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Performance Study of AODV with Variation in Simulation Time and Network Size

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Abstract - Adhoc network is network of mobile nodes without any infrastructure or centralised access point. In mobile adhoc networks (MANETs) nodes are connected by wireless links which forms a temporary network. These networks have dynamic topology, high node mobility, low channel bandwidth and limited battery power. Routing is one of the major challenges in MANETs which becomes more difficult when the network size increases. Routing protocol plays an important role in transferring the data to the destination. In this paper, the effect of network size and simulation time on the performance of AODV routing protocol under 802.11 is analysed. Qualnet Network Simulator is used to study the performance of the protocol with the metrics such as packets delivered, throughput, end-to-end delay and jitter. The results are compared for the networks without and with mobility of nodes.

Keywords- MANET, Mobility, Network size, AODV, Qualnet

I. INTRODUCTION

Wireless networks are becoming more common in many places including college campuses, offices, and hotels, etc. Wireless networks may be: a) infrastructure networks, and b) infrastructure-less networks. Infrastructure networks (also called cellular networks) have fixed and wired gateways (base stations or bridges) capable of establishing routes for transfer of data packets among nodes. Gateways act as interface between wired environments and wireless environments. Infrastructure-less networks (called Mobile Adhoc Networks) do not have fixed infrastructure. In MANETs nodes can move randomly in any direction with any speed and hence, the network topology is highly dynamic. Nodes are responsible for discovering, establishing and maintaining routes among communicating nodes [1]. Routing the data is one of the major challenges in MANETs and becomes more difficult with increase in network size. Hence, routing protocol must transfer data efficiently with the help of limited resources. This has created great interest in researches to design new routing protocols for MANETs [2]. In this work, the effect of simulation time and the network size on the performance of AODV protocol under 802.11 standards is carried out.

II. ROUTING PROTOCOLS IN MANETS

Several routing protocols have been proposed for MANETs. These can be classified into different categories based on different criteria. Based on the technique used for updating routing information (i.e. the way they react to the changes in network topology) they are classified into three major categories: i) proactive (also known as table-driven) protocols, ii) reactive (known as source initiated or demand-driven) protocols and iii) hybrid protocols. Based on the role of routing nodes and the organization of the network, routing protocols are classified into flat protocols and hierarchical protocols [8].

Proactive protocols maintain consistent up-to-date routing information from each node to every other node in the MANET. The nodes need to maintain one or more tables which contain latest routing information. If there is a change in network topology that has to be included by broadcasting updated information throughout the network in order to maintain consistent routing information. Optimized Link State Routing protocol (OLSR), Destination Sequenced Distance-Vector routing protocol (DSDV), and Wireless Routing Protocol (WRP) are the examples of proactive protocols.

Reactive or on-demand routing protocols are source-initiated, which do not maintain or constantly update their routing tables with the latest route topology. In this type of routing routes are created only when there is a need by the source node. When a node requires a route to a destination, it initiates a route discovery process within the network. It will be completed when one or more routes are established or all possible route permutations have been tested. The main motivation in designing on-demand protocols is to reduce large amount of overhead for maintaining the routing table in the table-driven protocols in the dynamic MANET and hence they are widely used. AODV, DSR, TORA, DYMO are examples of reactive protocols.

Hybrid routing protocols have combined the advantage of both proactive and reactive routing protocols to balance the delay and control overhead. The main disadvantage of hybrid routing protocols is that the nodes which have high level topological information maintain more routing information that leads to more memory and power consumption [7]. The most typical hybrid routing scheme is zone routing protocol (ZRP).

A. Adhoc On Demand Distance Vector Protocol (AODV):

AODV is an on-demand routing protocol which borrows route establishment and maintenance mechanisms from DSR [6] (Dynamic Source Routing) Protocol and sequence numbers and hop-to-hop routing from DSDV (Destination Sequenced Distance Vector) protocols. Route information in AODV is calculated on demand. Like DSR, it uses route discovery process. However, AODV maintains a routing table where it maintains one entry per destination unlike the DSR that maintains multiple route cache entries for each destination. AODV provides loop free routes while repairing link breakages but unlike DSDV, it doesn't require global periodic routing advertisements [3, 4].

III. RELATED WORK

Comparison of AODV and DSR was done [9] for packet transmission to variation of simulation time. It is found that AODV protocol performs much better than DSR protocol. Authors in [10] compared AODV and DSDV protocols and they observed that AODV is better than DSDV in almost every aspect. Authors in [11] compared the performance of AODV, OLSR and TORA using NS2 (Network Simulator version2). The result shows that AODV performs better in PDF and throughput compared to OLSR and TORA. However TORA performs better than OLSR and AODV related to end-to-end delay metrics. Comparison of AODV, DSDV and DSR routing protocols [12] was done using NS-2 and the result shows that AODV performs better than other two protocols.

IV. METHODOLOGY

In this work, we have used Qualnet Network Simulator to design the scenario, simulate it and analyze the results.

A. Simulation Environment

Using the simulator in architect mode, scenario was designed with sensor nodes distributed randomly in the terrain size of 1500 x 1500 square meters. The network size was varied. A CBR (Constant Bit Rate) application was chosen with AODV protocol for routing. CBR is the data traffic which maintains the same bit rate throughout the process. Simulation time was changed for each network size. Different scenarios were designed with static nodes and mobile nodes. Performance study for both the cases was carried out with variation in simulation time and network size. Simulation parameters are given in the following Table-I.

Table-I: Simulation Parameters

Parameters	**Values**
Area of the network	800 x 800m^2 1500 x 1500 m^2
Network size (nodes)	25, 50, 100, 150, 200, 250, 300
Mobility Model	Random Way Point
Maximum Speed	10 m/s
Pause time	10 seconds
Protocol used for study	AODV
MAC type	802.11
Traffic type	CBR
Item size	512 Bytes
Simulation time (minutes)	10, 15, 20, 25, 30
Antenna	Omni-directional

V. RESULTS AND ANALYSIS

A. Throughput

It is the ratio of the total amount of data received from the source to the time it takes for the receiver to get the last packet. It is usually measured in bits per second (bps), and sometimes in data packets per second. Better value of throughput indicates better performance of the routing protocol. Variation of Throughput with simulation time and network size is shown in Fig. 1(a) and (b). It is observed that throughput for the scenario *without mobility* less with smaller network size and becomes constant with increase in network size. The simulation time does not have much effect on the throughput. Whereas in the case of scenario *with mobility*, the graph shows that throughput is fairly constant for lower simulation time. With increase in simulation time and network size, initially shows low value and becomes closer for larger network.

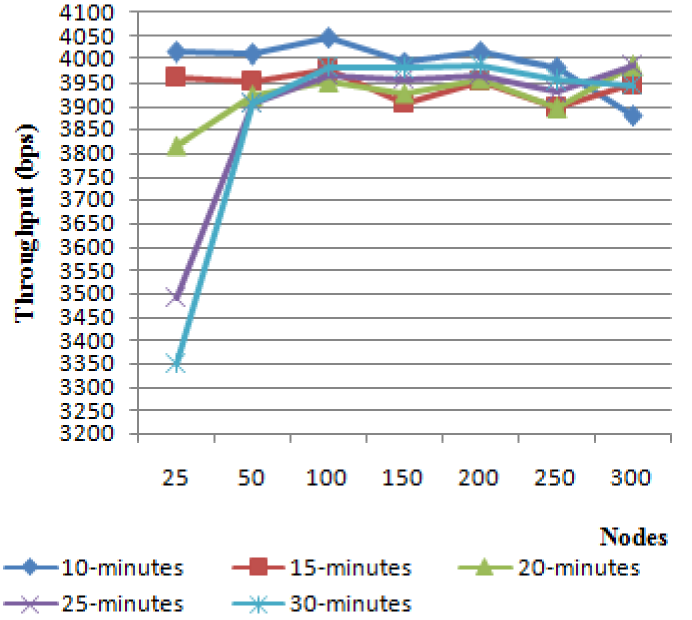

Fig.1(a) Throughput with mobility

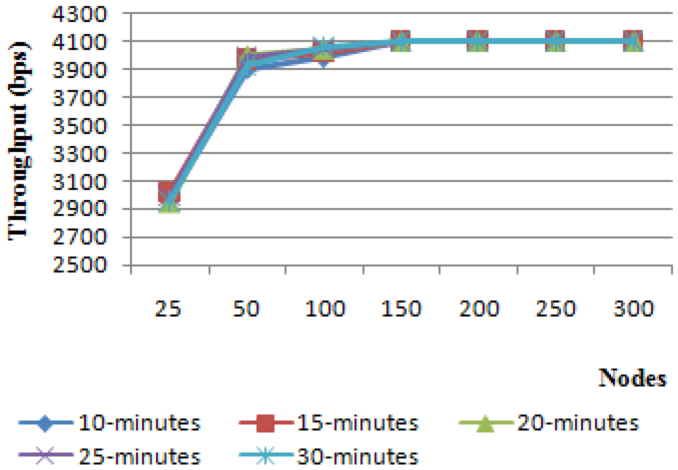

Fig. 1(b) Throughput without mobility

B. Average end-to-end delay

When packets transferred from source to sink, there are various delays involved. These delays include buffering during route discovery process, queuing at the interface queue, retransmission delays at MAC layer, propagation and transfer times delay. If the time difference between every CBR packet sent and received is recorded; dividing the total time difference over the total number of CBR packets received will give the average end-to-end delay for the received packets. The lower the end-to-end delay, the better is the performance of the protocol [13]. The variation of end-to-end delay is shown Fig.2 (a) and (b). For network *without mobility*, it is initially higher and decreases with increase in network size and becomes constant. Whereas *with mobility*, decreases and shows fairly closer values for larger network size. The variation in simulation time does not have much effect with increase in node density.

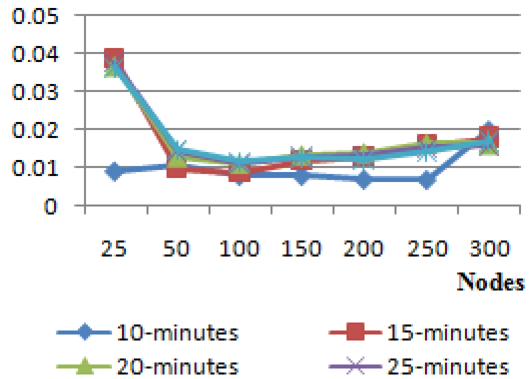

Fig. 2(a) Average end-to-end delay (sec) with mobility

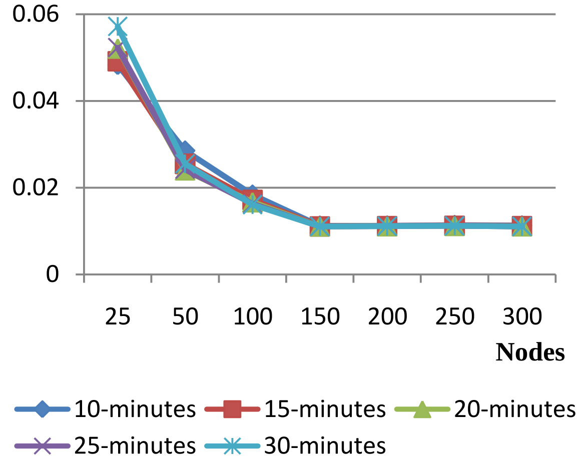

Fig. 2(b) Average end-to-end delay (sec) without mobility

C. Average Jitter

Jitter is the variation of the delay in packets arrival. If Jitter is low, better is the performance of routing protocol. It is caused due to congestion, topology change etc., in the network. Fig. 3(a) and (b) depict the average jitter. For the scenario *without mobility* it is higher for lower network size. Then decreases and becomes constant with increase in network size. Whereas in the case of network *with mobility*, it is higher for smaller network size and then decreases with rise in network size. It shows small variation as the simulation time is changed.

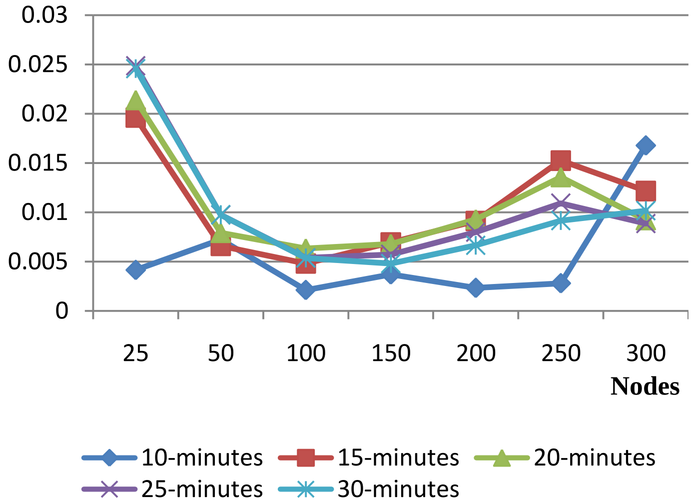

Fig. 3(a) Average Jitter (sec) versus Network size with mobility

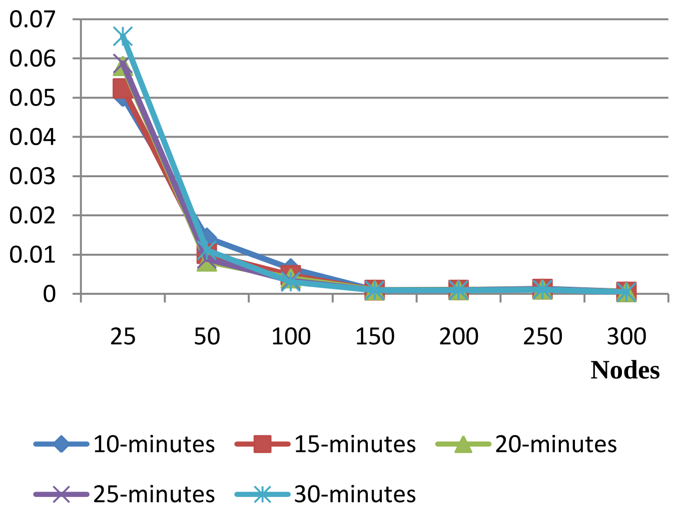

Fig. 3(b) Average Jitter (sec) versus Network size with No mobility

D. Packets Delivered

Fig. 4(a) and (b) shows the total packets delivered to the destination. Higher value measures better performance of the protocol. It gives better packet delivery fraction. For both the scenarios, it shows constant value with increase in network size for all the values of simulation time.

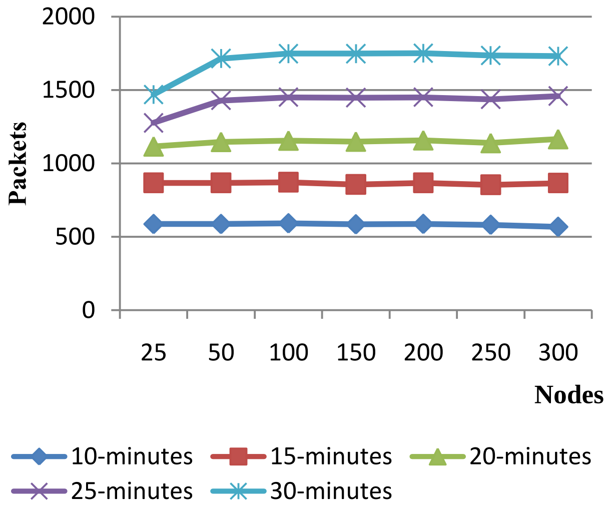

Fig. 4 (a) Packets delivered versus network size with mobility for different Simulation time

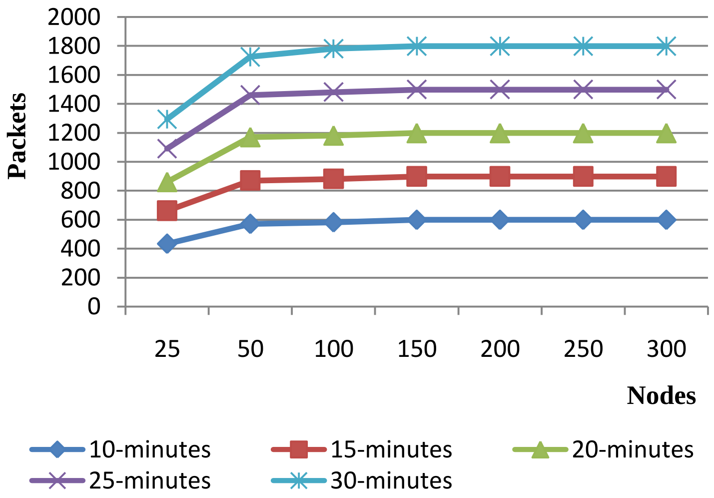

Fig. 4 (b) Packets delivered versus network size without mobility for different Simulation time

VI. CONCLUSIONS

In this paper, we have evaluated the performance of AODV protocol under 802.11 standards using Qualnet Network simulator. The results are compared for the scenarios with and without mobility of the nodes. The effect of network size and simulation time on the performance of the protocol is analysed. It shows better performance with increase in network size. In the future work, link failure and error analysis will be carried out.

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