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Behaviour of Reactive Routing Protocols of MANET Group Node Demanding Mobility (GNDM) Model

Nitin Tiwari, Prof. Neeraj Shukla, Prof. Balram Purswani

Gyan Ganga College of Technology, Jabalpur, India

Abstract- A mobile ad hoc network (MANET) is a collection of wireless mobile nodes forming a dynamic network Topology without the aid of any existing network infrastructure or centralized administration. Each node participating in the network acts as a host and as a router , means they have to forward packets and identify route as well. Random waypoint is the most common mobility model in most of the simulation based studies of various MANET routing protocols. The Group Mobility Model has been generated by Impact of Mobility Patterns on Routing in Ad-hoc Network (IMPORTANT). In the present communication is an attempt to develop a Group Mobility Model named Group Node Demanding Mobility 9GNDM) model, which provide the facility to assign number of nodes in a group according to demand. We have analyzed the Packet Delivery Ratio (PDR), Average End to End delay, Average Throughput, Normalized Routing Load (NRL) and number of Drop packets in CBR traffic model using reactive routing protocol, AODV . Research efforts have focused much in evaluating their performance with same number of nodes in each group as well as different number of nodes in each group. Simulations has been carried out using NS-2 simulator

Index Terms- MANET, IMPORTANT, CBR, GNDM, PDR, NRL, NS-2.

I. INTRODUCTION

A Mobile Ad hoc Networks (MANET) represents a system of wireless mobile nodes that move arbitrarily and dynamically self-organize in to autonomous and temporary network topologies, allowing people and devices to seamlessly communicate without any pre-existing communication architecture. Such infrastructure less networks are usually needed in battlefields, disaster areas, and meetings, because of their capability of handling node failures and fast topology changes. The most important characteristics are dynamic topology, where nodes can change position quite frequently, so we require such routing protocol that quickly adapts to topology changes.

Normal routing protocol, which works well in fixed networks does not show same performance in Mobile ad-hoc Networks. In MANET routing protocols should be more dynamic so that they quickly respond to topological changes[1]. A number of protocols have been developed to accomplish this task.

Routing paths in MANET potentially contain multiple hops, and each node has the responsibility to act as router[2]. Routing in MANET has been a challenging task because of high degree of node mobility. MANET routing protocol must have the following characteristics:

1) Keep the routing table up-to-date and reasonably small,
2) Select the best route for given destination and
3) Converge within an exchange of a small amount of messages[3].

There are several mobility models such as Random Way Point Model, Freeway Mobility Model, Manhattan Mobility Model and Reference Point Group Mobility Model (RPGM) and Gauss Markov Mobility Model etc.

Bindra, Maakar and Sangal[4] have studied performance evaluation of two reactive routing protocols of MANET using Group Mobility Model. In which they compare the performance of AODV and DSR with CBR and TCP traffic. In present paper, we have compared two routing protocols (AODV and DSDV) with CBR and TCP traffic with Group Mobility Model. PDR, Average End to End delay, Average Throughput, Normalized Routing Load and number of Drop packets has been evaluated as the function of Group and constant mobility speed..

This paper is organized in five sections. Section 2 gives brief description of studied routing protocols. Section 3 describes simulation environment, Reference Point Group Mobility (RPGM) Model and performance metrics. Simulation results are discussed in section 4. Section 5 describes our conclusion and future scope.

II. DESCRIPTION OF MANET ROUTING PROTOCOLS

Description of AODV protocol in brief is as follows:

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

AODV [5] is a reactive protocol, which performs Route Discovery using control messages route request (RREQ) and route reply (RREP) whenever a node wishes to send packets to destination. To control network wide broadcasts of RREQs, the source node uses an expanding ring search technique. The forward path sets up an intermediate node in its route table with a lifetime association RREP. When either destination or intermediate node using moves, a route error (RERR) is sent to the affected source node. When source node receives the (RERR), it can reinitiate route if the route is still needed. Neighborhood information is obtained from broadcast Hello packet. As AODV protocol is a flat routing protocol it does not need any central administrative system to handle the routing process. AODV tends to reduce the control traffic messages overhead at the cost of increased latency in finding new routes. The AODV has great advantage in having less overhead over simple protocols which need to keep the entire route from the source host to the destination host in their messages. The RREQ and RREP messages, which are responsible for the route discovery, do not increase significantly the overhead from these control messages. AODV reacts relatively quickly to the topological changes in the network and updating only the hosts that may be affected by the change, using the RRER message. The Hello messages, which are responsible for the route maintenance, are also limited so that they do not create unnecessary overhead in the network. The AODV protocol is a loop free and avoids the counting to infinity problem, which were typical to the classical distance vector routing protocols, by the usage of the sequence numbers [6].

III. SIMULATION ENVIRONMENT

The simulation is done with the help of NS-2 simulator version 2.34 [7]. The network contains 60 nodes randomly distributed under 4 and 5 groups in a 1000m X 1000m area with speed of 5m/s as basic scenario. The simulation time is 600s.

Parameter	Value
No. of nodes	60
No. of Groups	4, 5
Protocols	AODV
Simulation Time	600s
Speed Deviation	5m/s
Angle of Deviation	15
Traffic Type	CBR
Mobility Model	RPGM, GNDM
Area	1000m X 1000m

Table 1: Basic Simulation Scenario

3.1. Reference Point Group Mobility (RPGM) Model

Group mobility can be used in military battlefield communication, where the commander and soldiers form a logical group. Here, each group has a logical center (group leader or commander) that determines the group's motion behavior. Each member of the group (soldier) is uniformly distributed in neighborhood of group leader (commander). Subsequently, at every instant, each node has a speed and direction that is derived by randomly deviating from that of the group leader[8].

Each node derivates from its velocity randomly from that of leader. The movement in group mobility can be defined as follows:

$| V_{member} (t) | = | V_{leader} (t) | + random () * SDR * max\_spee$ ……………………...(1)

$| \Theta_{member} (t) | = | \Theta_{leader} (t) | + random () * SDR * max\_angle$ …………………(2)

Where 0 <= SDR (Standard Deviation Ratio) and ADR (Angle Deviation Ratio) <= 1.

SDR and ADR are used to control the deviation of the velocity of group members from that of the leader. Since the group leader mainly decides the mobility of group members, group mobility pattern is expected to have high spatial dependence for small values of SDR and ADR.

3.2. Group Node Demanding Mobility (GNDM) Model

Generally, Reference Point Group Mobility (RPGM) model can be used with equal number of nodes assigned in a group. The Group Node Demanding Mobility (GNDM) model is developed to assign demanding number of nodes to each group.

The Algorithm for GNDM Model is as follows:

```
Assume:
in_name, mobilenode as Two Dimension Dynamic Array
x as One Dimension Array
Current_Time,Simulation_Time,GROUP_NUMBERS,
NODE_NUMBERS as Integer
SPEED_DEV, ANGLE_DEV as Real
Let:
    Simulation_Time = 100 //second
Begin:
    GROUP_NUMBERS = input("Number of Groups")
   FOR I = 1 To GROUP_NUMBERS
      x [I] = input("Number of node in Group")
   NEXT I
     SPEED_DEV = input("Speed of Deviation")
     ANGLE_DEV = input("Angle of Deviation in degree")
     ANGLE_DEV = ANGLE_DEV / 2.314 * 180
 FOR I = 1 To GROUP_NUMBERS
  n_name [I] = input("Reference Point trace file for Group")
NEXT I
FOR I = 1 To GROUP_NUMBERS
   NODE_NUMBERS = x [I]
   FOR J = 1 To NODE_NUMBERS
        mobilenode [I][J].initialize_node( ) and save in
        output trace file
   NEXT J
NEXT I
FOR Current_Time = 0 To Simulation_Time
    FOR I = 1 To GROUP_NUMBERS
         NODE_NUMBERS = x [I]
         FOR J = 1 To NODE_NUMBERS
           mobilenode [I][J].update_node( ) and save in
  output trace file
         NEXT J
    NEXT I
 NEXT Current_Time.
End.
```

3.3. Performance Metrics

In present performance metrics, that we have been used for performance evaluation of ad-hoc network protocols. The following metrics are applied to comparing the protocol performance. These metrics are suggested by MANET working group for routing protocol evaluation [9].

Average Throughput: The sum of the data packets generated by every source, counted by k bit/s.

Average End to End Delay: This includes all possible delays caused by buffering during routing discovery latency, queuing at the interface queue, and retransmission delays at the MAC, propagation and transfer times.

Packet Delivery Ratio: The ratio between the number of data packets originated by the "application layer" CBR sources and the number of data packets received by the CBR sink at the final destination [10].

Normalized Routing Load: The sum of the routing control messages such as RREQ, RREP, RRER, HELLO etc, counted by k bit/s.

Number of Drop Packets: The number of the data packets originated by the sources failure to deliver to the destination.

IV. RESULTS

We have made an attempt to evaluate the performance of reactive routing protocol, AODV over 4 group and 5 group) of nodes using Reference Point Group Mobility (RPGM) and Group Node Demanding Mobility (GNDM) models in a area of 1000m X 1000m with CBR traffic. The results, which obtain are as discussed as follows

The Average Throughput with CBR Traffic Type of AODV in RPGM and GNDM models with 4 Group and 5 Group are shown in the figure 1.

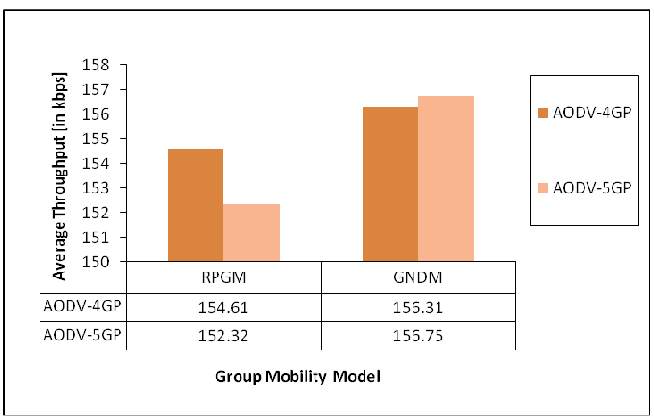

Figure 1: Average Throughput of AODV in RPGM and GNDM models with 4 and 5 Group

Figure 1 shows Average throughput performance of AODV with CBR traffic in RGPM and GNDM with 4 and 5 groups. The Average Throughput with RGPM model is less than GNDM model in both groups. In RPGM model, Throughput is decreased with increasing group, while in GNDM model; Average Throughput is slightly increased with increasing group.

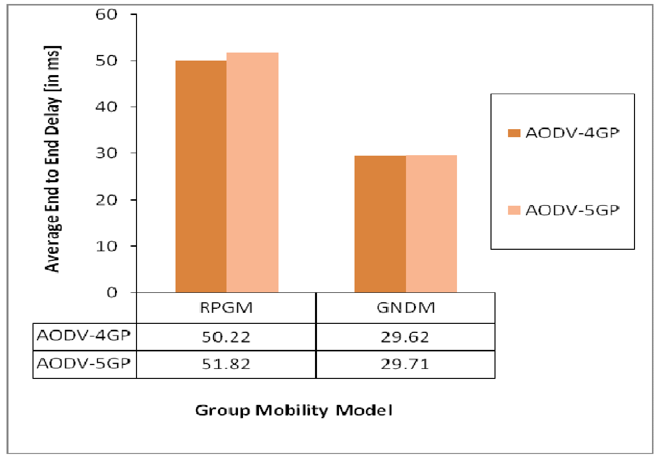

Figure 2: Average End to End Delay of AODV in RPGM and GNDM models with 4 and 5 Group

Figure 2 shows that Average End to End Delay performance of AODV with CBR traffic in RGPM and GNDM with 4 and 5 groups. The Average End to End Delay with GNDM model is much less than the RPGM model. In RGPM model, Average End to End Delay is slightly increases with increasing group, while Average End to End Delay is nearly same in GNDM model. However GNDM model perform well over the RPGM in both groups.

The Packet Delivery Ratio (PDR) with CBR Traffic Type of AODV in RPGM and GNDM with 4 Group and 5 Group are shown in the figure 3.

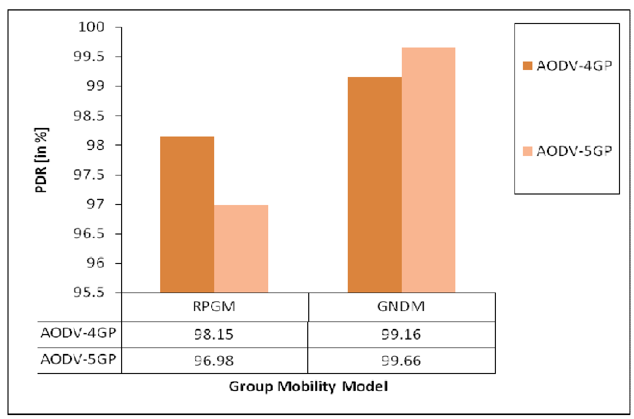

Figure 3: Packet Delivery Ratio of AODV in RPGM and GNDM models with 4 and 5 Group

Figure 3 shows that Packet Delivery Ratio (PDR) of AODV with CBR traffic in RGPM and GNDM with 4 and 5 groups. The Packet Delivery Ratio (PDR) of GNDM model with both groups is more than the RPGM group. In RPGM, the Packet Delivery Ratio is decreases with increasing number of groups, but in GNDM, the Packet Delivery Ratio is increases with increasing number of groups In both groups, the Packet Delivery Ratio in GNDM is better than RPGM.

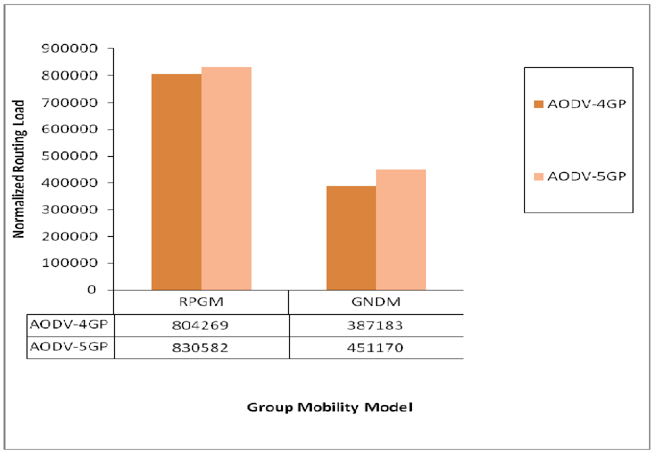

Figure 4: Normalized Routing Load of AODV in RPGM and GNDM models with 4 and 5 Group

Figure 4 shows that Normalized Routing Load of AODV with CBR traffic in RGPM and GNDM with 4 and 5 groups. The Normalized Routing Load is increased with increasing groups with both mobility models. The Normalized Routing Load is very high in RPGM model in comparison of GNDM model. Thus GNDM model perform well over RGPM model in terms of Normalized Routing Load.

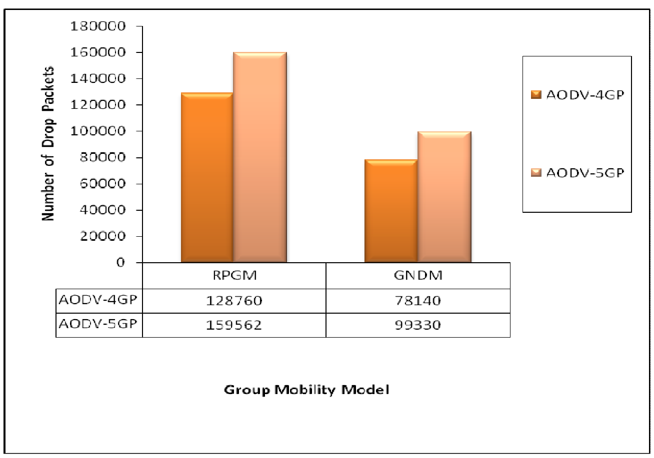

Figure 5: Number of Drop Packets of AODV in RPGM and GNDM models with 4 and 5 Group

Figure 5 shows Number of Drop Packets of AODV with CBR traffic in RGPM and GNDM with 4 and 5 groups. The Number of Drop Packets in both mobility models increases with increasing number of groups. The Number of Drop Packets in GNDM model is less than the RPGM model. Thus, GNDM performs well over the RPGM in terms of Number of Drop Packets along with both groups.

V. Conclusion and Future Scope

From the above simulation results, we observe that Average Throughput, Average End to End Delay, Packet Delivery Ratio, Normalized Routing Load and Number of Drop Packets performance of AODV with CBR traffic in GNDM model with 4 and 5 groups is perform well over the RPGM model.

These results indicate that reactive routing protocol AODV l with CBR traffic in GNDM model perform well in comparison of RPGM model. In future the work will enhance to evaluate and measure performance of these routing protocols with more number of groups under these scenarios and other routing protocol as well.

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Authors

First Author – Nitin Tiwari, M.Tech. Scholar, Gyan Ganga College of Tecnology, Jabalpur, Email: iwarinitin27@gmail.com
Second Author – Prof. Neeraj Shukla, Professor & Head, Gyan Ganga College of Tecnology, Jabalpur, Email: neerajshukla28@gmail.com
Third Author – Balram Purswani, Asst. Professor, Gyan Ganga College of Tecnology, Jabalpur, Email: balpurg@gmail.com