Implementation of Simulation Model for Wireless Network Using Matlab

Arti Gupta
Student, M.tech(IT)
University School of Information Technology
New Delhi, India
artigupta_84@yahoo.com

Abstract: The level of details for choosing a simulator has provided by experience of wired network. Wireless simulation raise many new questions about appropriate level of detail in simulation model for radio propagation and energy consumption. As we have many simulation tools which are easily available openly like OMNeT++, QualNet and Ns2 but each has its own limitation. Where as Matlab is an emerging computing tool provide wide variety of functional toolboxes and easy to use language. In this paper a simulation model for wireless network using Matlab is implemented and there execution timings are also compared to check the effectiveness.

Keywords: Wireless network, Simulation and Matlab.

I. INTRODUCTION

The rapid growth of the internet into our daily lives made computer networks more and more important. One can observe a pervasive use of network applications such as the World Wide Web, e-mail, instant messaging, or Voice over IP (VoIP). This growth sees to it that computer networks became a critical infrastructure, not only at home but also at work, and in government or military facilities. Simulation has become an indispensable method to design those networks. Furthermore, existing network technology can be improved using simulations. New protocols can be designed and tested, or existing algorithms can be adjusted to meet the requirements of today's networks, such as multicast transport, security, mobility, quality-of-service, or policy management. Beside the growth of computer networks, computer hardware becomes more and more powerful. High-performance hardware allows the simulation software to become faster or more accurate as better and more complex simulation models are available. Before going into network simulation, let's introduced a definition of the term `simulation' is given by Banks: Simulation is the imitation of the operation of a real-world process or system over time. [1] Simulation involves the generation of an artificial environment for a project to work on, whereas small simulations can be done manually, more complex real-world problems result in more complex simulations that need to be e.g. executed by a computer. A simulation can also be considered as a composition of several concepts. These concepts include models, system states, and activities among others. [1]

This paper will discuss about the different components which are required to simulate wireless network over Matlab and its implementation.

II. SIMULATION MODEL

As the objective of this project is to simulate wireless network using matlab as computing it provide a platform tool for simulation to This paper provide a model for simulation of wireless network based on matlab as matlab is easy to use computing tool and provide an open source environment. This model includes module for Radio propagation, Mobility, physical Layer, MAC and network layer and application layer.

Firstly Radio propagation predict the behavior of all nodes under similar constraints. It include 3 models like free space, two-ray, and lognormal shadowing models for calculating Packet delivery ratio over the network.

A. Free space model:

The free space propagation model assumes the ideal propagation condition that there is only one clear line of-sight path between the transmitter and receiver. [2]

$M = lambda / (4 * pi * d);$
$Pr = Pt * Gt * Gr * (M * M) / L;$

B. Two-ray ground reflection model:

This model consider both direct and ground reflection path. [2] Below mentioned formula is used to calculate the power at the receiver.

$Pr = Pt * Gt * Gr * (hr * hr * ht * ht) / (d * d * d * d * L);$

C. Shadowing model:

a. Here the received power at certain distance is a random variable due to multi path propagation effects, which is also known as fading effects that is implemented by shadowing model. [3]

$$Pr = \frac{Pt * Gt * Gr * (lambda^2)}{(4 * pi * d0)^2 * L} * \frac{d0^{passlossExp}}{d^{passlossExp}} * 10^{(X0/10)}$$

b. To represents the location of mobile user, its velocity, acceleration changes over time and its movement mobility models are used. It also predicts the future user positions. Random way point model is one the mobility model, which work on random based model where the mobile nodes move randomly and freely without restriction. To be more specific, the destination, speed and direction are all chosen randomly and independently of other nodes which are generated by implementing the following formulas.

$speed = MIN\_SPEED+(MAX\_SPEED - MIN\_SPEED)*rand;$

$dist = sqrt((X-x1)^2+(Y-y1)^2);$

time = time + dist/speed + PAUSE_TIME;

By storing the details of nodes like its intermediate location, speed and time consumed we can analyze the node location.

node = [x y speed x1 y1 time];

c. **PHY:** SNR-based packet capture, broadcast, dynamic transmission rate and power: SNR based function use probes packets to calculate window of time in order to capture the dynamics of the networks. [4]

Transmission time is calculated for data, acknowledge, request to send and clear to send.

For 'data'

Tx_time = (pkt.size + sizemacheader) / pkt.rate + sizeplcp / basicrate;

For 'ack'

Tx_time = (sizeack + sizeplcp) / basicrate;

For 'rts'

Tx_time = (sizerts + sizeplcp) / basicrate;

For 'cts'

Tx_time = (sizects + sizeplcp) / basicrate;

d. **MAC:** IEEE 802.11 (CSMA/CA and RTS-CTS-DATA-ACK) : Carrier sense multiple access with collision avoidance (CSMA/CA), is first sense the channel whether it is ideal not and then transmit the node over the channel which helps to reduce the possibility of collision. If the channel is sensed "idle," then the node is permitted to begin the transmission process. If the channel is sensed as "busy," the node defers its transmission for a random period of time. Once the transmission process begins, it is still possible for the actual transmission of application data to not occur. [5]

if (Pr+N0) > cs_threshold

    busy = 1;

else

  busy = 0;

end

N0: white noise variance

Pr: Power at receiver end

CSMA/CA reduces the collision due to the use of a random truncated binary exponential back off time. An IEEE 802.11 RTS/CTS exchange can be required to handle the hidden node problem in wireless networking. CSMA/CA can optionally be supplemented by the exchange of a Request to Send (RTS) packet sent by the sender S, and a Clear to Send (CTS) packet sent by the intended receiver R. Thus alerting all nodes within range of the sender, receiver or both, to not transmit for the duration of the main transmission. [6]

e. **NET:** ad hoc routing: An ad-hoc routing protocol decide which way to route the packets among many devices. The basic idea is that a new node may announce its presence and should listen for announcements broadcast by its neighbors.

Each node learns about nodes nearby and how to reach them, and may announce that it, too, can reach them. [7]

f. **APP:** overlay routing protocols: A network defined over another set of networks. The overlay addresses its own nodes Links on one layer are network segments of lower layers, requires lower layer routing to be utilized and overlaying mechanism is called tunneling. Nodes in the overlay can be thought of as being connected by virtual or logical links, each of which corresponds to a path, perhaps through many physical links, in the underlying network. [8] For example, distributed systems such as cloud computing, peer-to-peer networks, and client-server applications are overlay networks because their nodes run on top of the Internet. The Internet was built as an overlay upon the telephone network.

III. IMPLEMENTATION AND ANALYSIS

The objective of this paper is to simulate wireless network and compare there execution timings. Here in the below given snapshot the transmission and receiving of packets are represented with respect to their starting and receiving time and also represents repeat packet request (if not delivered on time).
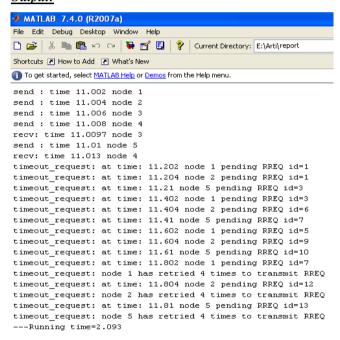
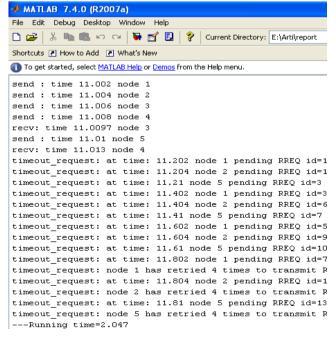***Output:***

Figure 1. Simulation of wireless network

Figure2. Simulation of wireless network

Transmitting the packets over the network is slightly different in each figure which represents that each time whenever packets are sent over the network, the running time is reduced through this model.

IV. CONCLUSION

The goals of this paper to simulate a wireless network using a model built in matlab. The knowledge of different simulator in term of their strength and weakness is necessary because it help user to select the most appropriate simulator. Since no single simulator is universally applicable to all situations, appropriate. Too much detail represented by a simulator results in slow simulations and cumbersome simulators. A very detailed simulation may accurately predict today's performance, but it may not predict tomorrow's protocol variations or be easily adapted to quickly explore alternatives.

This project represents simulation of wireless network where transmission and reception of packets and repeat request of packet are represented successfully. It also shows that whenever the packets are transmitted through this model repeatedly, it reduce total running time every time. Further this simulator can used to compare the running time of network on the basis of speed of network and network size.

V. REFERENCES

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