Enhancements in AODV Routing Using Mobility Aware Agents

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Abstract

In infrastructure-less mobile and ad-hoc networks the routes have to be refreshed oftenly due to the mobility of the nodes acting as routers. If a node is aware of the mobility of neighboring nodes, the highly mobile node can be avoided to be the part of routes and ultimately reduces the re-route discoveries. This paper introduces mobility aware agents in ad-hoc network nodes and modifies HELLO packets of the AODV protocol to enhance mobility awareness. Mobility aware agent can update its awareness through inquiry and reply to inquiries about neighbors on quasi-periodic bases. On receiving the HELLO packet with GPS coordinates of the originator, agent compares them with previous ones and hence has awareness about the mobility of the originator with reference to itself. The enhancements in the throughput of the network are studied through simulation in OPNET that has shown optimistic results.

Keywords: Mobile, Adhoc, Routing, AODV, Agent, Mobility

1. Introduction

MANETs consist of mobile nodes that communicate via wireless means and perform the roles of both hosts and routers. MANETs do not have a centralized controller, nor do they require any infrastructure, that is why they are also known as infrastructure-less networks [1]. The network topology of MANETs is dynamic as their mobile nodes are free to move around and can even freely leave or join the networks. This and other similar characteristics make MANETs very different from static wired networks that arose many challenging problems. One of the fundamental and most frequently addressed problem in these networks is to obtain a distributed routing scheme so that under the network connectivity assumption any mobile host can transmit/receive data from any other host in the network [2]. Many ad hoc routing protocols are available for routing discovery in MANETs that can be divided into two categories: source-initiated on-demand and table driven protocols. On-demand ad hoc routing protocols are generally more scalable than table driven protocols. They also generate less message traffic as they act source for routes only when the nodes need them [3].

2. Ad hoc On-demand Distance Vector (AODV)

Ad-hoc On Demand Distance Vector Routing (AODV) is dominant type of on-demand ad hoc network routing protocols. In AODV each mobile host operates as a specialized router that is quite suitable for a dynamic self-starting network, as required by users of ad-hoc networks. AODV provides loop-free routes even while repairing broken links. As the protocol does not require global periodic routing advertisements, the demand on the overall bandwidth available to the mobile nodes is substantially less than in those protocols that do necessitate such advertisements [4].

AODV uses traditional routing tables, which means it keeps one entry per destination that interns only the next hop towards the destination. AODV maintains fresh routes by implementing a counter for each node called a sequence number [5]. A node's sequence number is incremented each time the local connectivity for that node changes. RREQ packets contain a *broadcast_id* field [4]. This value is a counter maintained at each node and is incremented each time the node initiates a new RREQ. The *broadcast_id*, together with the source node's IP address, serves as a unique identifier for a RREQ. In addition to that AODV maintains timer-based states [6] in each node, regarding utilization of individual routing table entries.

3. Mobility Aware Agent

In mobile ad hoc networks, mobility of nodes plays a vital role in the overall throughput of the network. As we know that all the nodes in an ad hoc network also work as a router. So if a node is moving on a regular basis then it must not act as a router because it can cause path breakage very often. But there is no mechanism that an individual node can have any information about the mobility of other nodes in the network. Mobility awareness about the dynamic network topology can reduce this problem. We introduce a lightweight mobility aware agent[10] on each node of the network that helps nodes to know about the mobility status of other nodes in the network. To achieve agent based mobility awareness all agents in the network broadcast their current location in the network periodically or semi-periodically. Agents receiving this information update their knowledgebase for the mobility information of their neighbors i.e. stationary or in motion; that further helps to know about the direction of moving nodes. The status of those nodes, which are moving away from a particular node, is different from those, which are coming towards it. This movement is considered relative, if node-A is moving away from a static node-B then agent placed at node-A predicts it and can exploit this information for rerouting and link establishment. Placement of agents at network nodes help in many ways e.g. it can use different environmental statistics of network for example speed of a particular node can help for future predictions of network topology. In perfect agent based mobility aware network, parameter like high mobility of a node is recorded that helps in different intelligent decisions.

3.1. Motivation for Proposed Scheme

In AODV the mobility status of any node is not considered at all while establishing a route between two nodes. So if a mobile node moves in such a way that it is no longer able to help in transferring data, a route error is generated causing a reroute discovery process. Same thing happen again and again establishing routes after quick intervals resulting in the reduction of overall throughput of the network.

Mobility aware agent based ad hoc network prefers static nodes in route discovery. It also restricts highly mobile nodes to be the part of routes. More static nodes in the path help in establishing a route for a longer period, resulting in less reroute discoveries. Furthermore, network statistics helps in its future prediction.

4. Proposed Scheme

The Ad hoc On-Demand Distance Vector routing algorithm is initiated whenever a particular node wish to send data to some other node. AODV allows mobile nodes to obtain routes quickly for new destinations, and does not require nodes to maintain routes to destinations that are not in active communication. When links break, AODV causes the affected set of nodes to be notified so that they are able to invalidate the routes using the lost link. Although AODV allows mobile nodes to inform about link breakage in a timely manner, but our proposed scheme helps in reducing this link breakage by using the concept of mobility aware agent at each node. Following is the enhanced route discovery process of AODV using the concept of mobility aware agent.

Agent at the source node broadcast a RREQ single when it determines that it needs a route to a destination and does not have one available in its knowledgebase.

This can happen if the destination is previously unknown to the agent, or if a previously valid route to the destination expire or it is marked as invalid. When an agent on a node receives RREQ, it records previous hop address; even it is received after the expiry time. Agent on second node generates RREP if it is itself destination or it has an active route to destination. This RREP is sent to best neighbor. In backward path best neighbor is that node which is not moving more frequently. This process of the selection of best neighbor process is done at each intermediate agent based nodes. In this way it is tried to establish a path between two nodes having maximum number of less mobile nodes. During the selection of best neighbor

5. Simulation

Simulation is performed in OPNET Modeler version 8.0.C [7] and the test bed is OPNET Model from NIST [8] is used as standard AODV protocol implementation. The network mobility aware agents on each node modify the HELLO packet, by adding the GPS coordinates of the location of node into it. In mobility aware routing the REPLY is unicast to the best suitable neighbor instead blindly to the one received request first. Simulations are performed in different scenarios and results without and with mobility aware agent are compared. Some of these scenarios as follows:

Scenario 1*:* Initially 25 nodes labeled from 0 to 24 prefixed by f (fixed) and m (mobile) are deployed in the region of 900 X 500 as shown in figure in figure 1.0.

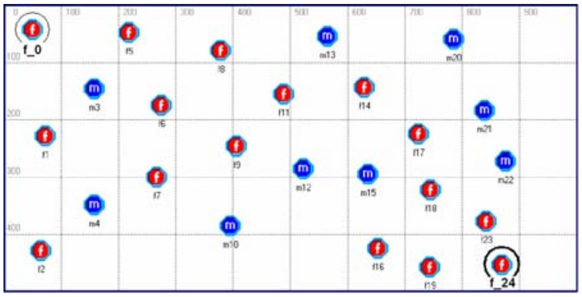

Figure 1.0: Scenario 1

Only node 0 is generating the traffic for node 24 and all other route are just performing routing if needed. Simulation results for 30 minutes are as under figure 1.1.

It is observed that average throughput of the mobility aware agent based ad hoc network is better than simple network.

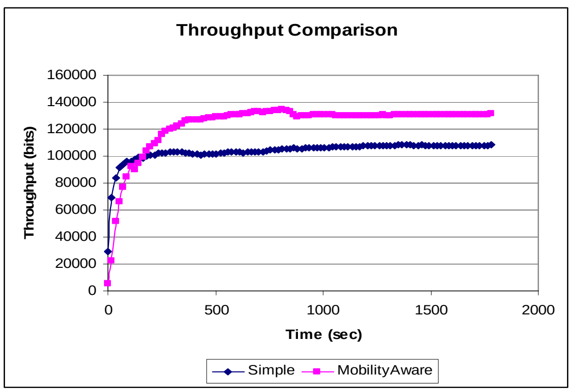

Figure 1.1: Through comparison of Scenario 1

Scenario 2: Again initially 25 nodes labeled from 0 to 24 prefixed by f (fixed) and m (mobile) are deployed in the region of 900 X 500 as shown in figure 2.0.

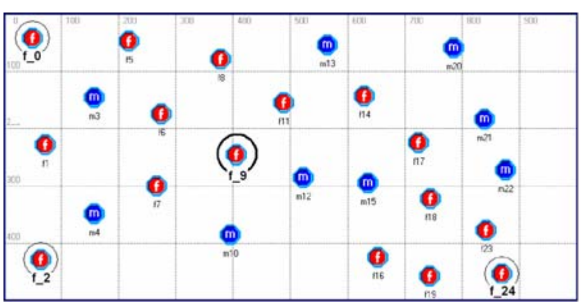

Figure 2.0: Scenario 2

Now nodes 0, 2, 24 are generating the traffic for node 9 and all other route are just performing routing if needed. Simulation results for 30 minutes are shown in figure 2.1.

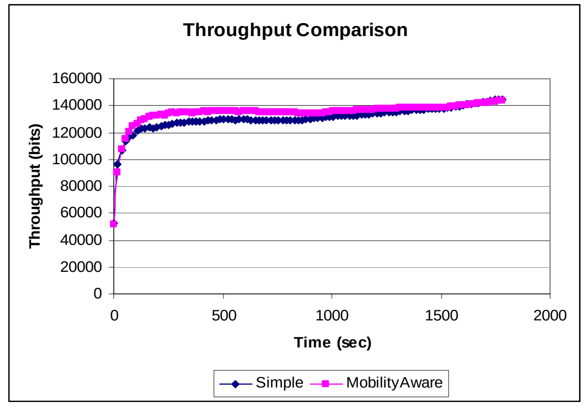

Figure 2.1: Through comparison of Scenario 2

In this scenario throughput of mobility aware agent based ad hoc network is again considered better than the simple one. But this time degree of improvement is low.

Scenario 3: This time again 25 nodes labeled from 0 to 24 prefixed by f (fixed) and m (mobile) are initially deployed in the region of 900 X 500 as shown in figure 3.0.

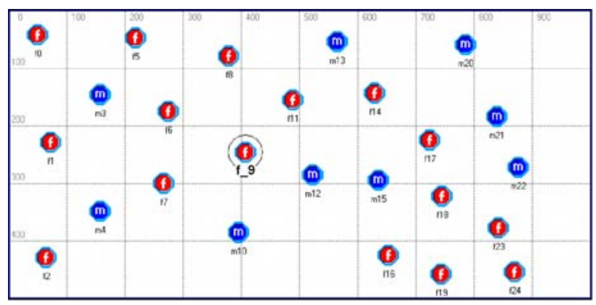

Figure 3.0: Scenario 3

Now node 9 is generating the traffic for all other nodes randomly. Also all other route are just performing routing if needed. Simulation results for 30 minutes are as under in figure 3.1.

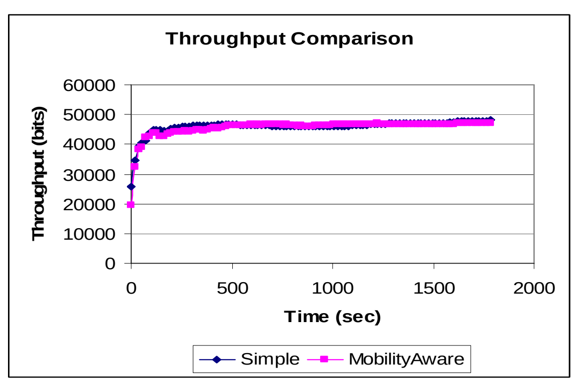

Figure 3.1: Through comparison of Scenario 3

Throughput of the mobility aware agent based ad hoc network is nearly same as that of the simple network. Initially it is just below and just above and again came just below than that of the network of simple node. The reason is obvious that traffic is also generated for the mobile node as hence this time re-route requests must be there all the time.

Scenario 4*:* This time again 25 nodes labeled from 0 to 24 prefixed by f (fixed) and m (mobile) are initially deployed in the region of 900 X 500 as shown in figure 4.0. Here the all nodes are allowed to generate traffic for other nodes randomly.

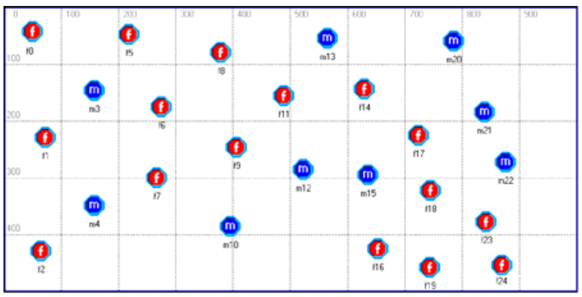

Figure 4.0: Scenario 4

This time simulation results for 30 minutes are as under figure 4.1.

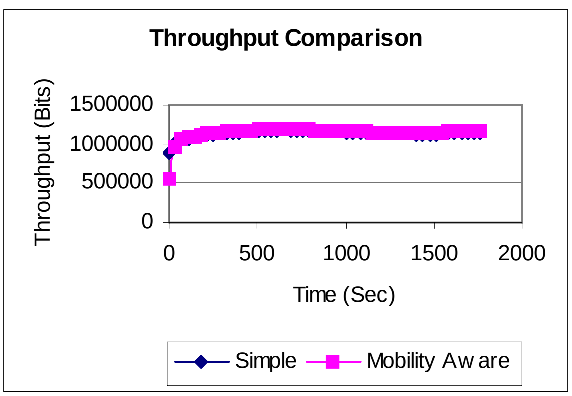

Figure 4.1: Through comparison of Scenario 4

Throughput of the mobility aware agent based ad hoc network is almost as that of the simple network like in scenario 3. It seems slightly better for more time and cross below once for a short interval.

Analysis: After executing the four different scenarios and focusing on there results, it is observed that in scenario 1 where network traffic is focused from one point to an other point having number of fixed nodes between then is giving a good enhancement. Scenario 2 is showing enhancement but lesser than that in scenario 1. This time number of fixed nodes is lesser in the routes of network traffic, especially for node f_2. Scenario 3 and 4 must have the number of mobile node in the network in greater number than in previous scenarios, resulting in the lesser, approaches to nil, enhancements in the throughput of the network. Therefore, it can be concluded that more fixed node in the routes will give comparatively better throughput of the MANET.

6. Conclusion

On the basis of discussion of the simulation results it can be concluded that enhancements in AODV using mobility aware agent helps in reducing the reroute discoveries of AODV which ultimately increase the overall throughput of the network. Since the AODV has already a local route recovery mechanism implemented so mobility aware agents on other protocols may leads to better results.

6.1. Applications of Mobility Awareness

The agent-based awareness of the mobility of the network may have more applications than enhancement of the throughput of the network. A highly mobile agent based node may deny itself to be the part of the network that subsequently decreases the overall network load.

Incorporating mobility aware agent in SAODV [5] node where local recovery mechanism is not implemented can give much better results as we have seen in similar enhancements of AODV.

As in [9] mobility awareness may also help in identifying the malicious nodes, we believe that agent based approach for mobility awareness is natural for this objective. It can also help network to avoid the declaration of a node as malicious, which is actually mobile.

6.2. Future Work

In the future, utilization of the speed and direction (w.r.t. the node) factors of a mobile node using mobility aware agent will be applied in the selection of best neighbor. It will also be tried to make the selection of best neighbor algorithm as efficient and dynamic as possible on the basis of existing network conditions. Creation and comparison of different scenarios will help in this regard. Also the more concerned measure like number of route requests/errors will be incorporated. These are not readily available in the model available from NIST and need time consuming programming efforts.

8. References

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