Power	-8dBm
Receiver Threshold	-48dBm
Data rate	1Mbps
Antenna	Omni directional
Path loss Exponent	3.5
Pause Time	0.5s
Hello message interval	1s

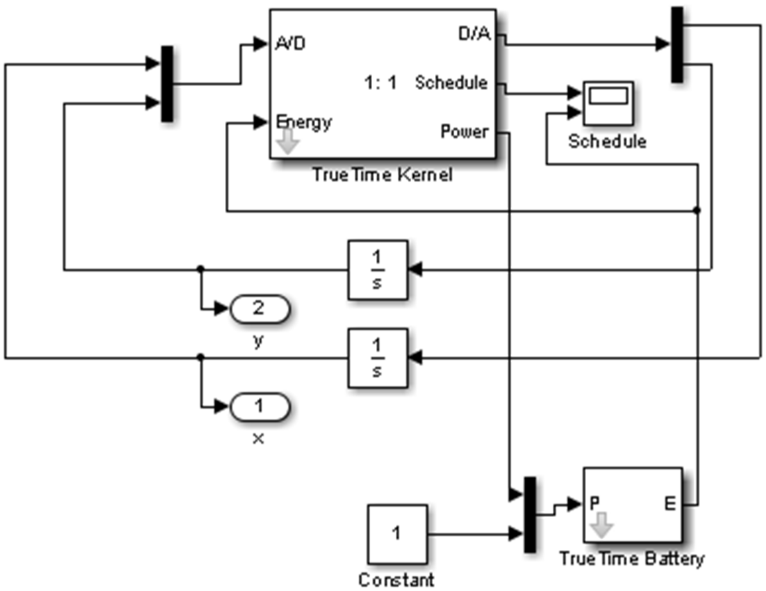

Figure 4: Internal structure of a Node

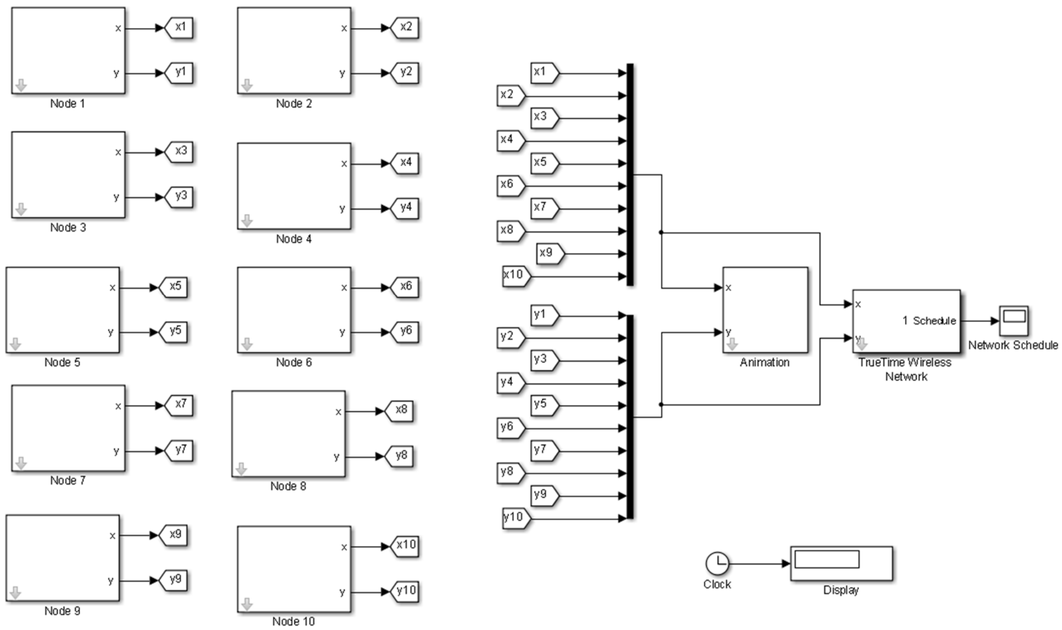

Figure 5: AODV TrueTime simulink model

Result Analysis

We simulated a MANET of size 10 nodes giving mobility for 2 nodes at different instants. Source and destination were randomly chosen. Figure 6 shows a scenario of node deployment. The instant at which RREQ is broadcasted, receiving RREP from destination; route establishment, link break etc are displayed in MATLAB command window as shown in Figure7.

The number of intermediate nodes between source and destination verses time taken for path establishment for 0%, 25% and 50% message loss in network is shown in figure8. Due to heavy load in the network message loss occurs; thereby time taken for path establishment in 25% and 50% cases is more compared to 0% loss. The packet loss during 0%, 25% and 50% were 6, 10 and 22 respectively.

The primary challenge in building MANET is to establish path between the communicating nodes. This type of network has power constraints since they depend on limited battery resources. Continuous change in position and connection consumes more energy. It is therefore required to known the energy status of the node.

The energy consumption of node for path establishment varies under different circumstances. For examples retransmission of RREQ or data or multipath establishment. Assuming 10%, 25% and 50% if its initial energy is consumed for path establishment. Energy consumption for one node is shown in figure 9 for a simulation time of 20s.

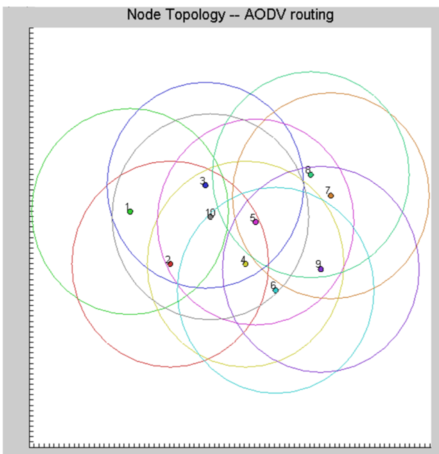

Figure 6: Node deployment scenario

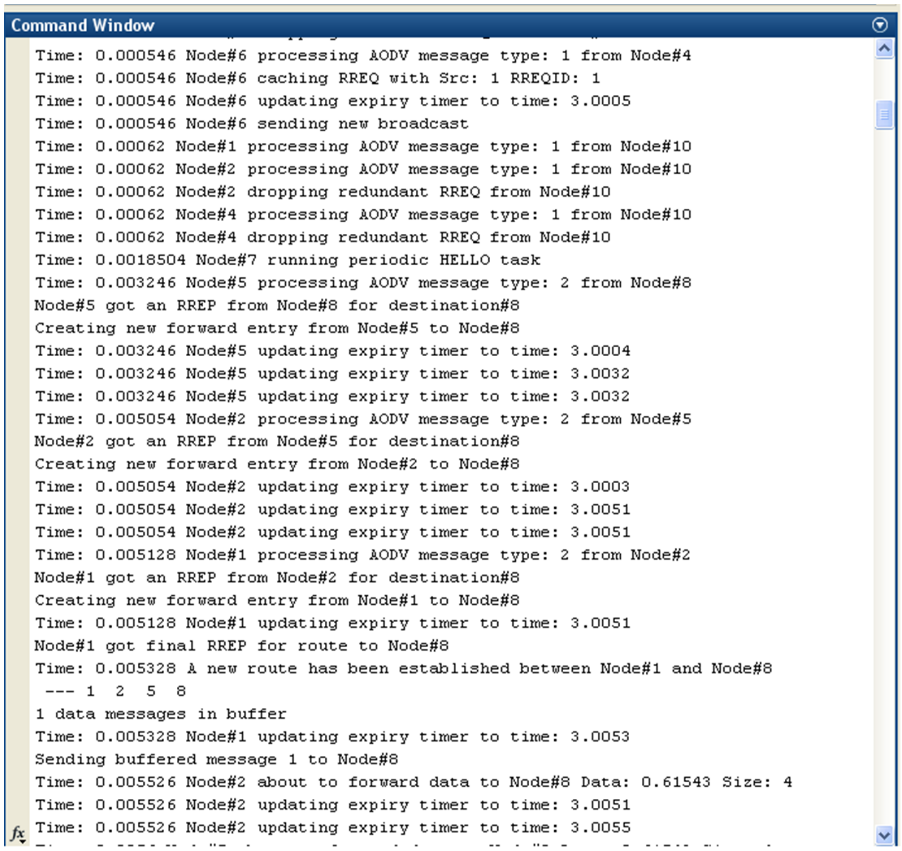

Figure 7: AODV routing display in MATLAB command window

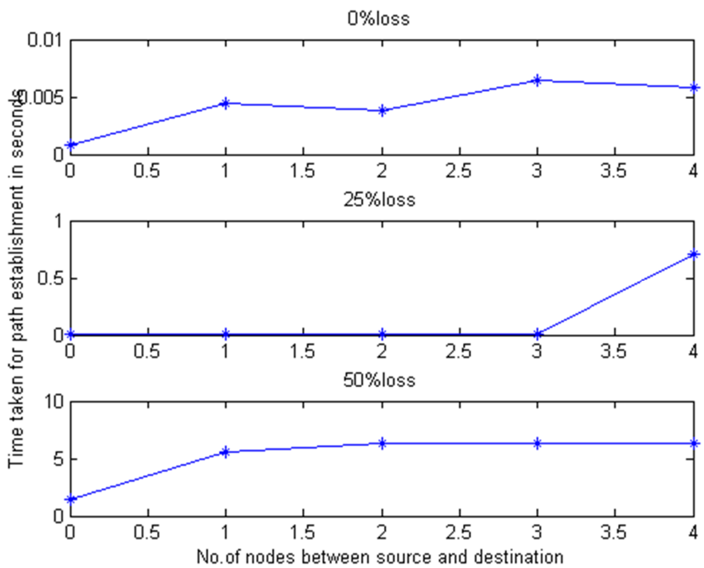

Figure 8: Time taken for path establishment

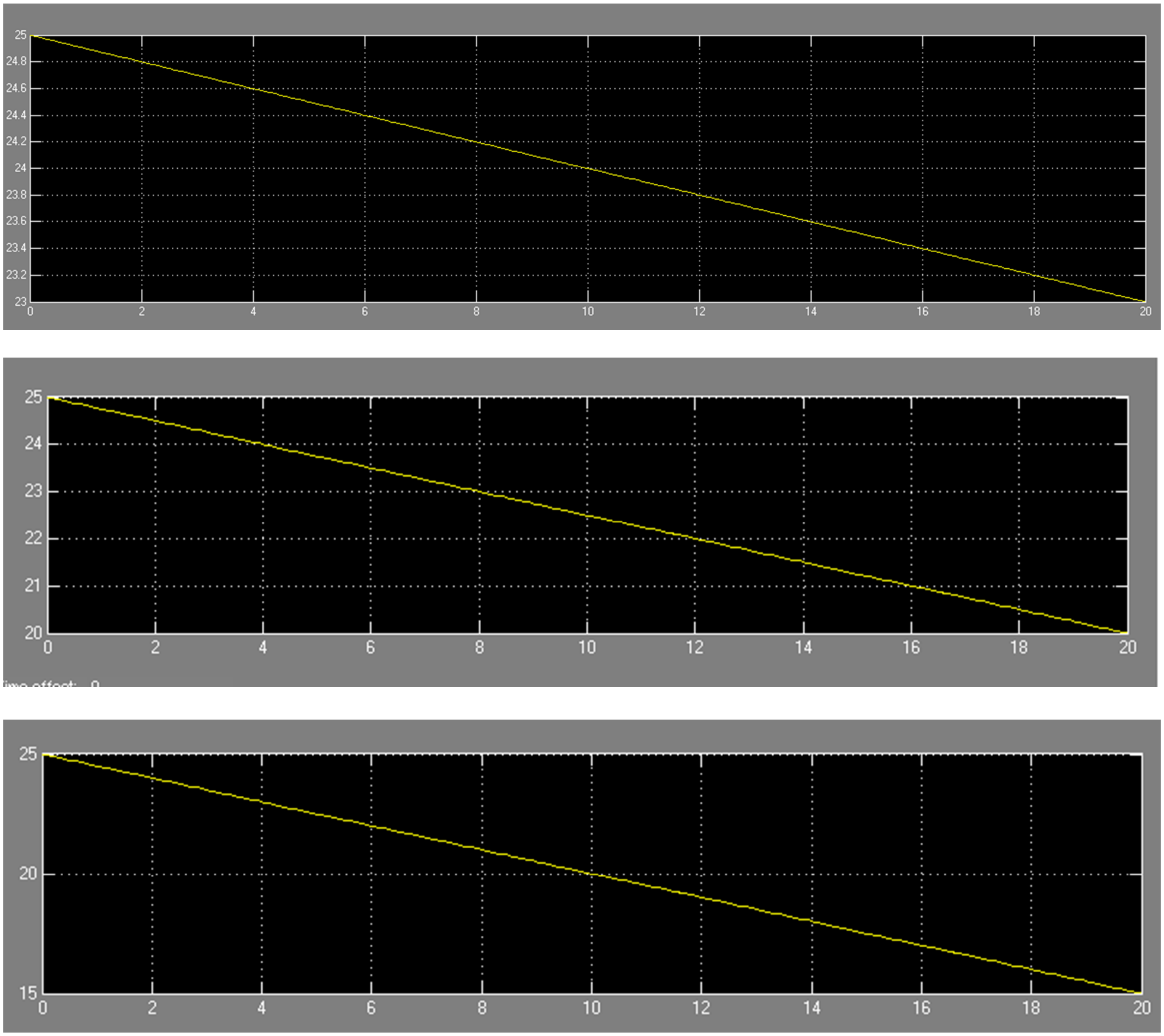

Figure 9: Energy consumption

Conclusion

In this paper, we have used TrueTime as a tool to implement AODV. We give an example of simulation which use 10 nodes deployed 400m*400m. We have simulated the network and in-node behavior. Energy is a constraint parameter in MANET's, it is necessary to save energy to maintain the life time of the network in order to enhance the life time of the MANET, energy efficient routing protocols are required. AODV does not consider any security schemes; it is vulnerable to various types of attacks. Security schemes can be considered in design of AODV in MANET's. If these parameters are included in AODV, source node can decide the data transmission in the path looking into the energy status and security from the route table.

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