Throughput Analysis of Many to One Multihop Wireless Mesh Ad hoc Network

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***Abstract*— Mobile ad hoc networks are formed by co operative association of wireless nodes communicating with each other without the use of infrastructure. Every node acts as a router in the network and enables the communication between nodes that are separated over their radio range. Typically in ad hoc networks one or more nodes may act as gateway connecting to the external world. The node acting as the gateway becomes a sink and the throughput capacity of the network in such networks becomes crucial to maintain QOS. This paper investigates throughput of many to one scenarios in wireless mesh network using Ad hoc On Demand Vector (AODV) Routing Protocol. It is proposed to specifically investigate the throughput of one hop, two hop and three hops to the sink in the wireless mesh network. Investigations are also carried out to measure the throughput of the wireless mesh network when the route timeout variable in the AODV routing protocol is decreased.**

Keywords: Manet, AODV, Throughput, Wireless

I. INTRODUCTION

Wireless networks have started touching everyday lives from simple hand held devices to gaming consoles . The simplest wireless network seen in everyday life is the wireless ADSL router connecting to the internet and wireless devices in the vicinity. Such networks are called as infrastructure based network with the wireless ADSL router acting as the gateway between the intranet and the internet. Broadly speaking wireless networks can be classified into infrastructure based network and infrastructureless networks[1]. In a infrastructure based wireless networks only the end user is mobile and relies on existing wireless infrastructure for connection to the external world. Infrastructureless wireless networks are dynamic with a group of co operative nodes forming a network in an adhoc fashion to communicate among themselves. The communication between the co operative nodes can either be single hop or multihop with the intermediate nodes which are within radio range acting as routers between the source and destination. These infrastructureless based networks are also called as Mobile Ad hoc Networks (MANET). In a MANET the nodes are free to move randomly at different speeds with the topology changing dynamically.

Since the network is dynamic in MANETs, each node has to act as a router every node should be capable of either maintaining the routing table or should be capable of discovering the route when required. This makes the conventional routing protocols of wired network inefficient. Since routing plays a very crucial role to the Quality of Service(QOS) various routing protocols have been proposed in literature. Routing in MANETs can be broadly classified into proactive routing and reactive routing. In Proactive routing also called as table driven routing routes are discovered for every pair of nodes even if there is no data communication between the nodes so that routes are available immediately for communication between any nodes in the network. Table driven routing protocols have additional overheads of control traffic in the network as the routing tables have to be refreshed continuously due to the dynamic nature of the network. Popular routing protocols include Distance Sequence Distance Vector(DSDV)[2] routing, Optimized Link State Routing(OLSR)[3], Fish eye State Routing(FSR)[4].

On the other hand reactive protocols discover the routes only when data communication has to be established between the nodes[5]. Advantages of reactive protocol include lower control data overheads. Popular reactive protocol routing algorithms include Adhoc On Demand Distance Vector (AODV) routing[6], Dynamic Source Routing (DSR)[7], Associativity Based Routing(ABR)[8].

Wireless mesh networks are self organized networks maintaining mesh connectivity among themselves[9]. It is comprised of a combination of static routers and mobile clients. The static mesh routers act as the infrastructure backbone and provice connectivity to the mesh clients either within the network or to the external world.

In this paper it is proposed to investigate the throughput of clients which are one hop, two hop and three hops to the sink in the wireless mesh network. The throughput of the wireless mesh network when the route timeout variable in the AODV routing protocol is decreased is measured. The rest of the paper is organized as follows. Section II describes the proposed methodology, Section III discusses the results obtained and section IV concludes this paper.

II. PROPOSED METHODOLOGY

The network layout used in this work consists of 9 nodes and one sink. Three of the nodes are within one hop distance from the sink, another three nodes are within 2 hop distance from the sink and finally the remaining nodes are three hop distance from the sink. Figure I illustrate the setup used in our analysis.

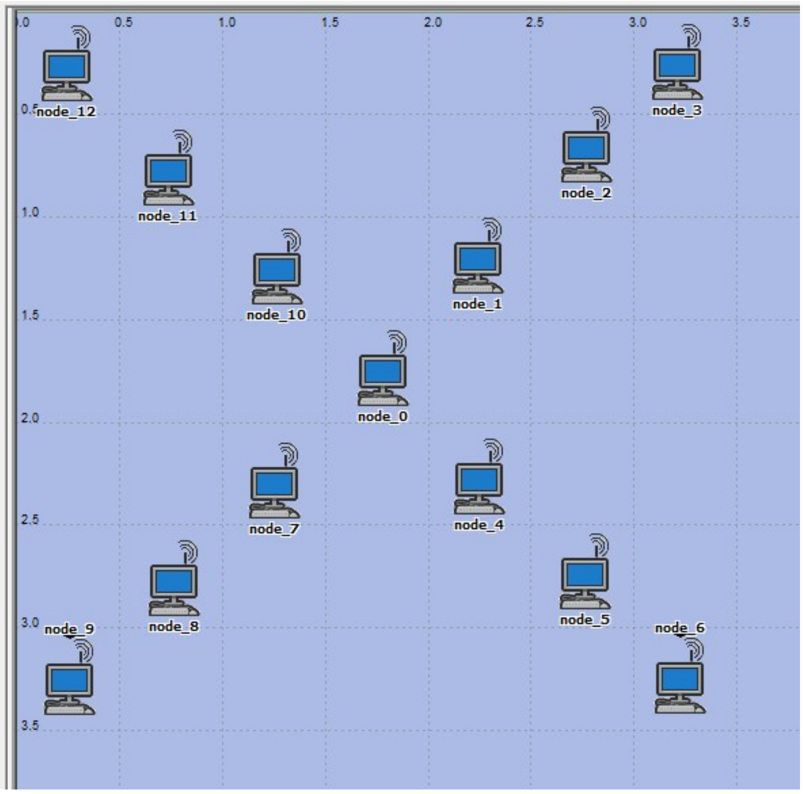

Figure I : The experimental setup with node_0 acting as the sink.

In the first stage of the experiment random traffic flows were initiated from three nodes within one hop distance from the sink. The same experiment were repeated for two and three hops. The network uses the AODV routing protocol. In the second stage, the route time out in the AODV routing parameters was increased by a factor one second and again evaluate the network. The details of each node used in this work is given in Table I.

Table I : Node parameters.

Data Rate	11 Mbps
Transmit Power	0.005 Watt
Packet reception power threshold	-95 dBm
Target beacon transmission time	0.002 seconds
Routing protocol used	AODV
Route request retries	5
Active route time out	3 and 4 seconds

AODV is a popular reactive protocol capable of unicast and multicast routing. When a route is discovered the routes are maintained as long as they are needed by the sources. AODV has been adapted from the Distance Vector(DV) routing protocol[10] by implementing sequence numbers which enables freshness of routes. AODV is loop free and scalable to very large networks. When a source initiates route creation, AODV creates routes using the concept of Route Request (RREQ) and Route Reply (RREP) query cycle. When data transmission has to be initiated from the source, the source floods the network with Route Request packetif a route is not available for the requested destination. All nodes within the radio range of the source receives the RREQ and checks if it is the destination node. If the node which receives the RREQ is not the destination, it checks if it has already received this RREQ by checking the source and destination ID. If it has already received this specific request through some other node then it drops the control packet. Alternatively if the intermediate node receives the request the first time it forwards the request to their neighbors which are within its radio range. This process is continued till the destination is reached. The destination replies with a RREQ and a communication is established between source and destination. Once a route is established every node maintains a route table entry. The route table entry has to be updated with the route expiry time which is the duration for which the route entry is valid after which the route entry is deleted. The route expiry time is governed by the Active Route Timeout(ART).

The average route discovery time with sink as the destination is shown in figure II and figure III displays the routing traffic received.

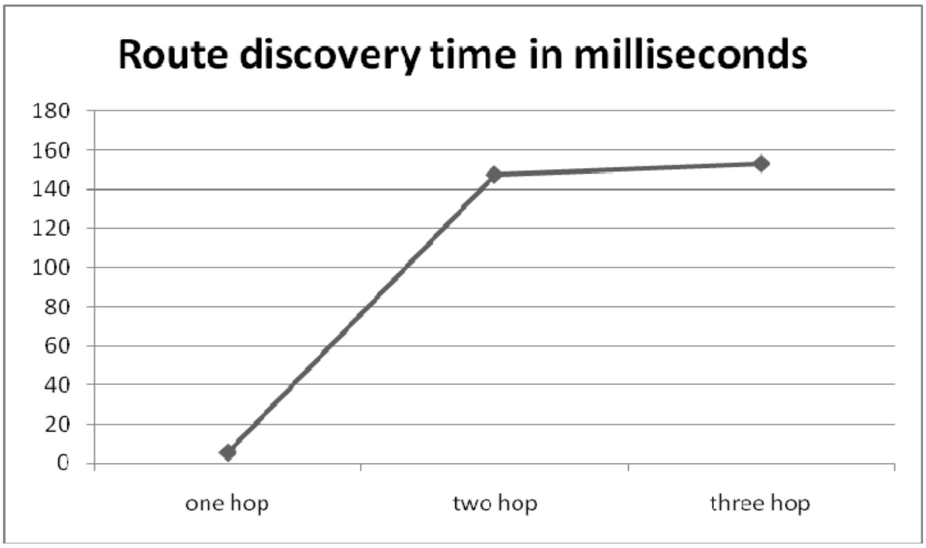

Figure II . Route discovery time for nodes running AODV routing protocol with ART=3

From figure II it is seen that the difference in route discovery time between two and three hops is nominal. However the time is very large for route discovery between the first hop and subsequent hops.

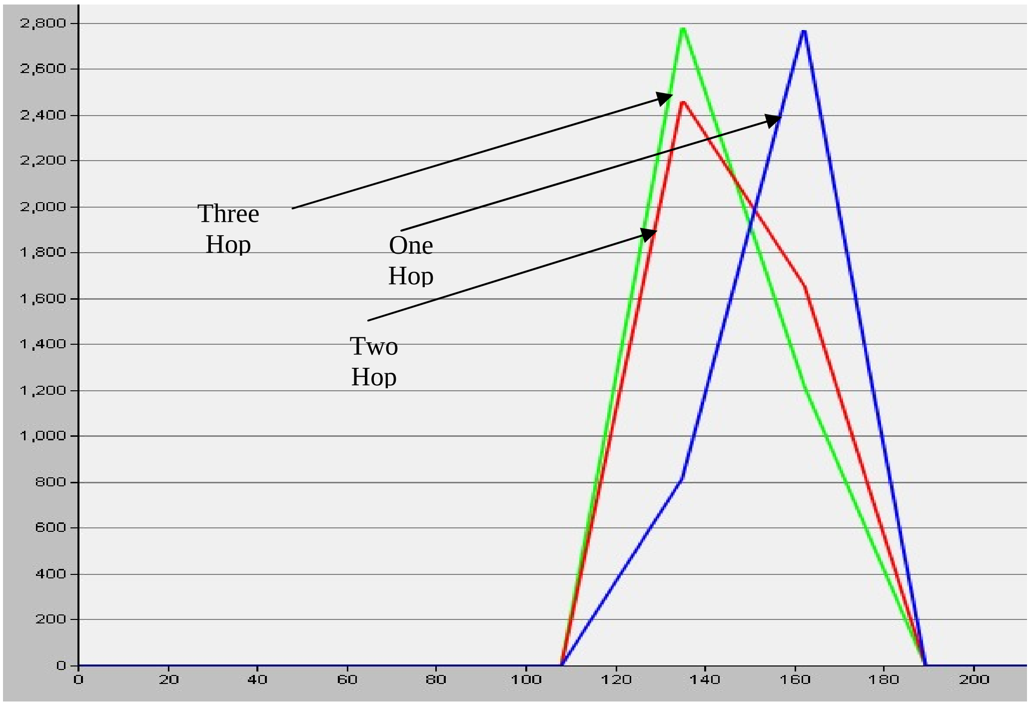

Figure III. Routing traffic received in bits per second when ART=3 seconds.

Only 50% of the nodes in the two hop and three hop distance nodes send traffic to the destination node acting as the sink. The routing traffic received by each node is almost similar in both the cases. Design of wireless mesh networks can take this into criteria without degrading the quality of service.

Figure IV and figure V shows the route discovery time and the routing traffic received when ART=4. It is seen that when the active route timeout is increased

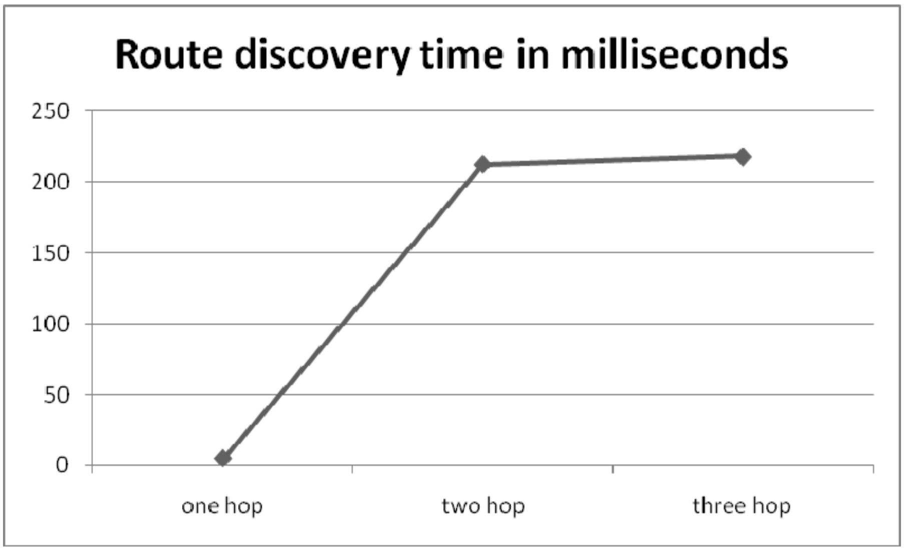

Figure IV. The route discovery time with ART=4 seconds

It is observed that when the active route time out is increased by 25% of the initial set values the route discovery time roughly increases by 25%. The routing traffic received by the two hop and three hop nodes are almost the same as shown in figure V.

Figure V Routing traffic received in bits per second when ART=4 seconds.

The maximum throughput of the many to one scenario under different multi hop scenarios and with different ART is shown in Figure VI.

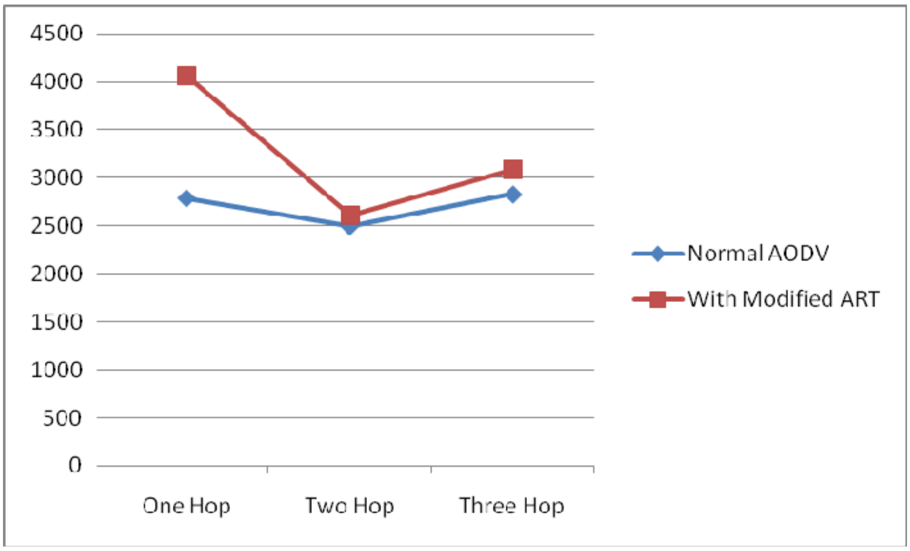

Figure VI. Throughput under each hop and different ART

From figure VI it is seen that the throughput increases when the active route time out is increased. This is primarily due to the mesh structure of the network and low mobility.

III. CONCLUSION

In this paper investigations were carried on a wireless mesh network with many to one scenario. One node acts as the sink with all other nodes at ‘n’ hops from the sink acting as sources. The route discovery time and the maximum throughput with n={1,2,3} was measured. Since the experimental setup was for a wireless mesh network the throughput was measured after increasing the active route timeout of the AODV routing protocol by 25%. It is observed with increased active route timeout the route discovery time increases significantly along with throughput. Further investigation needs to be carried out to reduce the route discovery time which can affect the performance of dense wireless mesh networks. AODV routing protocol may be modified suitably to improve the QOS in mesh networks with many to one configuration.

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