Analysis of AODV Routing Protocol for Minimized Routing Delay in Ad Hoc Networks

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***Abstract* — Ad hoc wireless networks consists of mobile terminals communicating directly with other mobile terminals without any pre existing infrastructure. In Ad hoc network each mobile terminal acts as a router to enable multi hop communication. Reactive routing protocols are used to discover routes when a mobile terminal wants to establish communication link with another terminal in the network. AODV and DSR are popular reactive protocol extensively studied. In this paper we investigate the efficiency of AODV routing protocol in a bandwidth constrained network by toggling the destination only flag in the AODV header. The throughput is studied and evaluated.**

Keywords-component; Ad hoc network, AODV, routing,

I. INTRODUCTION

Wireless network are increasingly becoming popular and has enabled communication between mobile devices using standard network protocols. Wireless networks can be broadly classified into Access point networks and Ad hoc networks. In access point, wireless network uses an access point or base station, which acts as hub providing connectivity between different nodes which can either be wired or wireless. In ad-hoc networks, nodes communicate directly with each other without any special access point equipment. Because of its infrastructure less feature, ad-hoc wireless networks can be used when the mobile devices are on the move even in places where access points are not feasible.

In an Ad hoc network connectivity is achieved in the form of a multihop graph between the nodes. The QOS of the network depends on the terminal position, coverage pattern, and transmission power and interference level. Unlike wired networks the topology may change continuously and hence the QOS parameters also change dynamically [1]. As the topology is dynamic planning the configuration of MANET is challenging and difficult. The network should be capable to reconfigure itself based on the dynamic nature of the terminals and based on application it is running along with the protocols used [2].

For effective utilization of Ad hoc network three important parameters namely secure routing, service location issues and security need to be considered. Considerable data in the mentioned areas is available in [3][4]. Due to the inherent qualities of MANET, simulations of the network have been extensively used to evaluate the QOS and routing performance.

In this paper the performance AODV routing protocol is investigated for nodes which move in and out of the subnet under study. In the second phase of our study we set the destination only flag in the AODV header so that only the destination may respond to the route request (RREQ) and evaluate the performance of the network for random traffic. Section II of this paper describes in detail about the AODV protocol, Section III describes the experimental setup and section IV discusses the obtained results.

II. AODV

The Ad hoc On Demand Distance Vector (AODV) routing algorithm is a popular reactive routing protocol. AODV is capable of both unicast and multicast routing [5]. It is an on demand algorithm, for finding routes, meaning that it builds routes between nodes only as desired by source nodes for transmitted data packets. Routes are maintained till the communication is completed by the node. Sequence numbers are used in AODV routing protocol to maintain the freshness of routes. Advantages of AODV is include loop free operation and scalability to a large number of terminals.

To create routes when required AODV uses a route request / route reply query cycle. During data transmission from a source to destination, the source node floods the Route Request (RREQ) packet in the network when a route is not available for the desired destination. If an intermediate or neighbors node receives a Route Request (RREQ) packet, it checks if it is the destination node. If not, it checks if it has seen this Route Request (RREQ) before by checking the request ID and source node ID. The intermediate node in turn forward the request to their neighbors until the RREQ message reaches the destination or an intermediate node that has an up-to-date route to the destination. If this is the case the node just drops the packet and does not forward the Route Request (RREQ) any further. In AODV, each node maintains its own sequence number, as well as a broadcast ID. Each RREQ message contains the sequence numbers of the source and destination nodes and is uniquely identified by the source node's address and a broadcast ID. Destination sequence number is used to ensure loop free routing and use of up-to-date route information. Intermediate nodes can reply to the RREQ message only if they have a route to the destination whose destination sequence number is greater or equal to that contained in the RREQ message. A route Request carries the source identifier (SrcID), the destination identifier (DestID), the source sequence number (SrcSeqNum), thw destination sequence number (DestSeqNum), the broadcast identifier (BcastID), and the time to live (TTL) field. Based on DestSeqNum the freshness of the route is identified by the source.

During the process of forwarding the RREQ messages, an intermediate node automatically records the address of the neighbor from which it received the first copy of the RREQ message, thereby establishing a reverse path. If a Route Request is received multiple times, which is indicated by the BcastID-SrcID pair, the duplicate copies of the same RREQ message are discarded. All intermediate nodes having valid routes to the destination, or the destination node itself, are allowed to send Rout Reply packets to the source. Every intermediate node, while forwarding a Route Request, enters the previous node address and it's BcastID. A timer is used to delete this entry in case a route reply is not received before the time expires. Once the RREQ message reaches the destination or an intermediate node with a fresh route, the destination or the intermediate node responds by sending a route reply (RREP) packet back to the neighbor from which it first received the RREQ message. As the RREP message is routed back along the reverse path, nodes along this path set up forward path entries in their routing cache [7].

III. EXPERIMENTAL SETUP

The setup used in our study consists of 40 mobile nodes moving randomly in a subnet of seven kilometer by seven kilometer as show in figure 1. Some of the nodes move out of the subnet and return back after a delay d_n. The nodes are programmed to move at various speeds at different trajectories. Initially the nodes are all placed randomly in the subnet. All the nodes were programmed to run AODV routing protocol. In the first part of the experiment AODV protocol is run with the destination only flag set to '0'. In this mode a route reply RREP is created by the intermediate nodes between the source and destination. During route discovery when a mobile terminal N_k receives a RREQ from another terminal, it first creates or updates a route to the previous hop without a valid sequence number. The terminal then increments the hop count value in the RREQ by one, which indicates a new hop through the intermediate node. The next task of the terminal running AODV protocol is to search for a reverse route to the originator terminal. The intermediate then generates a RREP (route reply) to the originator. In the second phase the destination flag is set to '1'. When the destination flag is set, the intermediate node will not send generate route replies. The outputs obtained for both the scenarios during random traffic sent between the nodes is shown in figure 2, 3 and 4.

From figure 2 it can be observed that route discovery time can increase drastically if the destination only flag is set when the node is highly mobile and the number of nodes in the subnet is lower than the initial population of 40 nodes. This shows that destination only flag 'set' can adversely affect the network during route discovery in a sparse network.

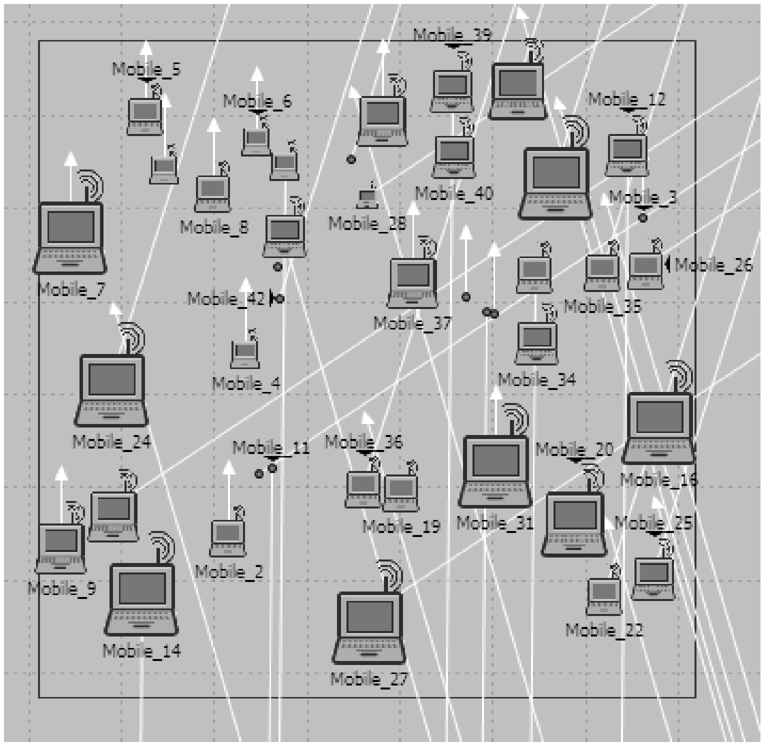

Figure 1 : The initial location of the mobile terminals

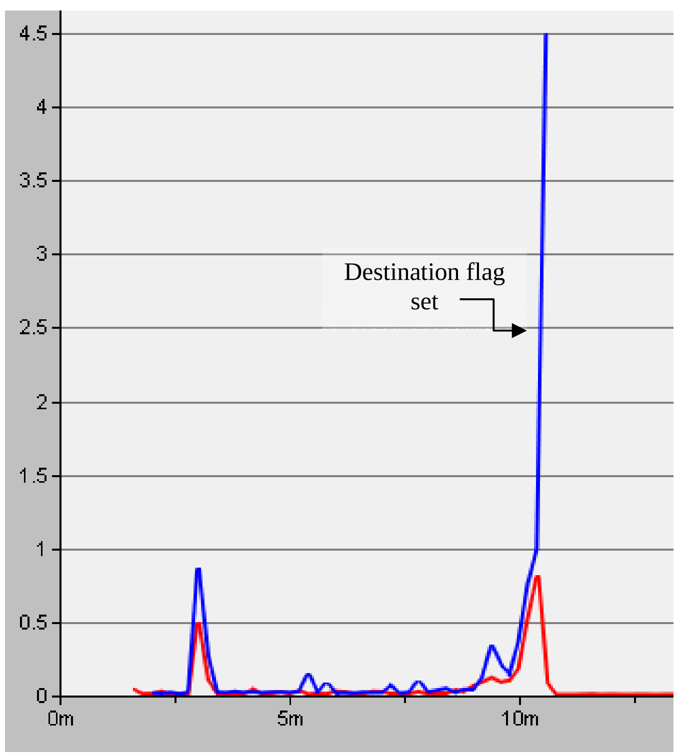

Figure 2 : Route discovery time

The challenge in a bandwidth constrained environment is to reduce the non data traffic and the traffic sent within the route discovery process to a minimum. From figure 3 it is clear that the non data traffic falls down to almost one third the traffic when the destination only flag is set. As the number of nodes increase and if the nodes are highly mobile in a bandwidth constrained environment, the performance of the system improves. Similarly from figure 4 it can be seen that the total number of route errors is extremely as the cached data in the intermediate nodes are not fully utilized.

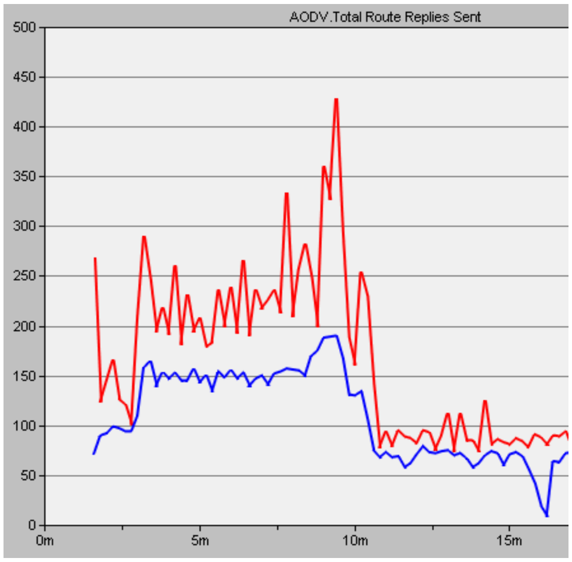

Figure 3 : Total route replies sent

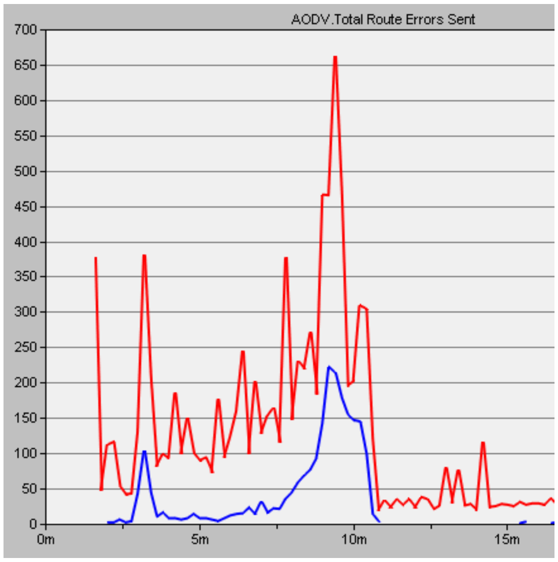

Figure 4: Total route errors sent.

IV. Conclusion

In this paper we studied the effect of destination only flag of the AODV protocol. The experimental setup consisted of 40 nodes which were highly mobile moving at average speeds. Part of the nodes were designed to move out of the subnet and back so that the subnet becomes sparsely populated for a short period of time. Due to the constrained bandwidth in the network, it has been found that if the destination only flag is set, the QOS of the network does not deteriorate. However further work needs to be done as how to improve the route discovery time when the network is sparse with many nodes moving out of the subnet.

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