Analyzing the QoS metrics of Ad hoc on-demand distance vector protocol

Vasamsetti Satyapriya
satyapriyav055@gmail.com
Andhra University College of Engineering for Women, Visakhapatnam, Andhra Pradesh

Narava Gowthami
satyagowthami1211@gmail.com
Andhra University College of Engineering for Women, Visakhapatnam, Andhra Pradesh

Rajapithamahuni Manasa
manasa.rajapithamahuni@gmail.com
Andhra University College of Engineering for Women, Visakhapatnam, Andhra Pradesh

Patagolusu Ramyasri
ramyasri0041@gmail.com
Andhra University College of Engineering for Women, Visakhapatnam, Andhra Pradesh

Kuda Babysai
kudababysai0003@gmail.com
Andhra University College of Engineering for Women, Visakhapatnam, Andhra Pradesh

Dr. K. Soumya
soumyaindian@gmail.com
Andhra University College of Engineering for Women, Visakhapatnam, Andhra Pradesh

ABSTRACT

A mobile ad-hoc network (MANET) is self-configuring infrastructure-less network in which all the nodes are connected using wireless medium without any base station. In brief, an Adhoc network is a decentralized wireless network in which all the nodes participate in the routing process. In this project work, an attempt has been made to study Adhoc On-Demand Distance Vector (AODV), reactive protocol using OPNET simulator.

Keywords— OPNET, AODV, Mobile Ad-hoc Network (MANET), Routing protocols, End-to-End delay, Throughput

1. INTRODUCTION

"A network is a collection of computers, servers, mainframes, network devices, peripherals, or other devices connected to one another to allow the sharing of data." [1] Broadly, Networks are divided into two groups. They are wired networks and wireless networks.

1.1 Wired Networks

A wired network connect device to the internet or other networks using cables. The most common wired networks use cables connected to Ethernet ports on the network router on one end and to a computer or other devices on the cable's opposite.[2]

1.2 Wireless Networks

"A wireless network is any type of computer network that uses wireless data connections for connecting network nodes".[3] Wireless networks are further divided into two groups. They are cellular networks and ad hoc networks.

1.2.1 Cellular Networks:
A cellular network or mobile network is a wireless network distribution over land area called cells, each served by at least one fixed-location transceiver, known as cell site or base station.[4]

1.2.2 Ad hoc Networks

"An Ad hoc network is a network that is composed of individual devices communicating with each other directly. The term implies spontaneous or impromptu construction because this networks often bypass the gatekeeping hardware or central access point such as a router." [5] Ad hoc networks routing is used to find a route between source and distance. One type of routing protocol is reactive routing protocol in which in order to send data a source uses route discovery process to find a route to source to destination.

AD HOC on demand distance vector (AODV) is a reactive routing protocol that uses characteristics of proactive routing protocols. Routes are established on Demand, as they are needed. However, once established, a route is maintained as long as it needed. It is a reactive, table-driven routing protocol for MANETs developed by Charles E. Perkins and Elizabeth M. Royer. In this routing protocol, each node uses a routing table with next hop address, destination node, the sequence number, and install Time. In this paper, an attempt has been made to study the AODV protocol using the OPNET simulator.

2. LITERATURE REVIEW

This paper presents the research papers required to implement this project.

2.1. Literature review of OPNET simulator

Pt Ravishankar, Sanjay Kumar in their paper, "OPNET - NETWORK Simulator",[6] discussed about OPNET simulator. The OPNET simulator environment is a flexible tool for network engineers to investigate performance of various protocols under

different topologies and configurations. It stands better than other simulators in terms of its power and versatility. OPNET is user friendly in nature.

2.2. Literature review of Ad hoc on Demand Distance Vector (AODV)

Sunil Taneja, et al., in their research paper, "A Survey of Routing Protocols in Mobile Ad hoc Networks",[11] provided an overview of protocols by presenting their characteristics, functionality, benefits and limitations. The authors have compared protocols (DSR, AODV and TORA) in order to analyse their performance. AODV shares DSR's on-demand characteristics in that it also discovers routes on an as needed basis via a similar route discovery process. However, AODV adopts a very different mechanism to maintain routing information.

2.3. Literature review of Mobile Ad Hoc Network (MANET)

S.-J. Lee, et al, in their paper, "A simulation study of table-driven and on-demand routing protocols for mobile ad hoc networks" [8], have analysed the two on-demand routing protocols (dynamic source routing and associativity-based routing) with distinctive route selection algorithms which are simulated in a common environment to quantitatively measure and contrast their performance.

2.4. Literature review of Quality of Service (QoS) metrics:

M. Mirhakkak, et al, in their paper, "A new approach for providing quality-of-service in a dynamic network environment" [9], focused on an approach to expand the semantics of the reservation so that instead of being a single value indicating the level of service needed by an application.

2.5. Literature review of propagation Model

SM Itoua, et al, in their paper "Effect of propagation models on ad hoc networks routing protocols" [10] stated that a mobile ad hoc network is (MANET) suffers from the performance limitations of wireless channels, like the obstacle between the transmitter and the receiver.

3. METHODOLOGY

This chapter presents the methodology used to do this paper.

3.1. OPNET Simulator

OPNET simulator is a tool to simulate the behaviour and performance of any type of network. It is a open free software Large number of project scenarios that are offered information on OPNET Network Simulator. OPNET simulator is Discrete event Simulation workflow.

3.2. Simulation Workflow

The general process of creating a simulation can be divided into several steps:

(a) Create/import topology or configuration: The topology of a network is defined as the manner in which nodes are arranged and connected.
(b) Create traffic: It is also possible to generate traffic based on the traffic characteristics rather than applications.
(c) Choose Statistics: To measure the performance of the applications, nodes and entire network, specify the timings for simulation runs.
(d) Run Simulation: To run the application and to change the duration and the speed for some scenarios.
(e) View Results: After the simulation, the data is available as a time-stamped event trace.
(f) Duplicate or create new scenario: To create more scenarios or duplicate scenarios after the first scenario is simulated.

(g) Publish Results: Raw or processed data collected in a simulation can be graphed in Result window.

3.3. Installing OPNET 14.5 and Visual Studio 2010:
3.3.1 Requirements
(a) Windows 7/8/10/Vista operating system
(b) Microsoft Visual Studio 2010
(c) Opnet 14.0.A included:
    -modeler_145A_PL8_7808_win
    -modeler_docs_02_Sep_2008_win
    -models_145A_PL8_24Sep08_win
(d) Crack file(license maker)
    -OPNET.Modeler.14.5. License. Maker-FFS

3.3.2 Procedure
(a) Insert the Visual Studio 2010 installation disk into the DVD-ROM drive.
(b) After inserting the drive, a window appears and progress bar runs. Click Install Visual Studio 2010 and Click Next.
(c) On the start page, accept license agreement and click Next.
(d) Select full features to install and choose the installation destination drive and size(6.4 GB minimum space is recommended), set the Path. Then click "Install".
(e) Automatically installed all the 40 components. It takes some time to install all the components.
(f) In the Finish page, click "Finish". Visual Studio 2010 installed successfully.
(g) Install and run the "modeler_145A_PL8_7808_win", set the path and check the three ACE Capture files.
(h) Install and run the "modeler_docs_02_Sep_2008_win", it completes the modeler documentation of OPNET.
(i) Install and run the "Models_145A_PL8_24Sep08_win" it completes the Model Library of OPNET.

4. RESULTS AND ANALYSIS
4.1. Simulation Parameters
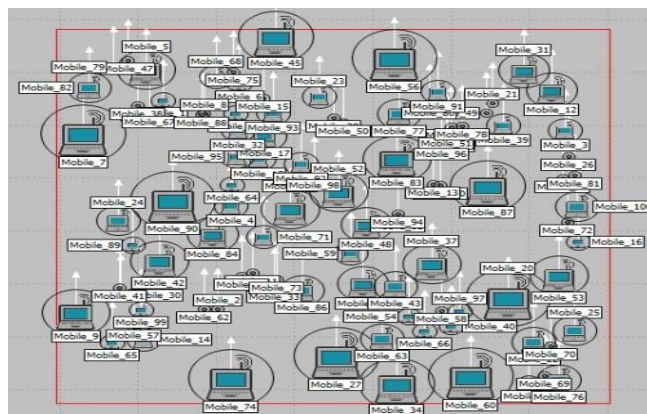The screenshot for simulation of 100 nodes is shown below:

Fig.1: Simulation of 100 nodes

The following simulation parameters used in this work are given below:

Table 1: Simulation parameters

Routing Protocol	AODV
Number of Nodes	10,20,30,40,50,60,70,80,90,100
Simulation Time	5 minutes
Simulation Area	500x400m
Propagation Model	Two-way ground reflection model
Traffic Model	TCP
Application Protocol	FTP
MAC Protocol	802.11
Antenna Direction	Omni

4.2. QoS metrics

The following simulation metrics are considered to estimate the performance of AODV under different network sizes.

4.2.1. Throughput (bits/sec): The amount of data actually received by the receiver from the sender divided by the time taken by the receiver to get the last packet. [12]

4.2.2. Delay (sec): The time taken for a packet to travel from a source to destination.[12]

4.3. Results and analysis of AODV protocol

The QoS metrics considered for simulation parameters are given below.

4.3.1. Throughput (bits/sec): It is found that the throughput is maximum for 100 nodes and is minimum for 20 nodes. The overall results of the throughput are shown in MS-Excel.
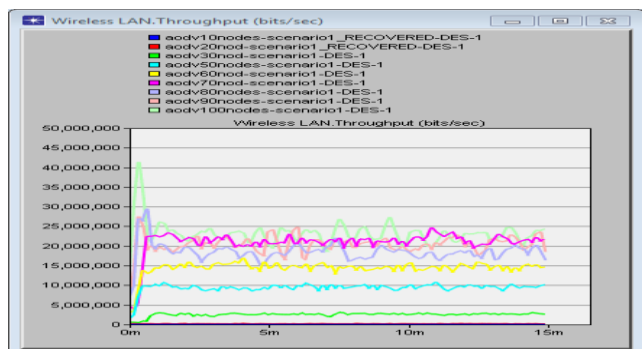
Fig. 2: Variations of Throughput with different
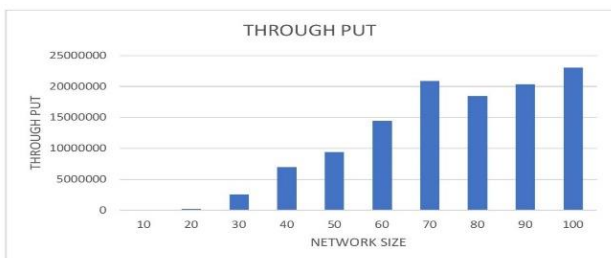
Number of nodes in OPNET

Fig. 3: Variations of Throughput with different number of nodes in EXCEL

4.3.2. Delay (sec): The variation of delay with different numbers of nodes is shown in figure. From the graph, it is found that the delay is maximum for 100 nodes and is minimum for 10 to 70 nodes. The overall results of the delay are shown in MS-Excel.
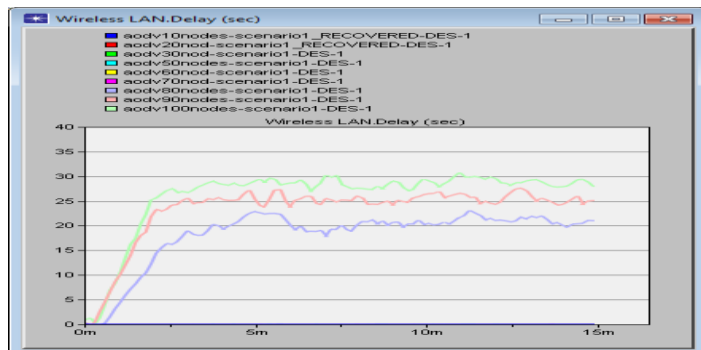
Fig. 4: Variations of delay with different number of Nodes in OPNET
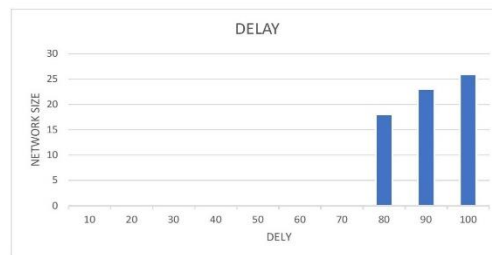
Fig. 5: Variations of Delay with different number Nodes in EXCEL

5. CONCLUSION

This paper provides the simulation of different network nodes namely 10, 20, 30, 40, 50, 60, 70, 80, 90 and 100. All the nodes are equipped with speeds ranging from 1 to 10 m/s. The simulator area is considered to be 500x400m.From the result it observed that the throughput is maximum for 100 nodes and minimum for 20 nodes. The delay is maximum for 100 nodes and is minimum for 10 to 70 nodes. For any network, the throughput should be more and delay should be low. It is concluded that this protocol lacks scalability from the results.

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