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Comparative Analysis of MANET Routing Protocol by Varying Number of Groups in Group Mobility Model

Ms. Rini Sara Alex
M. Tech Student (ECE), UIT
Allahabad, India
rinisaraalex@gmail.com

Ms. Swati Chauhan
Asst. Professor (ECE Dept.). UIT
Allahabad, India
chauhan.swati20@gmail.com

Abstract- A mobile ad hoc network (MANET) is a network consisting of wireless mobile nodes that are self configuring and communicate with each other any centralized infrastructure. Each device in a MANET can move freely and independently in any direction and will therefore change its links to other devices frequently. In order to facilitate the communication within a network, a routing protocol is used to discover the routes between nodes. The preeminent goal of such an ad-hoc network routing protocol is to establish correct and efficient routes between a pair of nodes so that messages are delivered in a timely manner. In this paper, we have compared the performance of MANET routing protocol AODV in Group Mobility Model. We have analyzed the performance of protocol by varying the number of groups in a Group Mobility Model. The simulation has been carried out in Qualnet 6.1. The metrics used for performance are Average Jitter, Throughput, End-End delay and Data Received. It has been observed that AODV gives better result when there are maximum numbers of groups in Group Mobility Model.

Keywords: *MANET, AODV, CBR, Group Mobility Model, Qualnet 6.1*

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1. INTRODUCTION

For the past few years there has been a tremendous increase in the usage of notebook, laptop and PDAs while their prices are steadily decreasing. Being battery operated and with increasing processing capabilities, these devices are allowing people to get internet access easily whether being wired or wireless network. Though traditionally wired network was the only solution to get network or internet access, the use of wireless technology has become a more popular technique to access Internet or connect to a local network for a private, educational or private users. It is much easier and less expensive to create a wireless network as compared to a wired network, since wired cables are more expensive. Moreover, additional devices can be added to wireless network at less cost. Wireless equipped devices are called Nodes and every node has a fixed transmission range to communicate with each other. If the desired node(receiver) is out of range from the transmitter then the intermediate nodes works as the routers and forwards the packets towards the destination and thus communication can be established between nodes by multiple hops. In this type of networking, nodes might be moving arbitrarily which result in multi hop networks with dynamic topology. This type of networks is called Mobile Adhoc Network (MANET). MANET is a collection of wireless mobile nodes which dynamically forms a temporary network without the use of any existing infrastructure or centralized administration. Since nodes in MANET moves arbitrarily the network may experience rapid and unpredictable toplogy changes. Thus routing paths in MANETs contain multiple hops and every node acts as a router. Routing in MANET is a challenging task and a number of protocols have been developed to accomplish this task.

There are various mobility models such as Random WayPoint, Reference Point Group Mobility Model (RPGM), Manhattan Mobility Model, Freeway Mobility Model,Gauss Markov Mobility Model etc that have been proposed for evaluation.

In this paper we have compared the performance of AODV routing protocol for performance comparison in the scenario of Group Mobility Model such as battlefield, rescue operations etc. The purpose of this work is to understand the working mechanism of nodes in Group Mobility Model as the number of groups is increased and the performance of AODV protocol in Group Mobility Model.

The rest of the paper is organized as follows. The next section gives a brief description about Group Mobility Model. In section 3, we have described about AODV protocol. Section 4 deals with the simulation setup and results obtained.

2. GROUP MOBILITY MODEL

The group mobility models are models where each node is dependent on each other or a predefined leader node. In an adhoc network there are many situations where a team work is needed such as a battlefield, a rescue operation or search teams, for such condtions the group mobility models have been modeled. Here all the mobile nodes move all together with a pre-assigned reference point or region. The most commonly used model is the Reference Point Group Mobility Model. This model represents the random motion of a group of Mobile Nodes(MN) as well as the individual MN within the group. The group movements are based upon the path travelled by the logical center of the group. The logical center of the group is used to calculate the group motion via a group motion vector, GM. The motion of the group center completely characterizes the movement of its corresponding group of MNs, including their direction and speed respectively. Individual mobile nodes randomly move about on their own pre-defined reference points, whose movements depend on the group movement.

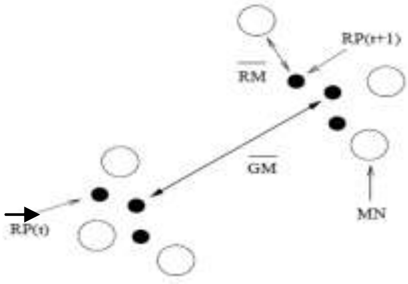

Figure1: Movement of three MNs using RPGM model

The figure 1 shows an example of two group models. Each Group has a group motion vector GM. This figure also gives us an illustration of how a node moves from time t to t+1. First, the reference point of a node moves RP(t) to RP(t+1) with group motion vector GM. The new node position is generated by adding a random motion vector RM to the new reference point(t+1). Vector RM has its length uniformly distributed within a certain radius centered at the reference point and its direction uniformly distributed between 0 and 360 degree. This random vector RM is independent from the previous node location.

The RPGM model defines the motion of groups explicitly by giving a motion path for each group. The RPGM model is designed to depict scenarios such as an avalanche rescue. During an avalanche rescue, the human guides tend to set a general path for the dogs to follow, since they usually know the approximate location of the victims. The dogs can create their own random paths around the general area chosen by their counter parts [3].

3. AODV ROUTING PROTOCOL

AODV is a relative of the Bellmann-Ford distant vector algorithm, but is adapted to work in a mobile environment. Ad hoc on-demand distance vector (AODV) routing protocol is a typical reactive routing protocol. It creates routes between nodes only as required by the application layer. It uses traditional routing tables with one entry per destination. It minimizes the number of required broadcasts, by creating routes on demand basis. For nodes which are not selected in the path, AODV do not maintain any routing information or do not take part in the routing table exchanges. AODV prepares loop free routes. It provides unicast, multicast and broadcast capabilities to all nodes. It disseminates information about link breakage to its neighbouring nodes. It uses this information to minimize the broadcast of control packets. A routing table expires if not used recently. AODV uses destination sequence numbers to ensure that all routes are loop-free and it contains the most recent information. Each node has its own sequence number and broadcast-id. The sequence number is used to indicate the freshness of routing information and to prevent routing loop. The algorithm uses different types of messages to discover and maintain the links.

When a source node wants to send packets to the destination but no route is available then, it initiates a route discovery process. In the route discovery process, the source node broadcasts a route request (RREQ) packet to all its neighbours. The RREQ packet consists of the destination node's IP address, the last known sequence number for that destination and the source's IP address and the current sequence number. The RREQ also contains a hop count, initialized to zero and a RREQ ID. The RREQ ID is a per-node, monotonically increasing counter that is incremented each time the node initiates a new RREQ. In this way the source IP address together with the RREQ ID identifies a RREQ and can be used to identify the duplicates. Intermediate nodes can reply to the RREQ only if they have a route to the destination whose corresponding destination sequence number is greater than or equal to that contained in the RREQ.

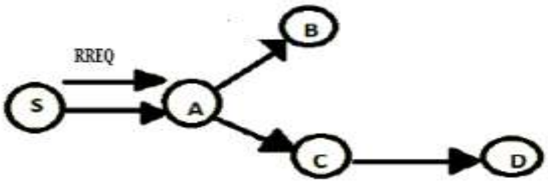

Figure 2: Route Discovery

During the process of forwarding the RREQ, the intermediate nodes record the address of the neighbor in their route table from which the first copy of broadcast packet is received, thereby establishing a reverse path. When the RREQ reaches the destination or intermediate nodes with a fresh route, the destination/intermediate node responds with a route reply (RREP) packet back to the node from where it received the RREQ. The RREP contains the source's IP address, the destination node's IP address the destination sequence number and the hop count. The hop count in the RREP is set equal to the node's distance from the destination. If the destination itself is creating the RREP the hop count is set equal to zero. The reverse route that was created as the RREQ was forwarded is utilized to route the RREP back to the source node. Once the source node receives the RREP, it can utilize the path for the transmission of data packets. If the source receives more than one RREP, it selects the route with the greatest sequence number and smallest hop count.

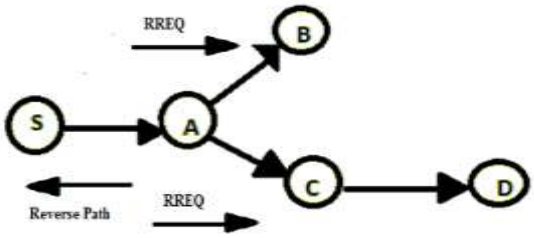

Figure 3: Reverse path setup by A to S

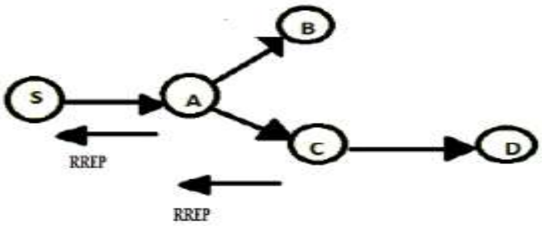

Figure 4: Route Reply from C

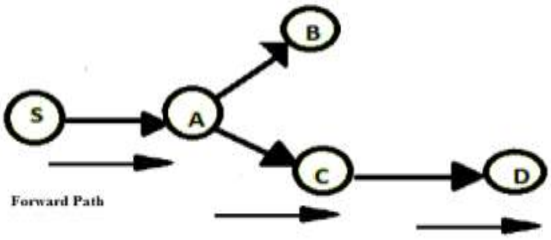

Figure 5: Forward path setup by S to D

Once a route is established, it must be maintained as long as it is needed. A route that has been recently used for the transmission of data packets is known as Active Routes. Because of the mobility of nodes, links along the path may get break. When a link break occurs along an active path, the node closer to the source node invalidates the routes to all the destinations in the routing table. It then creates a route error (RERR) message. In this message it lists all of the destinations that are now unreachable due to the link break. After creating the RERR message, it sends this message to all its neighbors that were utilizing this link. These nodes in turn invalidate the broken routes and send their own RERR messages to their upstream nodes that were utilizing the link. Once the source node receives the RERR, it can repair the route if the roué us still needed.

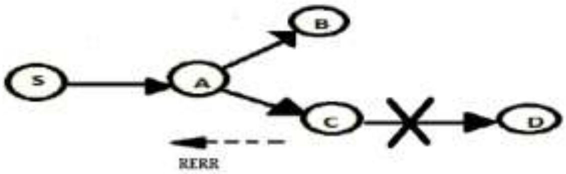

Figure 5: Link Breakage

4. SIMULATION SETUP

The simulation has been carried out using Qualnet version 6.1, a software that provides scalable simulations of Adhoc Networks. The traffic source used here is CBR (Constant Bit Rate). The Group Mobility model uses the rectangular field having an area of 1500m*1500m. I have taken three cases of simulation, where the number of nodes and groups are varied in each case. And the performance analyses of AODV routing protocol with varying number of groups are studied comparatively in this paper. The simulation parameters used are given in the table below.

Parameters	**Values**
Qualnet	6.1
Channel Type	Wireless Channel
Number of Nodes	10,20,50
Topological Area	1500m*1500 m
Mobility Model	Group Mobility Model
Routing Protocol	AODV
Application	CBR
Packets Size	512 Bytes
Packets Send	100
Start Time	1s
End Time	150s

Table 1: Simulation Parameters

4.1. Performance Metrics

There are number of performance metrics that can be used for the evaluating performance of MANET routing protocols. Here I have used the following performance metrics for evaluating the performance of AODV in Group Mobility Model.

4.1.1. Jitter.

Jitter is the difference between the expected time of arrival of a packet and the actual time of arrival. It is caused by delays and congestion in the packet in network.

4.1.2. Throughput

The throughput is defined as the the percentage of the packets received by the destination among the packets sent by the destination. The throughput is measured in bits per second (bits/s or bps).

4.1.3. End-End Delay

The end-end delay is the time interval taken when a data packet generated from Constant Bit Rate source is completely received to the application layer of the destination.

4.1.4. Data Received

It is the measure of the packets received by the destination successfully.

5. RESULT

In this paper, I have taken three cases with varying number of nodes in each case.

5.1. Case 1: With 10 nodes

In this case there are 10 nodes and two groups. Group 1 from node1-5 and Group 2 from node 6-10.

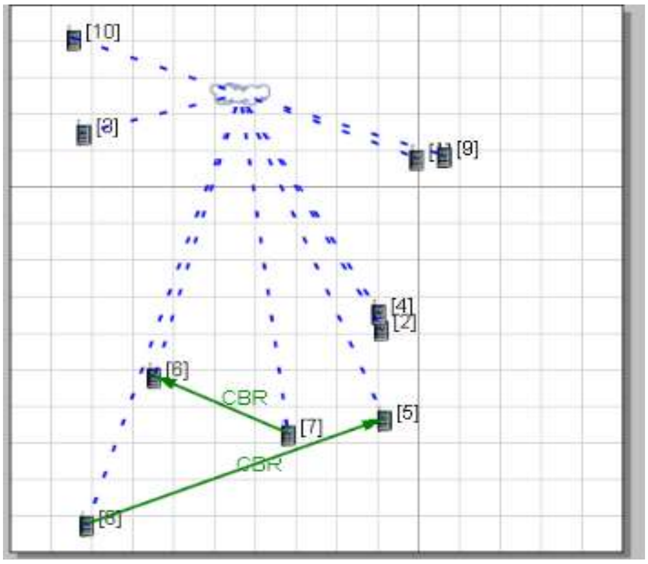

Figure 6: Simulation snapshot of 10 nodes

The CBR is connected between node 7- 6 and 8-5. Node 7 and 6 belongs to the same group hence, they are intra-group nodes and node 8 and 5 belongs to two different groups hence, they are inter-group nodes.

5.1.1. Jitter

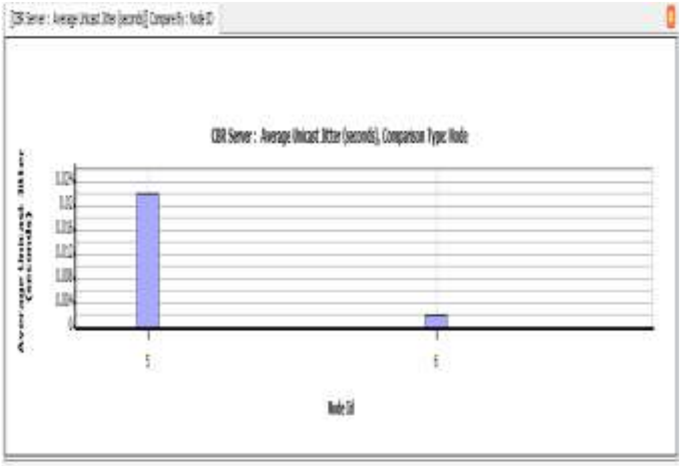

Figure 7: Jitter for 10 nodes

The jitter for node 5 is high since nodes 8 and 5 is an intergroup node and the distance between nodes is large as compared to distance between nodes 6 and 7.

5.1.2. Throughput

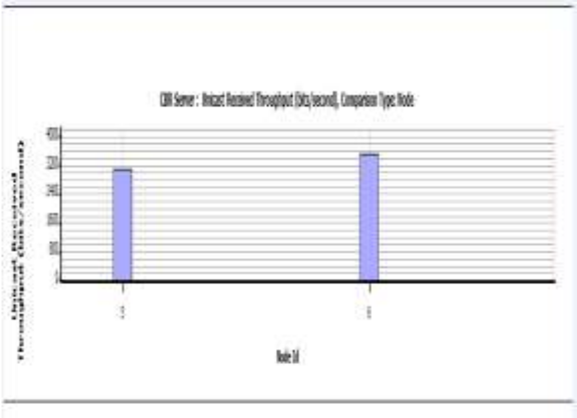

Figure 8: Throughput for 10 nodes

Node 5 has the lowest throughput since it is intergroup and the distance is large and Node 6 has the highest throughput because it is intragroup and the distance is low.

5.1.3. End-End Delay

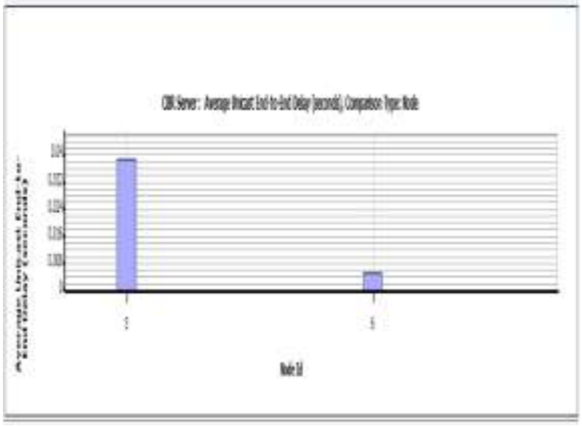

Figure 9: End-End Delay for 10nodes

Node 5 has the highest end-end delay and node 6 has the lowest.

5.1.4. Data Received

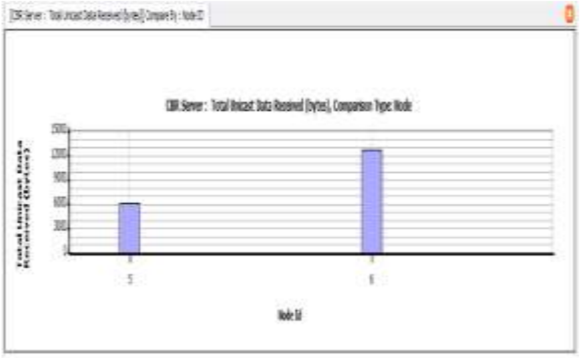

Figure 10: Data received for 10 nodes

Node 5 has the lowest amount of data received and Node 6 has the highest amount of data received.

Since fewer nodes are deployed in this case the intergroup communication is poor and the intragroup communication better. Hence we need to increase the number of nodes in the area and simulate the performance in that case.

5.2. Case 2: With 20 nodes

In this case there are 20 nodes and four groups. The nodes assigned to each group are as follows:

Group1: Node1-5
Group2: Node6-10
Group3: Node11-15
Group4: Node16-20

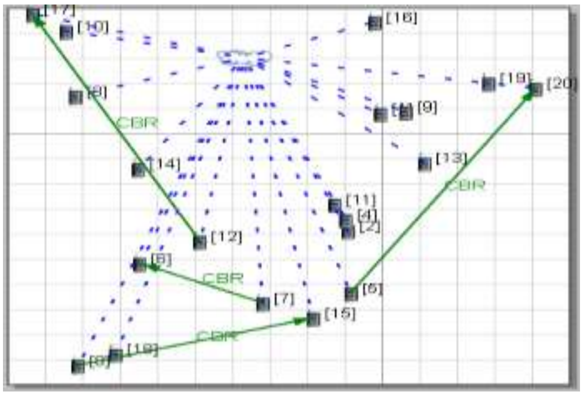

Figure 11: Simulation snapshot of 20 nodes

The CBR is connected between node 7-6 which is an intragroup node and node 8-15, node5-20 and node12-17 are intergroup nodes

5.2.1. Jitter

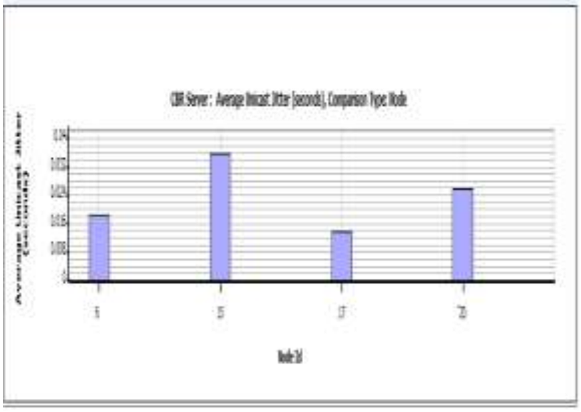

Figure 12: Jitter for 20 nodes

Node 15 has the highest jitter since node 8 and node 15 are intergroup nodes and only one node is deployed in between them. Node 17 has the lowest jitter. Both nodes 15 and 17 belong to closer lying group. We can see node 20 has an average jitter since they belong to far groups and the communication is also better.

5.2.2 Throughput

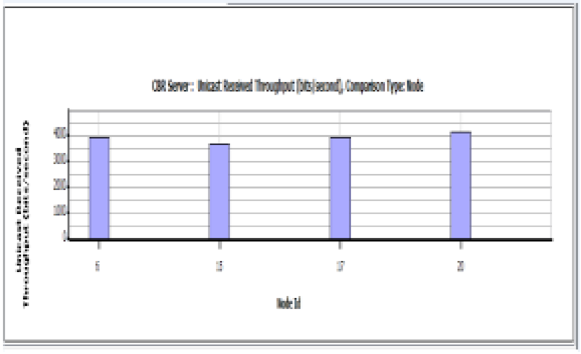

Figure 13: Throughput for 20 nodes

Node 20 has the highest throughput since it belongs to intergroup and no nodes are deployed in between as we can see in the figure 11. Node 15 has the lowest throughput since its jitter is high.

5.2.3 End – End Delay

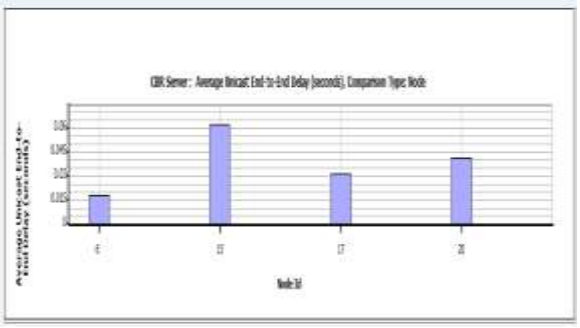

Figure 14: End-End Delay for 20 nodes

Node 15 has the highest end-end delay, it is an intergroup node and its jitter is also high. Node 6 has the least end-end delay as its jitter is low. So the data packets are transmitted with less delay.

5.2.4 Data Received

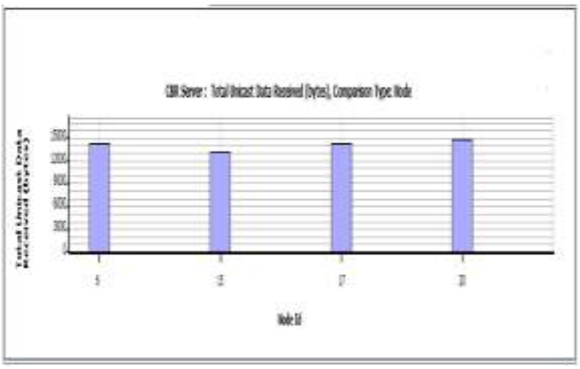

Figure 15: Data Received for 20 nodes

Node 20 has the highest amount of data received since it has a good throughput and Node 15 has the least.

5.3 Case 3: With 50 nodes

In this case there are 50 nodes and ten groups. The nodes assigned to each group are as follows:

Group1: Node1-5
Group2: Node6-10
Group3: Node11-15
Group4: Node16-20
Group5: Node21-25
Group6: Node26-30
Group7: Node31-35
Group8: Node36-40
Group9: Node41-45
Group10: Node46-50

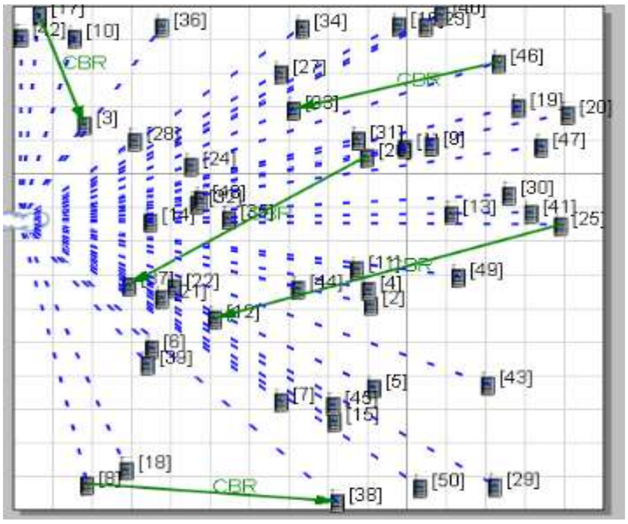

Figure 16: Simulation snapshot of 50 nodes

The CBR is connected between node 17-3, 46-33, 26-37, 8-38 and 25-12. In this case the CBR is connected between intergroup nodes.

5.3.1 Jitter

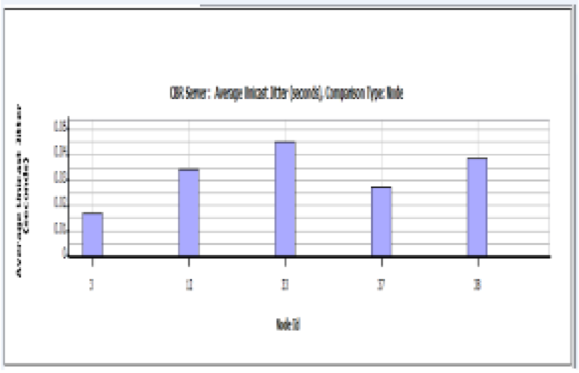

Figure 17: Jitter for 50 nodes

Node 33 has the highest jitter due to delay in packets and node 3 has the least since it covers less distance.

5.3.2 Throughput

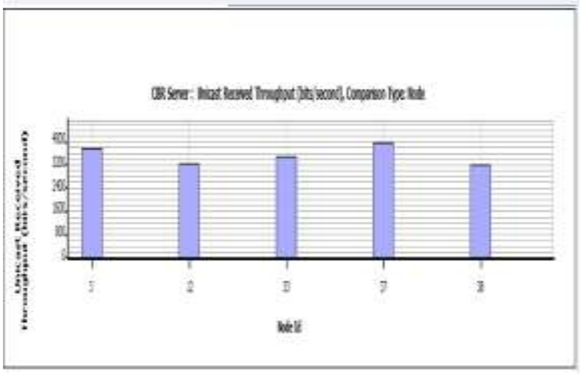

Figure 18: Throughput for 50 nodes

As we can see Node 37 has the highest throughput and node 12 the least since, node 37 has lower distance as compared to node 12.

5.3.3 End-End Delay

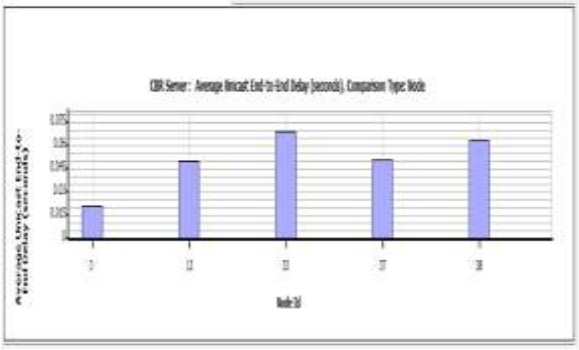

Figure 18: End-End Delay for 50 nodes

Node 33 has the highest end-end delay since the distance covered by node 46-33 is larger than node 17-3. And node 3 has the lowest delay.

5.3.4 Data Received

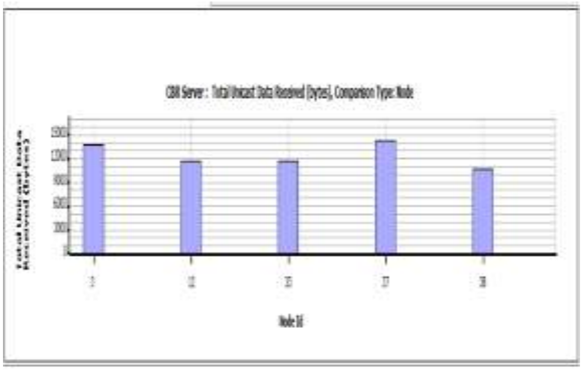

Figure 19: Data Received for 50 nodes

Node 37 has the highest amount of data received because of good throughput and node 12 has the lowest.

6. RESULT AND DISCUSSION

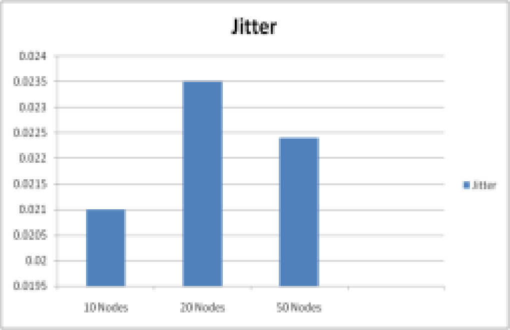

Figure 20: Jitter

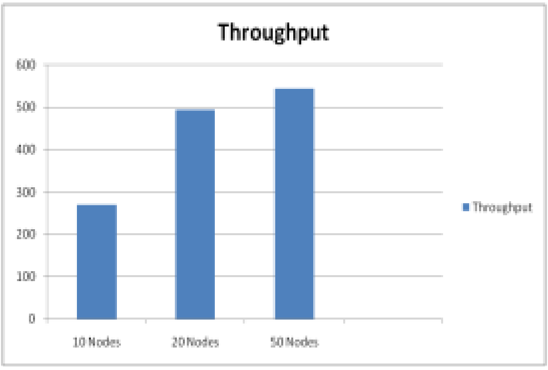

Figure 21: Throughput

Figure 22: End-End Delay

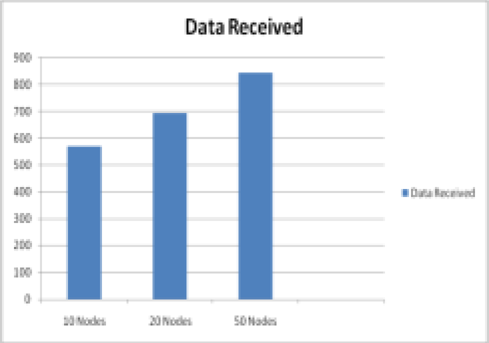

Figure 23: Data Received

From the above four results, we can see that AODV performs very well as the number of nodes and groups are increased and a better communication is established. In case of 50 nodes, it has better throughput and amount of data received is high as compared to all other cases. We can also see that case 3 has lower jitter and end-end delay.

Thus we can say that in a particular area as the number of groups is increased we can establish a better communication between the nodes. We should check that the number of nodes should not go beyond the average number of nodes that should be included in an area. The average number of nodes varies according to area we are using, because if the nodes exceed the average number, there would be interference between nodes which would lead to poor communication.

This would be helpful in a disaster rescue area where there if we introduce more rescue men for operation we can help out more number of peoples from the area. Like this we can imply this to many other applications.

REFERENCES

[1] Rani, Vanita. Dhir, Dr.Renu. “A Study of Ad-Hoc Network: A Review”, IJARCSSE, Volume 3, Issue 3, March 2013, pp135-138.

[2] C.E. Perkins and E.M. Royer., Ad hoc on demand Distance Vector routing, mobile computing systems and applications, 1999. Proceedings. WMCSA ’99. Second IEEE Workshop on, 1999, p90 - p100.

[3] T. Camp, J. Boleng, and V. Davies, “A Survey of Mobility Models for Ad Hoc Network Research”, in Wireless Communication and Mobile Computing (WCMC): Special issue on Mobile Ad Hoc Networking: Research, Trends and Applications, vol. 2, no. 5, pp. 483-502, 2002.

[4] Bai,Fan. Helmy,Ahmed. “A Survey of Mobility Models in Wireless Adhoc Networks”

[5] Liu, Changling. Kaiser,Jorg. “A Survey of Mobile Ad Hoc network Routing Protocols”, University of Magdeburg,2005

[6] Muralishankar, V.G.Dharma, Dr.E.George.Raj, Prakash. “Routing Protocols for MANET: A Literature Survey”, International Journal of Computer Science and Mobile Applications, Vol.2 Issue. 3, March- 2014, pg. 18-24

[7] Li,XianYang, “Wireless Ad hoc and Sensor Networks-Theory and Applications”, Cambridge University Press 2008.

[8] Murthy, S. and J.J. Garcia-Luna-Aceves, “An Efficient Routing Protocol for Wireless Networks”, ACM Mobile Networks and App. J., Special Issue on Routing in Mobile Communication Networks, Oct. 1996, pp. 183-97.

[9] S. R. Biradar, Hiren H D Sarma, Kalpana Sharma, Subir Kumar Sarkar , Puttamadappa C, “Performance Comparison of Reactive Routing Protocols of MANETs using Group Mobility Model”, International Conference on Signal Processing Systems,2009.

[10] Xiaoyan Hong, Mario Gerla, Guangyu Pei and Ching-Chuan Chiang, “A Group Mobility Model for Ad-hoc Wireless Networks”, ACM/IEEE MSWiM, August 1999.

[11] C. Perkins, E. Belding-Royer, S. Das, “Ad hoc On-Demand Distance Vector (AODV) Routing”, RFC 3561, July 2003.

[12] Stefano Basagni, Marco Conti, Silvia Giordano, Ivan Stojmenovic. “Mobile Ad-hoc Networking", IEEE Press, A John Wiley & Sons,Inc Publication.

[13] Andrew S. Tanenbaum. “Computer Networks”, Fourth edition, Pearson Education year 2003.

[14] QualNet 6.1 User’s Guide: Scalable Network Technologies, Inc.