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Analyzing the impact of Simulation Area on the Performance of AODV, DSR, AOMDV and DSDV Routing Protocols for MANETS under Two-ray and Shadowing Propagation Models

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ABSTRACT

A Mobile Ad Hoc Network consists of mobile nodes which are move arbitrarily within the specified range. MANETs can be easily organized without the aid of any infrastructure. Due to the nature of shared resources performance of routing protocols and congestion control is a critical issue in mobile Ad hoc networks. In this paper we formulate different simulations using NS2 for Ad hoc networks of different sizes. This paper analyzed impact of Simulation area on the performance of some commonly used routing protocols under the radio propagation models Two-ray and shadowing. The performance metrics used are Throughput, End-to-End Delay and PDF (Packet Delivery Fraction). Simulation experiments found that the impact of dimension filed of mobile nodes shows significant changes on the performance AODV and DSR.

Keywords: MANET, NS2, PDF, TWO-RAY, SHADOWING

1. INTRODUCTION

A mobile ad-hoc network is a collection of mobile nodes forming an ad-hoc network without the aid of any centralized infrastructure. These networks introduced a new art of network establishment and these are established where the existing networks are collapsed due to natural calamities or where organization of an infrastructure network highly impossible [1]. Mobile ad-hoc networks can operate in a standalone fashion or could possibly be connected to a larger network such as the Internet.

Mobile ad-hoc networks can turn the vision of getting connected "everyplace and at every time" into reality. Typical applications are military or battle fields and disaster recovery, these networks may equally show better performance in other places. As an example, we can imagine a group of peoples with laptops, in a business meeting at a place where no network services is present. They can easily network their machines by forming an ad-hoc network. This is one of the many examples where these networks may possibly be used.

One of the major issues in MANET is its routing and routing characteristics. Unlike wired communication, wireless communication has some issues in terms of data transmission. The mobile ad hoc networks only consist of nodes equipped with transceiver. The network is formed to be autonomous from an infrastructure. Therefore, the nodes must be able to organize their own networks. Keep in mind that a node can now exchange data only with other nodes in its dimension only. In the infrastructure based wireless network, the nodes can communicate with a node, which is located in a different network area, by sending data to destination access point and this access point relay the data to the desired node.

To maintain and allocate network resources effectively and fairly among a collection of users is a major issue in MANETS. The resources shared mostly are the bandwidth of the links and the queues on the routers or switches. Packets are queued in these queues awaiting transmission. When too many packets are contending for the same link, the queue overflows and packets have to be dropped. When such drops become common events, the network is said to be congested.

2. LITERATURE SURVEY

A large number of studies have analyzed the performance of wireless networks. We summarize a representative sample of the existing work. Several studies have utilized measurements from production wireless networks to compute traffic models and mobility models. The primary focus of these studies is to analyze the impact of propagation models, mobility models and congestion on the performance of commonly used routing protocols like AODV, DSR, AOMDV and DSDV etc.

Rajneesh Kumar Gujral analyzed some of the widely used routing protocols with varying transmission range, mobility speed and number of nodes [4]. He focused on the analysis of varying a range of the transmission in terms of distance, mobility speed and number of nodes in the network. Parminder Kaur, performed various simulations in order to study the factors that cause congestion in an ad hoc wireless network. The main focus in his report is to simulate and study the effect of change in topology and number of users on network congestion [5]. Qian Wang and his team investigate several TCP-friendly congestion control mechanisms and sort them according to their implementation methods [6]. A.venkataramana and Dr.S.P.setty, investigates the impact of MAC layer protocols 802.11 and CSMA on AODV and DSR routing protocol for MANETS [11].. Madhuri Agrawal et al had done the performance analysis of various routing protocols by varying transmission rate and basic rate using NS-2[7].

The above studies do not offer an experimental evaluation, i.e. Network performance against the simulation area. Therefore the objective of this paper is to analyze the impact of radio propagation models and simulation area on the performance of routing protocols.

2.1 Radio Propagation Models

Radio channels are much more complicated to analyze than wired channels. Their characteristics may change rapidly and randomly. There are large differences between simple paths with line of sight (LOS) and those which have obstacles like buildings or elevations between the sender and the receiver (Non Line of Sight (NLOS)). To implement a channel model generally two cases are considered: large-scale and small-scale propagation models. Large scale propagation models account for the fact that a radio wave has to cover a growing area when the distance to the sender is increasing. Small scale models (fading models) calculate the signal strength depending on small movements or small time frames. Due to multipath propagation of radio waves, small movements of the receiver can have large effects on the received signal strength. In the following, four frequently used models for the ns-2 network simulator are described in more detail [8].

The Two Ray Ground model is also a large scale model. It is assumed that the received energy is the sum of the direct line of sight path and the path including one reflection on the ground between the sender and the receiver. A limitation in ns-2 is that sender and receiver have to be on the same height. It is shown that this model gives more accurate prediction at a long distance than the free space model [9].

The shadowing model of ns-2 realizes the lognormal shadowing model. It is assumed that the average received signal power decreases logarithmically with distance [10]. A Gaussian random variable is added to this path loss to account for environmental influences at the sender and the receiver.

3. ROUTING PROTOCOLS IN MANETS

Routing is the act of moving information from a source to a destination in an internetwork. At least one intermediate node within the internetwork is encountered during the transfer of information. Routing Protocols plays crucial role in MANETS [1]-[3]**.** Routing protocols for MANETs have been classified according to the strategies of discovering and maintaining routes into three classes: proactive, reactive and Hybrid. `

AODV stands for Ad hoc On-demand Distance Vector. It can be thought of as improved version of DSDV. The Ad hoc On-Demand Distance Vector protocol is both an on-demand and a table-driven protocol. The packet size in AODV is uniform but in case of DSR it is not uniform. In AODV, there is no need for system-wide broadcasts due to local changes. AODV supports multicasting and unicasting within a uniform framework. AODV minimizes the number of broadcasts by creating routes on-demand as opposed to DSDV that maintains the list of the entire routes. To obtain a path to the destination, the source broadcasts a RREQ packet. The neighbors in turn broadcast the packet to their neighbors till it reaches an intermediate node that has recent route information about the Destination or till it reaches the destination. The destination responds with RREP (Route reply) packet. A node discards a route request packet that it has already seen. The route request packet uses sequence numbers to ensure that the routes are loop free and to make sure that if the intermediate nodes reply to route requests, they reply with the latest information only. AODV uses RERR packets for informing errors in the network. The Network Simulator 2 consists of built in package for AODV.

DSDV stands for Destination-Sequenced Distance Vector. DSDV is a proactive routing scheme for mobile ad hoc networks. Each node maintains routing information for all known destinations Routing information must be updated periodically. The Destination-Sequenced Distance-Vector (DSDV) Routing Algorithm is based on the idea of the classical Bellman-Ford Routing Algorithm with certain improvements. DSDV is somewhat brute force approach, because connectivity information needs periodical update throughout the whole network. Sequence number is used to distinguish stale routes from new ones and thus avoid the formation of loops. DSDV guarantee Loop Freeness. It allows fast reaction to topology changes and makes immediate route advertisement on significant changes in routing table.

DSR stands for Dynamic source routing protocol. It is an on-demand protocol. It deploys source routing. It is designed to restrict the bandwidth consumed by control packets in ad hoc wireless networks by eliminating the periodic table-update messages required in the table-driven approach. DSR includes source routes in packet headers Resulting large headers can sometimes degrade performance, particularly when data contents of a packet are small. In DSR each node catches the specified route to destination during source routing of a packet through that node. This enables the node to provide route specification when a packet source routes from that node. The error packet is sent by reverse path in case it is observed by a router. DSR also user three types of packets like AODV [2]. The major difference between DSR and other on-demand routing protocols is that it is beacon-less and hence does not require periodic hello packet (beacon) transmissions, which are used by a node to inform its neighbors of its presence.

AOMDV stands for Ad hoc On-demand Multipath Distance Vector routing. AOMDV is an extension to the AODV protocol for computing multiple loop-free and link disjoint paths. The routing entries for each destination contain a list of the next-hops along with the corresponding hop counts. All the next hops have the same sequence number. This helps in keeping track of a route. For each destination, a node maintains the advertised hop count, which is defined as the maximum hop count for all the paths, which is used for sending route advertisements of the destination. Each duplicate route advertisement received by a node defines an alternate path to the destination.

4. SIMULATION ENVIRONMENT

Table 1: Simulation Parameters

Routing Protocols	AODV,DSR,AOMDV,DSDV
Simulation Time	300s
Area (sq.m)	500 x 500, 1000 x 1000 & 1500 x 1500sqm.
Propagation Model	Two Ray, Shadowing
Traffic	FTP
Packet Size	2048 MB
Nodes	5,10,15,20
Antenna Type	Omni directional
Transmission range	200m
Receiver range	200m
Pause time	0 sec
Min &Max speed	1 m/s to 10 m/s
Queue size	50
Mobility Model	Random Waypoint
MAC	802.11

The simulation study is done by using worldwide accepted simulator NS-2. NS2 is widely recognized and improved network simulator for Mobile Ad-hoc Networks (MANETs). Simulation environment was showed in Table 1. All simulations are performed for various network regions like 500m x 500, 1000m × 1000m and 1500 x 1500sqm consisting of different node density (5, 10, 15 and 20nodes), distributed randomly over the two-dimensional grid. The source destination pairs are randomly chosen from the set of nodes in the network. We consider transmission rate 3m/s, in our simulations all with pause time of 0. Pause time 0 means each node moves constantly throughout the simulation. TCP packet size of 2048 Mb and radio propagation models are two ray ground and shadowing are used in our analysis. Figure 1 shows the start of simulation for DSR with 20 nodes.

The queue sizes are set to 50 packets to avoid frequent drop of packets due to buffering. We measured the performance metrics Throughput, End-to-End delay and Packet delivery fraction for predicting the congestion in the network.

4.1 NS2: Network simulator is a simulation tool which simulates the Network architecture, protocols, and their functioning. In NS2 we can Create Network Topologies and Analyze events to understand the network behavior. NS2 contains NAM. NAM stands for Network Animator. It is an animation tool compatible with NS2. NAM has the capability to show the designed network and topology of the program designed in NS2. It enables the user to see the change in packet flow, packet drop, congestion, and all other packet level details.

NS2 implements different network protocols (TCP, UDP), traffic sources (FTP, web, CBR, Exponential on/off), queue management mechanisms (RED, Drop Tail), routing protocols (Dijkstra) etc. NS2 is written in C++ and OTCL to separate the control and data path implementations.

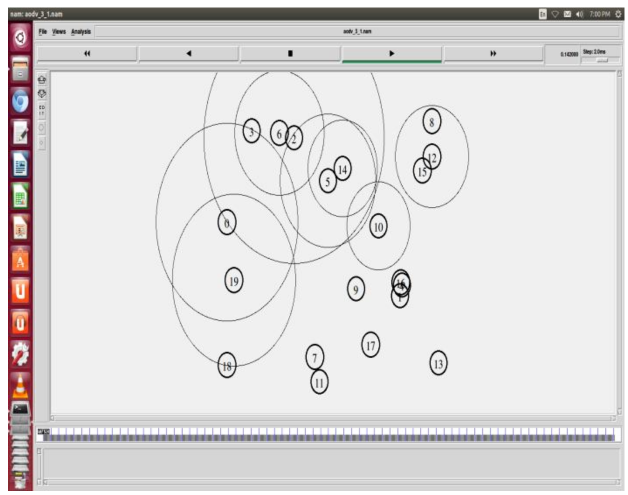

Figure 1: Start-of-simulation for DSR- with 20 nodes

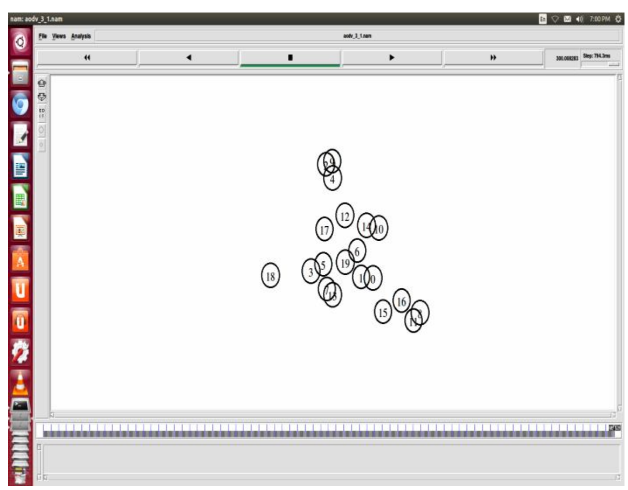

Figure 2: End-of-simulation for DSR- with 20 nodes

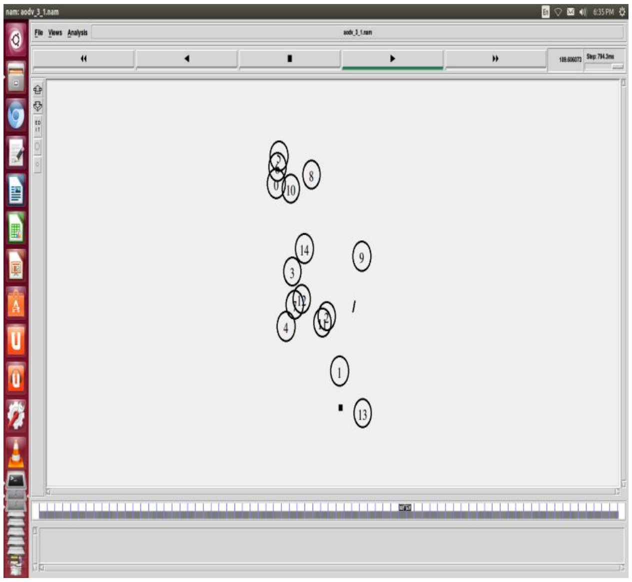

Figure 3: Middle-of-simulation for DSR- with 15 nodes

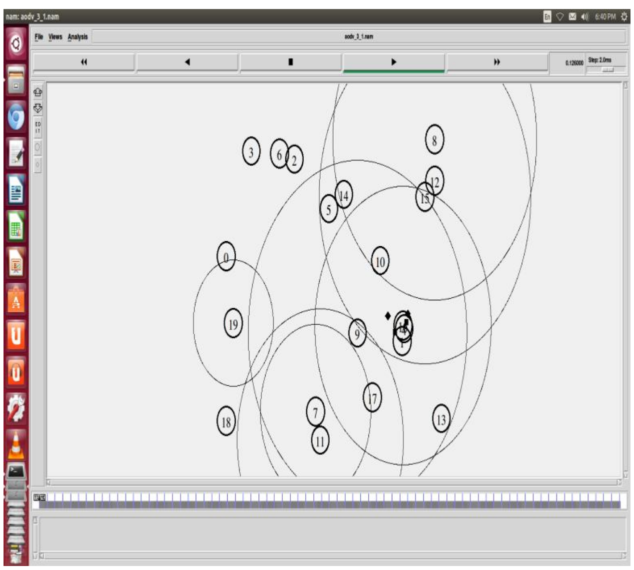

Figure 4: Start-of-simulation for AOMDV-with 20 nodes

5. RESULTS AND DISCUSSIONS

5.1. Results for Throughput: Throughput is the average rate of successful packets delivered over a communication channel. From simulation results and figure: 5 for AODV, as the simulation area increases the variance in throughput is less in shadowing model when compared to Two-ray model, i.e. in Two ray model when the network size is 5 and simulation area is increases from 500 x 500 to 1500 x 1500 sqm, throughput was decreased from 2038.23 to 1953.37, Where as in shadowing model for the same scenario the throughput is increased from 1888.25 to 1949.25. In case of AOMDV and DSDV in both two ray and Shadowing models as the simulation area increases throughput decreases. In case of DSR impact is less on simulation area under both models. Figure 5 shows throughput for the four routing protocols.

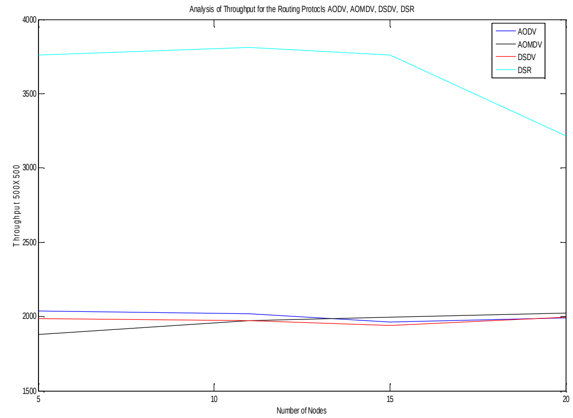

Figure 5: Analysis of Throughput for AODV, AOMDV, DSDV, DSR with 500 x 500sqm.

5.2 Results for End-to-End Delay: Average End-To-End Delay (AE2E Delay): This is defined as the average delay in transmission of a packet between two nodes. From simulation results and figure 6 for AODV and AOMDV, as the simulation area increases throughput was decreased in both Two-Ray and Shadowing models. i.e., for AODV with network size 11, the delay is 82.0757, 87.1249, 93.7851 for simulation areas 500 x 500, 1000 x 1000, and 1500 x 1500 sqm respectively. In case of DSR with 20 nodes, the delay is minimum (87.541) in Two ray model when simulation area is 1000 x 1000sqm, in case of shadowing model the delay is minimum at (35.3803) simulation area 500 x 500 sqm. In case AOMDV delay is maximum when Simulation Area is 1500 x 1500 sqm in Two ray model with network size 15., and delay is minimum at 500 x 500 sqm for the same scenario in shadowing model. Figure 6 shows results of Average End-to-End Delay.

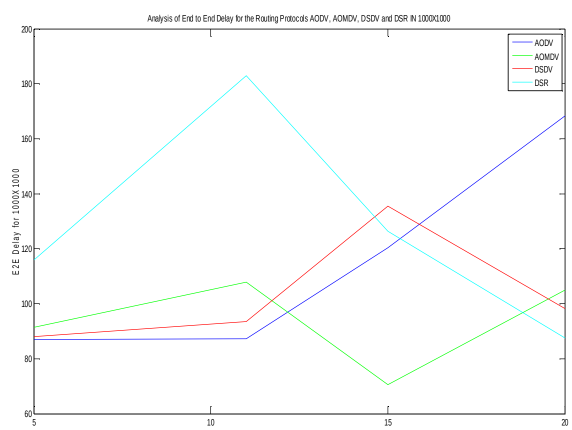

Figure 6: Analysis of End-to-End Delay for AODV, AOMDV, DSDV, and DSR with 500 x 500sqm.

5.3 Packet Delivery Fraction: PDF can be defined as fraction of number of packets received by sent. Figure 7 indicates that for all four protocol packet delivery fraction increases with simulation area under both two ray and shadowing models. For example in case DSR with node size 20, the values of packet delivery fraction is as follows 0.9743, 0.9968, 0.9990 for simulation areas 500 x 500, 1000 x 1000, 1500 x 1500 sqm respectively. Figure 7 shows PDF results.

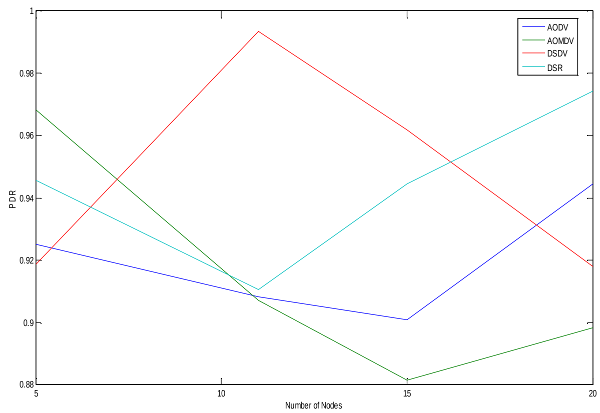

Figure 7: Analysis of Packet Delivery Fraction for AODV, AOMDV, DSDV, DSR at 500 x 500

6. CONCLUSIONS

This paper analyzes the impact of Simulation area on the performance of the routing protocols AODV, DSR, AOMDV AND DSDV under two ray and shadowing propagation models. Simulations are carried out using NS-2 simulator. From simulations results we found that impact of simulation area shows significant changes on the performance of routing protocols, i.e. by varying simulation areas from 500 x 500sqm to 1000 x 1000sqm and 1500 x 1500sqm we found change in performance of protocols in terms of throughput, Average End-to-End delay and Packet Delivery Fraction. In this paper we also found that propagation models two ray and shadowing shows some impact on the performance of protocols. This work can be extended by analyzing the impact of offer load on the performance of protocols to predict the congestion in the network.

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Mr.Venkataramana Attada is a Research scholar in the Department of Computer Science and Systems Engineering of Andhra University, under the supervision of Prof. S. Pallam Setty. He received his M.Tech (CST) from Andhra University and presently working as Associate Professor in IT Department of GMR Institute of Technology. He is Life Member of CSI and ISTE. He has presented more than 10 papers in various national and International Conferences.

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