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Performance Analysis of Ad hoc On-Demand Distance Vector Protocol for MANET

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Abstract-A mobile ad hoc network (MANET) is temporary organized wireless network that does not require the services of any networking infrastructure such as base stations or routers. Ad hoc On-demand Distance Vector Routing (AODV) is a novel routing protocol for the operation of MANETs. Each mobile node operates as a specialized router and routes are obtained as needed i.e. on-demand with little or no reliance on periodic advertisements. In this paper, we carry out the performance analysis of AODV protocol over networks of different size using the OPNET simulator. The performance metrics selected for this analysis are Total Traffic Received, Traffic Load and Throughput. The simulated results show that AODV is an effective and efficient routing protocol for all forms of ad-hoc mobile networks.

Keywords— Throughput, TCP, AODV, OPNET, MANET

1. INTRODUCTION

An ad hoc network is an instantly deployable wireless network that does not require the services of any networking infrastructure such as base stations or routers. A key feature of these networks is their ease of deployment that makes it ideally suitable for battlefield, search and rescue and disaster relief operations. A Mobile Ad hoc Network (MANET) [1] is a set of wireless mobile nodes forming a dynamic autonomous network. Nodes communicate with each other without the intervention of centralized access points or base stations. In such a network, each node acts both as a router and as a host. Due to the limited transmission range of wireless network interfaces, multiple hops are needed to exchange data between nodes in the network. Figure 1 shows an example of an ad hoc network, where there are numerous combinations of transmission areas for different nodes. From the source node to the destination node, there can be different paths of connection at a given point of time. But each node usually has a limited area of transmission as shown in Figure 1 by the oval circle around each node. A source can only transmit data to node B but B can transmit data either to C or D. It is a challenging task to choose a really good route to establish the connection between a source and a destination so that they can roam around and transmit robust communication.

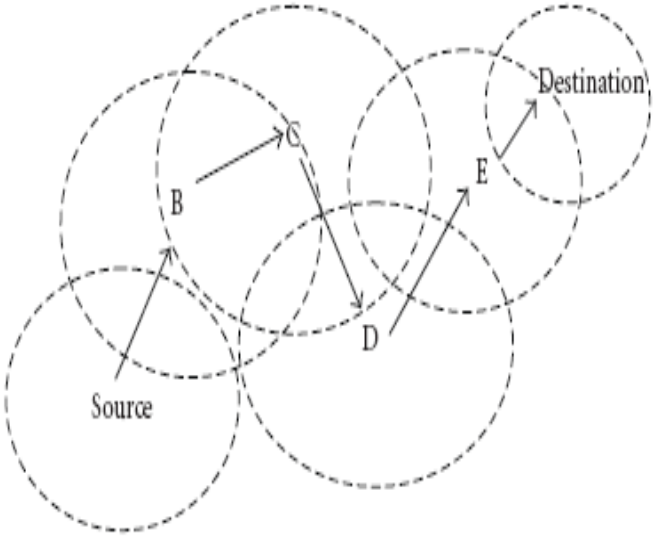

Figure 1 Mobile Ad-hoc Network

Ad hoc On-demand Distance Vector routing (AODV) [2],[3],[4] is one of the most popular reactive type of MANET protocols. In this paper, we carry out the performance analysis of AODV protocol over networks of different size using the OPNET simulator. We take different networks of size 20,50,100,150 and 200 nodes. The performance metrics selected for this analysis are as follows:

1. Total Traffic Received
2. Traffic Load
3. Throughput.
4. Number of Hops per Route
5. Route Discovery time

This analysis was done using the MANET model in OPNET simulator [5]. OPNET Simulator is the industry's leading simulator specialized for network research and development. It allows to design and study communication networks, devices, protocols, and applications with great flexibility. Section 2 presents the mobile ad hoc routing protocols categories. The overview of AODV routing protocols is given in section 3. Section 4 describes the Simulation environment. Simulation results and analysis are presented in Section 5. Finally section 6 summarizes the work.

2. MOBILE AD-HOC NETWORK ROUTING PROTOCOLS

There are many ways to classify the MANET routing protocols. Depends on how the protocols handle the packet to deliver from source to destination, most of the protocol classifications are made as [6],[7],[8],[9].

A. Proactive Routing

These types of protocols are called table driven protocol. In the routing, the route is predefined. Packets are transferred to that predefined route. In this scheme, packet forwarding is faster but routing overhead is greater because one has to define all of the routes before transferring the packets. Proactive protocols have lower latency because all routes are maintained at all the times. Examples of proactive are DSDV (Destination Sequenced Distance Vector), OLSR (Optimized Link State Routing).

B. Reactive Routing

These types of protocols are called On Demand Routing Protocol. In the routing, the routes are not predefined. A node calls for route discovery to find out a new route when needed. This route discovery mechanism is based on flooding algorithm which employs on the technique, a node just broadcasts the packet to all of its neighbors and intermediate nodes just forward the packet to their neighbors. This is a repetitive technique until reaches to destination; reactive techniques have smaller routing overheads but higher latency because a route from node A to node B will be found only when A wants to send to B. Examples of Reactive are DSR, AODV, TORA.

C. Hybrid Routing

Hybrid protocols are the combinations of reactive and proactive protocols. It takes advantages of these two protocols and as a result, routes are found very fast in the routing zone. ZRP (Zone Routing Protocol) is an example of Hybrid protocol.

3. MOBILE AD HOC ROUTING PROTOCOL

AODV routing protocols has been used for the present analysis. AODV can be called as a pure on-demand route acquisition system because nodes do not lie on active paths neither maintain any routing information nor participate in any periodic routing table exchanges. Hello messages may be used to detect and monitor links to neighbors. If Hello messages are used, each active node periodically broadcasts a Hello message that all its neighbors receive. Because nodes periodically send Hello messages, if a node fails to receive several Hello messages from a neighbor, a link break is detected. When a source has data to transmit to an unknown destination, it broadcasts a Route Request (RREQ) for that destination. At each intermediate node, when a RREQ is received a route to the source is created. If the receiving node has not received this RREQ before, is not the destination and does not have a current route to the destination, it rebroadcasts the RREQ. If the receiving node is the destination or has a current route to the destination, it generates a Route Reply (RREP). The RREP is unicast in a hop-by-hop fashion to the source. As the RREP propagates, each intermediate node creates a route to the destination. When the source receives the RREP, it records the route to the destination and can begin sending data. If multiple RREPs are received by the source, the route with the shortest hop count is chosen. As data flows from the source to the destination, each node along the route updates the timers associated with the routes to the source and destination, maintaining the routes in the routing table. If a route is not used for some period of time, a node cannot be sure whether the route is still valid; consequently, the node removes the route from its routing table. If data is flowing and a link break is detected, a Route Error (RERR) is sent to the source of the data in a hop-by-hop fashion. As the RERR propagates towards the source, each intermediate node invalidates routes to any unreachable destinations. When the source of the data receives the RERR, it invalidates the route and reinitiates.

4. SIMULATION ENVIRONMENT

It is very difficult to estimate the performance of a network in real life and as a result, many network simulators have been proposed to design and simulate networks in many perspectives. In the paper, simulation is performed on OPNET simulator [2]. In the simulation, a 400 x 400 meters square geographical area is selected with varying number of MANET workstations where 40% of the total nodes are source-destination pairs. One third of the total nodes in any scenario are mobile nodes,

moving according to Random Waypoint Mobility Model [11]. A predefined trajectory "manet_down_left" is used in every network. Each mobile node waits for 260 seconds and starts moving along the path defined in the trajectory. The rest of the nodes are stationary nodes. Many different networks of different size like 20, 50,100,100 and 200 nodes are taken to make the different scenarios. Sources start traffic generations exponentially at 100 seconds and continue till the end of the simulations. The performance metrics selected to make the performance differences are: Total Traffic Received, Traffic Load, Throughput, Number of Hops per Route and Route Discovery time and simulation parameters is given table 1.

Parameters	**Values**
Simulator	OPNET
Simulation time	30 minutes
Simulation area	400 x 400
Node movement model	Random Waypoint
Speed	128
Values Per Statistics	100
Update interval	500000 events
Traffic type	TCP

Table 1 Simulation Parameters

5. RESULTS AND ANALYSIS

This section presents the results and observations for AODV routing protocol by varying the size of networks on the basis of the earlier mentioned performance metrics.

A. Total Traffic Received

Based on Traffic Received for different number of nodes of AODV networks, figure 2 shows that, as number of nodes increase, the packet received per second will also increase. After 15-18 minutes, every curve is getting a steady state condition.

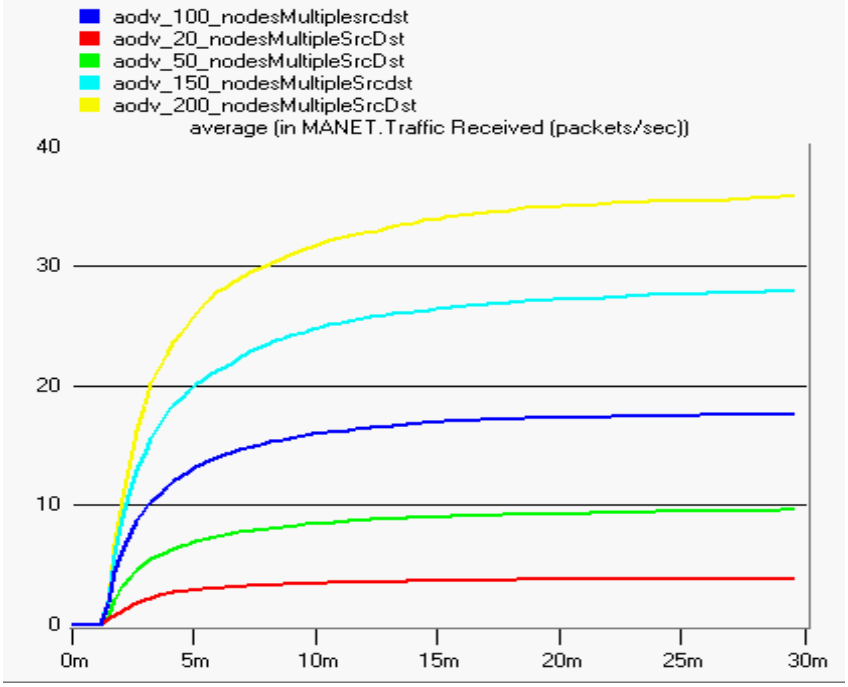

Figure 2 Total Traffic Received for different loads of AODV networks

B. LAN Load and Throughput

Figure 3 and 4 show loads and throughputs of different AODV networks. It can be observed that with increasing the number of nodes, loads and throughputs will also increases. For 200 nodes, throughput is much higher than that of 20 nodes network.

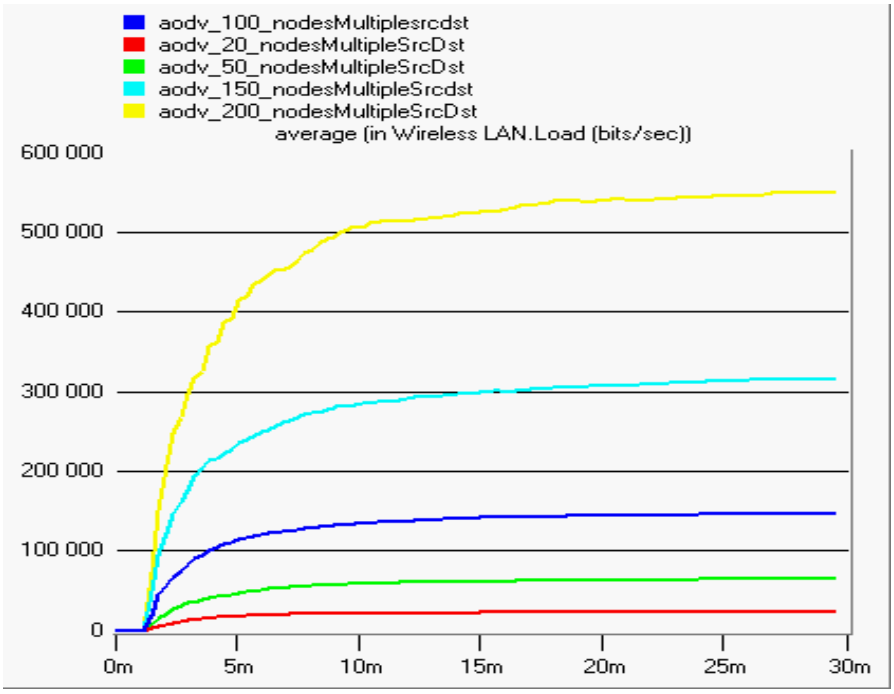

Figure 3 LAN load for different loads of AODV networks

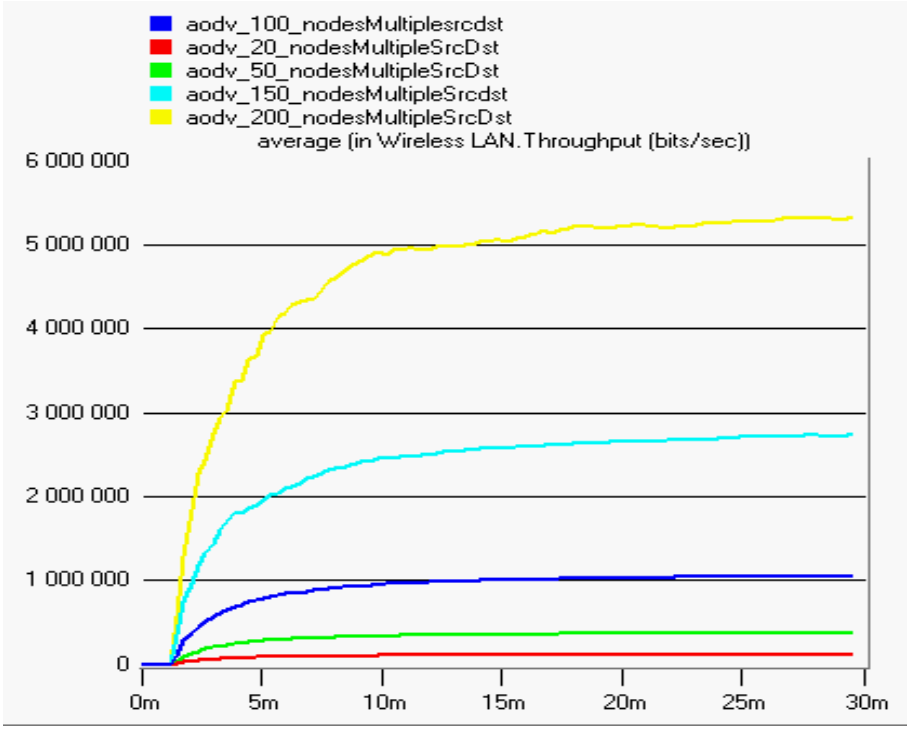

Figure 4 Throughput for different loads of AODV networks

C. Average Number of Hops and Route Discovery Time

Figure 5 and 6 show required number of hops per route and route discovery time for AODV. For every network, in the beginning of simulation, there is a peak for number of hops because of route discovery and after that, the number of hops ranging between 1 and 2.

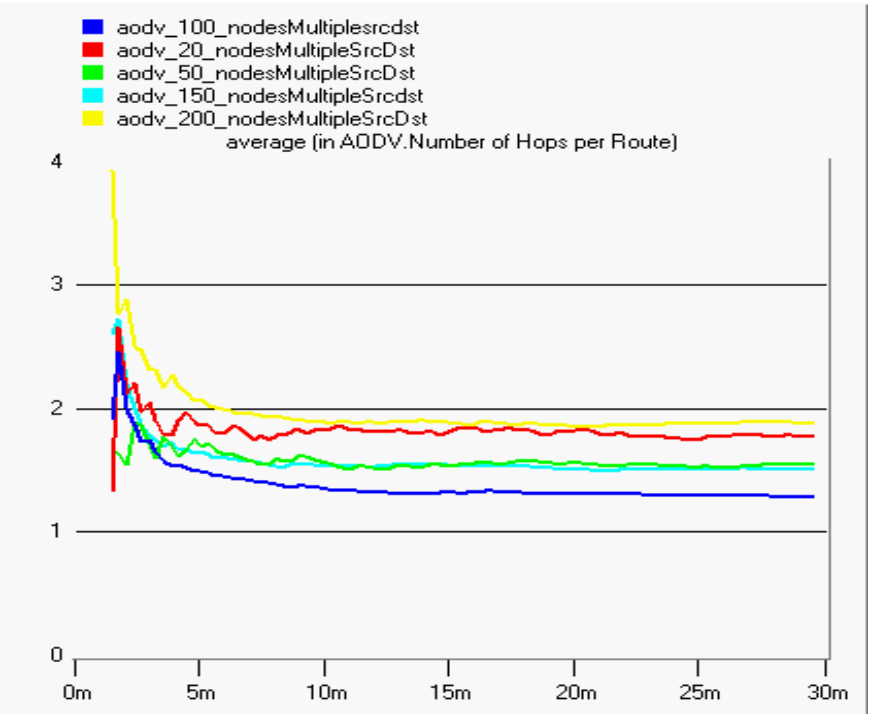

Figure 5 Average Number of Hops for different loads of AODV networks

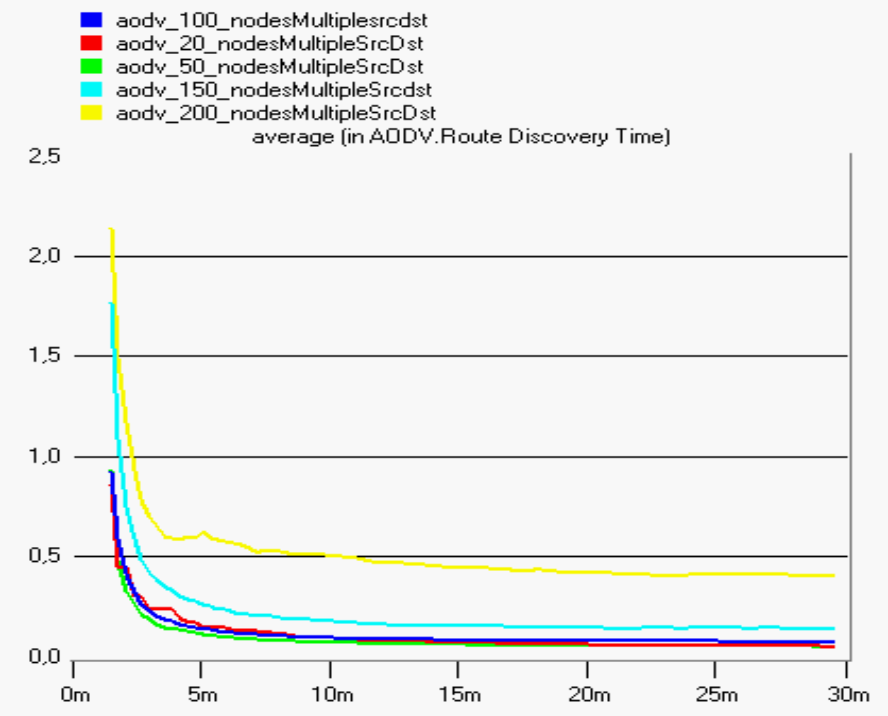

Figure 6 Average Route Discovery Time for different loads of AODV networks

6. CONCLUSION

AODV protocol is one of the most popular reactive type of MANET protocols. In this paper, we carry out the performance analysis of AODV protocol over networks of different size using the OPNET simulator. We take different networks of size 20, 50,100,150 and 200 nodes. Several simulations were performed to investigate the behavior AODV protocol with different parameters. After several simulations, it has been observed that the performance of AODV remains stable, for low node density as well as in the high node density. As the number of nodes in AODV network increased, the packet received per

second, LAN load and throughput is also increased and after a certain limit they becomes stable due to increase in end-to-end delay. It was found that with high node mobility, route failure occurs more frequently, and AODV will cause flooding of large number of route finding packets. In future, this protocol should be tested for real data set. In addition behavior of AODV protocol is to be investigated with mobility models such as Point Group Mobility model which represents multiple MANETs moving together and similar swarm based clustering.

REFERENCES

[1]. Internet Engineering Task Force (IETF) Mobile Ad Hoc Networks (MANET) Working Group Charter, Chaired by Joseph Macker and Scott Corson, http://www.ietf.org/ html.Charters/manet -charter.html

[2]. C. Perkins, E. Belding-Royer and S. Das, "Ad hoc On-Demand Distance Vector (AODV) Routing," IETF RFC, 3561, July 2003

[3]. C.E Perkins, E.M Royer " Ad-hoc on-demand distance vector routing" Mobile Computing Systems and Applications Proceedings, pp: 90 –100, 1999

[4]. G. Jayakumar, G. Ganapathy, "Performance Comparison of Mobile Ad-hoc Network Routing Protocol," International Journal of Computer Science and Network Security (IJCSNS 2007), vol. 7, no. 11, November 2007, pp. 77-84

[5]. M. W. Subbarao, "Ad Hoc networking Critical Features and Performance Metrics" Wireless Communications Technology Group, NIST, 7th October, 1999.

[6]. Network Simulator, OPNET Modeler 10.5, available at http://www.opnet.com/

[7]. E. M. Royer, C. K. Toh, "A Review of Current Routing Protocols for Ad- Hoc Mobile Wireless Networks", IEEE Personal Communications Magazine, April 1999, pp. 46-55.

[8]. A. Boukerche, "A performance comparison of routing protocols for ad hoc networks", 15th International Symposium on Parallel and distributed Processing, April 2001, pp. 1940-1946.

[9]. X. Zou, B. Ramamurthy, S. Magliveras, "Routing Techniques in Wireless Ad Hoc Networks – Classification and Comparison" Sixth World Multiconference on Systemics, Cybernetics and Informatics, SCI, July 2002.

[10]. J. Svedlund, J. Köpman, Master thesis, "Routing protocols in wireless adhoc networks – An implementation study", Uppsala University, Sweden.

[11] W. Navidi and T. Camp, "Stationary Distributions for the Random Waypoint Mobility Model", Technical Report MCS-03-04, the Colorado School of Mines, April 2003

