Performance Modification of MOADV protocol in Wireless Mobile Ad Hoc Networks

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Abstract

MAODV protocol keeps sending control packets within static periods, whether there is sending of data packets or not, and it is not concerned with the amount of these data packets. Based on this, many people found out that there are a high number of control packets in the short-lived connection.
The main goal of this paper is to reduce the number of control packets by increasing the period between the control packet transmissions. The length of the transmission period depends on the amount of data packets sent on the network. The final result is reduce the CO and TO.

Keywords

MAODV, CO, TO, GRPH, NS2, MANET.

1. Introduction

A mobile ad hoc network (MANET) is a type of wireless networks. This type depends on the mobile nodes, and there is no infrastructure in such type. There are no routers, servers, access points or cables. Nodes (mobiles) can move freely and in arbitrary ways, so it may change its location from time to time. MAODV protocol is an extension of the last AODV routing protocol. It discovers multicast routes just on demand by using a broadcast route discovery. MAODV employs the same control messages found in the unicast AODV protocol, and it developed other messages to perform a multicast operation for itself [3].

MAODV has a set of control messages that are required to perform its work: route requests (RREQ), route replies (RREP), multicast (MACT) and group hellos (GRPH) are the basic MAODV protocol control messages. These messages are used to establish a delivery tree, and then maintain it [4,5]. MAODV protocol keeps sending control packets within static periods, whether there is sending of data packets or not, and it is not concerned with the amount of these data packets. Based on this, many people found out that there are a high number of control packets in the short-lived connection [1, 2].

The main idea of this research is to reduce the number of control packets by increasing the period between the control packet transmissions. The length of the transmission period depends on the amount of data packets sent on the network. While there is no data packets transmit over the network, the period has been increased in a mathematical equation. This period will not still increase to be a long time, because this may cause a delay. The period that increased, will back to default value once any data packet sent. After implementing for the enhanced code on the NS-2 simulator, the result that gained was a decrement of the TO and CO. This research will discuss previous idea and the gained results. This research falls in five sections; section number two will show the previous work, section three will study the formulation of the problem, the proposed solution will be discussed in section four, section five will show the results of study simulation, and final section is summary and conclusion.

2. Related Works

Many papers studied the performance of the MANET protocols, focusing on different ideas. Some of them compared two or more protocols to determine which one is the best. Other papers studied protocols with different nodes or ways to evaluate the protocol performance.

Lee,S.,Su"A Performance Comparison Study of Ad Hoc Wireless Multicast Protocols". In this paper, they investigated the performance of multicast routing protocols in wireless mobile ad hoc networks. They simulated a set of wireless ad hoc multicast protocols and evaluated them in various network scenarios. The relative strengths, weaknesses, and applicability of each multicast protocol to diverse situations are studied and discussed [6].

Al-Tarawneh, E. "Mobile Ad hoc Networks Route Maintenance Analysis in Reactive Routing Protocols". In this master thesis, she gave a new idea by studying the short-lived connection and small transfers, but it evaluated them for unicast AODV and DSR. This thesis idea is new, where no researches talked explicitly about it before.

Al-Mimi, H. "Performance Evaluation of Multicast Ad hoc On-Demand Distance Vector". In this master thesis, the different connection models are identified, and the values of transmission rate for each model are determined. Many simulation experiments were executed, the result was studied and analyzed, then the decision for each model was taken. He executed all of his experiments using NS-2 simulator.

3. Problem Formulation

When a node sends a data packet, the neighbors of this node hear this communication and update their local connectivity information to ensure that it includes this neighbor. However, if a node has not transmitted any things, it broadcasts to its neighbors a Hello message. This message means to all neighbor nodes that the sender node is still in the transmission range.

Hello message must send every HELLO-INTERVAL milliseconds, and it contains the sender IP address and its sequence number. To prevent the hello message from rebroadcast outside the neighborhood, the Time to Live (TTL) value is added. It sets to 1 to prevent rebroadcast. The failure of receiving any transmission from a neighbor within a given time called ALLOWED-HELLO-LOSS, which means the local connectivity is changed and the information about this neighbor rout must be updated.

The main problem that is tried to enhance for MAODV protocol was the high number of control packets, it causes an increase of CO and TO. The MAODV protocol sends a type of control packets called (GRPH) from the group leader to the members in static period of time, this sends is not affected with the congestion on the network. Because the long gap time between data packets in short-lived connection, the control packets which are sent through this gap it will be high, and they waste the bandwidth and cause an increase the TO and CO.

4. Methodology of Solution

This thesis tried to reduce these packets without lose any other advantages of the protocol. It enhance the protocol to be more sensitive to the traffic, and it make the period time between GRPH messages is not static; it depends on the data packets that send on the network. The new protocol senses the network, if there are some milliseconds of sending control packets without data packets, it will increase the period time between sends the control. The increase of the period time increases while there are no data messages sent or the period time aren't arrived to maximum value, then it stops increase. If any data packet sent on the network, the period time back to original value. This code is implemented and simulated. This algorithm's flowchart is shown in figure 1.

By researches that studied the MAODV protocol, it indicates to the high control packets in the short lived-connection because there is a gap between send the data packets, this gap uses to send a hello packets which is a control packets, this cases an increase of CO and TO. The idea of enhancing the code is came because the high value of the control packets in short lived-connection in original code.

The idea is work as shown in figure 1 to make the time between the hello messages is not static, this time will depend on the data transmission on the network, this mean, there is no need to send big number of hello messages if there is no data messages communicated. The new code sensing network, if there are data packets and no hello packets then the status is normal, but if there is a hello message, its time records, if it repeats, the time between the hello messages will increase.

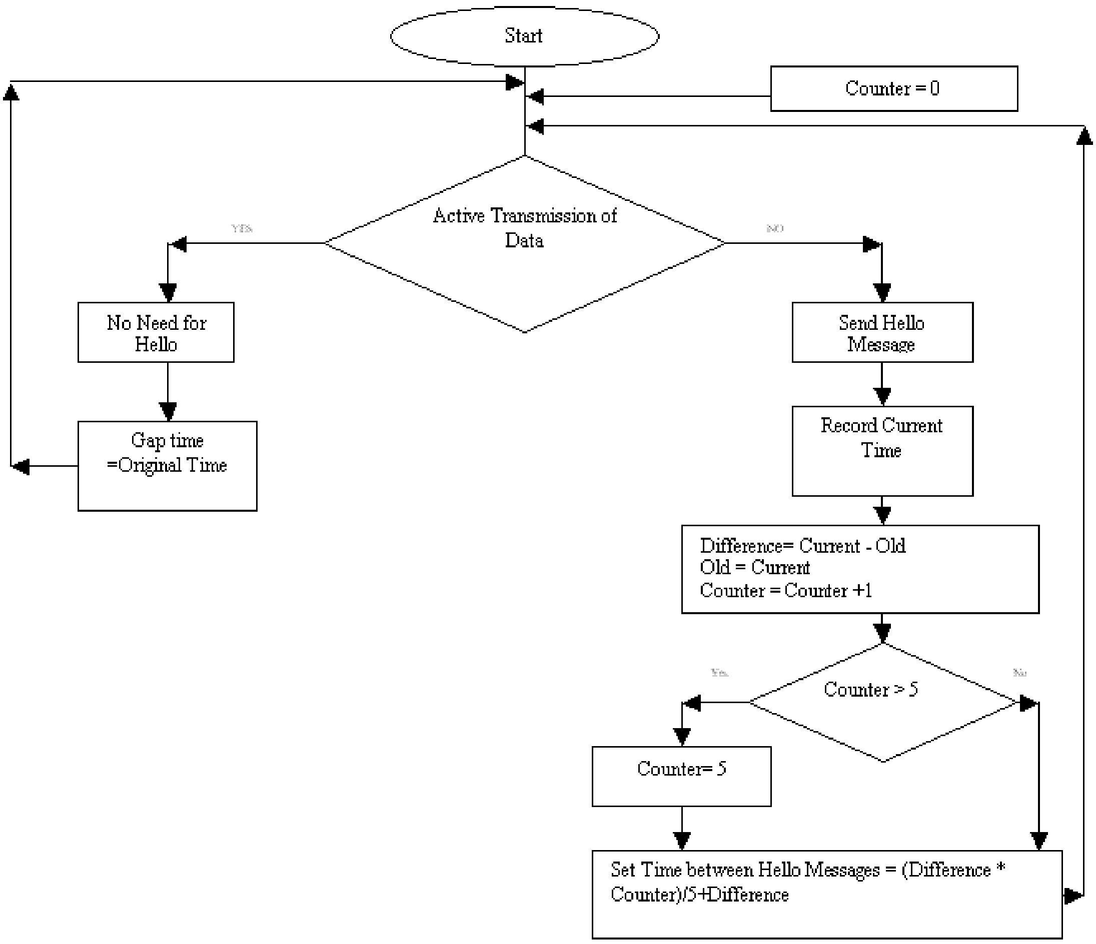

Fig.1 Flowchart of the proposed approach

5. Simulated Results

The network simulator (NS) is strong software, and it is widely used in network research because it supports many types of simulations. These types include transmission control protocol (TCP), multicast protocols over wired and wireless networks, and the routing protocols [7].

There are two basic limitations in implementing the initial MAODV protocol in Version 2 of NS. These are because only the group members can send multicast traffic to multicast group, and the wasting of the bandwidth because of unicasting the multicast data packets. However the version NS2.26 solved these problems [8].

The NS is very useful to test protocols and our MAODV protocol. This protocol will simulate original parameters. Then it will modify and simulate again to gain a new result. By comparing these results, we can know if our modification enhanced the performance. All results of simulation will be analyzed, and we can make a judgment about these updating and modifications.

This paper tried to modify the MAODV protocol to reduce the CO and the TO in the short lived connection. There are three parameters that change to study the performance of protocol before and after modification. The first parameter is the mobility speed. This may effect the construction and the maintenance for the multicast delivering tree. The second parameter we change is the number of receivers, and how it affects the metrics. The final parameter we change is the number of senders.

The connection model can describe as long-lived or short-lived, this depends on the amount of sent data packets/second, and it may know by the lifetime of a session, when the lifetime of the transmission session is short then it is a short-lived, but if it is long then it is a long-lived.

The problem is how we can determine the value of this amount of sent data to know the connection type, some new researches worked to determine how many packets must send per second to say this is a short-lived or long-lived model, many researches worked on MAODV performance on the long-lived connection, but none of them talked explicitly about the performance in the different connection models, the researches [9,10] mentioned to the short-lived and the small transfers for the AODV and DSR, the research [14] studied the difference connections in more details and determined the values for the long-lived and the short-lived connection. As a result of these researches, they determined the long-lived if the traffic rate is more than or equal (15) packets/second, but it is a short-lived if the traffic rate is less than or equal (0.05) packets/second and this mean 1 packet every 20 seconds.

According to the previous studies and because this thesis will try to reduce CO and TO by reducing the control packets in the suitable time, and these packets are high in the short-lived connection, for all these reasons, this study will depend on the same values that determined the connections to simulate our experiments.

In the following figures, we studied MAODV protocol after enhancing the code this studied for two metrics. Total overhead and the control overhead are studied when some of the simulator parameters changed, the parameters we changed are: the mobility speed, number of receivers, and the number of senders. The CO is high because the network needs a high number of control packets to send some data packets. By this experiment we can calculate that we need to send 62 times of control packets to send one data packet. In Fig.2, this relation is studied too for the E-MAODV, and the general result of increasing the CO by increasing the speed is same effect, but the values of CO is different.

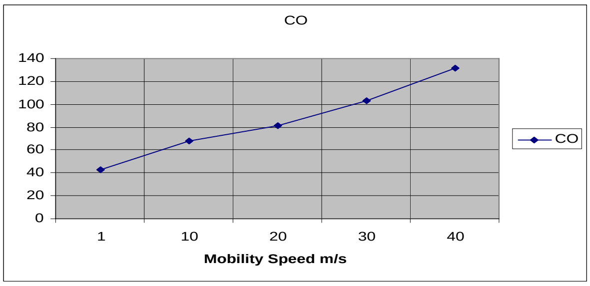

FIG.2 CO WITH VARYING MOBILITY SPEED FOR E-MAODV

As Fig. 2, we can see the decreasing of CO in the E-MAODV than it in MAODV, this enhanced in the new protocol to reduce the using of control packets, CO is decreased from 64 to be 42 for 1m/s speed, and this is similar for all speeds, this in total enhanced the protocol.

Fig.3 for enhanced MAODV code shows the effect of increasing the number of senders, by this experiments the relation appears the decreasing of CO when the number of senders increases.

The main reason of this relation is by increasing the senders, the data packets will increase and grows more than the increasing of the control packets, by this relation, the CO in all must decrease, and this is the explanation of this relation between CO and senders. From Fig.3, we see the decreasing of CO in the enhanced code.

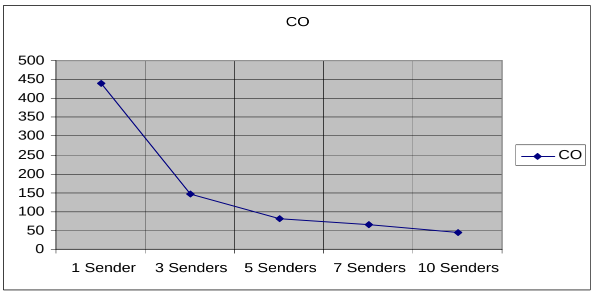

FIG.3 CO WITH VARYING NUMBER OF SENDERS FOR E-MAODV

In short-lived connection the data packets is too less than the control packets, so the CO is always high in this connection model, this decreasing of the CO when increasing the receivers can explain by an important reason, this when increasing the receivers number this make an increasing of data packets transmission and delivering, an when the data packets increase, this mean it will grows more than the growing for the control packets, so the CO will decrease because it depends on the control packets number. The values of CO in these experiments are less than it in MAODV original code.

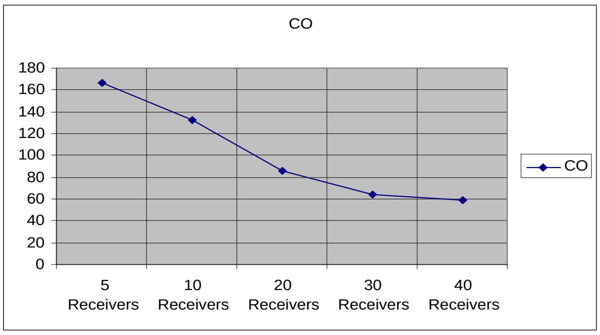

FIG.4 CO WITH VARYING NUMBER OF RECEIVERS FOR E-MAODV

Fig.4 shows the TO for the enhanced MAODV with increasing the Mobility speed, the behavior for the enhanced protocol is similar to MAODV but the TO is less in the enhanced protocol, the increasing of the TO is normally with increase the mobility speed, this because changing the routes and reconstruction and discovering, all of these need control packets and this increase the TO.

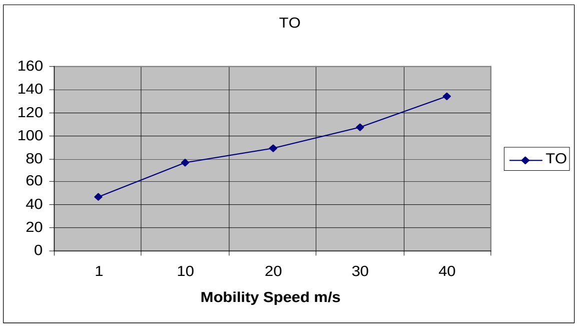

FIG.5 TO WITH VARYING SPEEDS FOR E-MAODV

The relation between TO and senders number is shown in Fig.5 for enhanced MAODV. The increasing of senders effected the TO decreasing, the main reason of this decreasing came because the increasing of senders gives more data packets to deliver, so increasing these data packets will effect to be the number of data packets more than the number of control packets, this will decrease the amount of TO values.

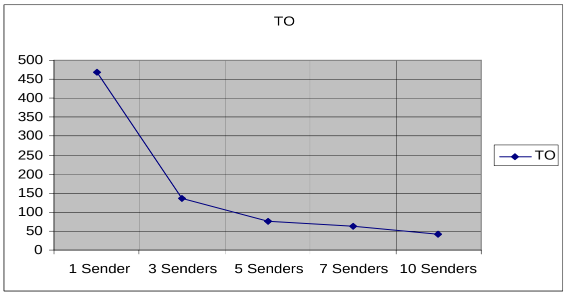

FIG.6 TO WITH VARYING NUMBER OF SENDERS FOR E-MAODV

Fig.4 shows the decreasing of the TO by increasing the number of receivers for the modified MAODV. This decrement happened because the increment of the receivers this will increase the delivering of data packets, and the TO is a relation between control packets and data packets, so increasing data packets that delivered will decrease the TO as normal equation.

Increasing the number of receivers is increased the total over head, but the ratio of this decrement in coming to be lower by increase the receivers more and more, this clear by the difference of TO from 5 receivers to 10 receivers. But from 30 to 40 receivers the rate of decreasing is less.
The TO is decreased in the modified MAODV by use our new mechanism.

6. Summary, Conclusion and Future Works

In this paper, the MAODV code is enhanced to be more sensing for traffic. It sends the control packets depending on the amount of transmission. Both codes are studied at the same environment. These results were described and analyzed in hopes to gain better results especially in the CO and TO. The final result of this enhancing is that the decreasing of CO and TO. The advantage gained from decreasing the CO and TO is very important. The reliability of the MAODV protocol is enhanced. Other future work that may continue this study is to evaluate the protocol by other metrics such as radio range, terrain size, and others.

An important future research may study the optimal number of senders or receivers to make the protocol give the best performance. It may also study the effect of increasing the area of the MANET or increasing the reliability of each node to send and receive, and study their effects on the performance.

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