GROUP MOBILITY MODEL BASED PROACTIVE AND REACTIVE ROUTING PROTOCOL IN MANET

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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, 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 and TCP traffic models using routing protocols namely AODV and DSDV. Research efforts have focused much in evaluating their performance with same number of nodes but divided in different number of groups. Simulations has been carried out using NS-2 simulator

Keywords- *MANET, IMPORTANT, CBR, TCP, PDR, NRL, NS-2.*

1. 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.

2. DESCRIPTION OF MANET ROUTING PROTOCOLS

Description of routing protocols AODV and DSDV in brief are 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].

2.2.   DSDV (Destination Sequenced Distance Vector)

The Destination Sequenced Distance Vector is a proactive routing protocol. Which include freedom from loops in routing tables, more dynamic and less convergence time. Every node in the MANET maintains a routing table which contains list of all known destination nodes within the network along with number of hops required to reach to particular node. Each entry is marked with a sequence number assigned by the destination node. The sequence numbers are used to identify stale routes thus avoiding formation of loops.   In DSDV[7], each node have a routing table, here each table must contain the destination node address, the minimum number of hops to that destination and the next hop in the direction of that destination. The tables in DSDV also have an entry for sequence numbers for every destination. These sequence numbers form an important part of DSDV as they guarantee that the nodes can distinguish between stale and new routes. Here each node is associated with a sequence number and the value of the sequence number is incremented only by the node the sequence number is associated with. Thus, these increasing sequence numbers here emulate a logical clock. Suppose a node receives two updates from the same source then the receiving node here makes a decision as to which update to incorporate in its routing table based on the sequence number. A higher sequence number denotes a more recent update sent out by the source node. Therefore it can update its routing table with more

actual information and hence avoid route loops or false routes.

DSDV determines the topology information and the route information by exchanging these routing tables, which each node maintains. The nodes here exchange routing updates whenever a node detects a change in topology. When a node receives an update packet, it checks the sequence number in the packet. If the information in the packet is older than the receiving node has in its routing tables, then the packet is discarded. Otherwise, information is updated appropriately in the receiving node's routing table. The update packet is then forwarded to all other neighboring nodes (except the one from which the packet came). In addition, the node also sends any new information that resulted from the merging of the information provided by the update packet. The updates sent out in this case, by nodes resulting from a change, can be of two types that is either a full update or a partial update. In case of full updates, the complete routing table is sent out and in case of a partial updates only the changes since last full update are sent out.

3.   SIMULATION ENVIRONMENT

The simulation is done with the help of NS-2 simulator version 2.34 [8]. The network contains 60 nodes randomly distributed under 3 and 4 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	3, 4,5
Protocols	AODV, DSDV
Simulation Time	600s
Speed Deviation	5m/s,7m/s,10m/s
Angle of Deviation	5,10,15
Traffic Type	CBRP
Mobility Model	Group Mobility Model
Packet Size	512byte
Wireless Range	250m
Area	1000m X 1000m

Table 1: Basic Simulation Scenario

3.1.   Reference Point Group Mobility Model (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[9]. 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.

3.3. 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 [10].

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 [11].

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.

4. RESULTS

We have made an attempt to evaluate the performance of one reactive routing protocol, AODV and one proactive routing protocol, DSDV over 3 group, 4 group and 5 group in a area of 1000m X 1000m with CBR   traffic under Group Mobility Model. The results, which obtain are as discussed.

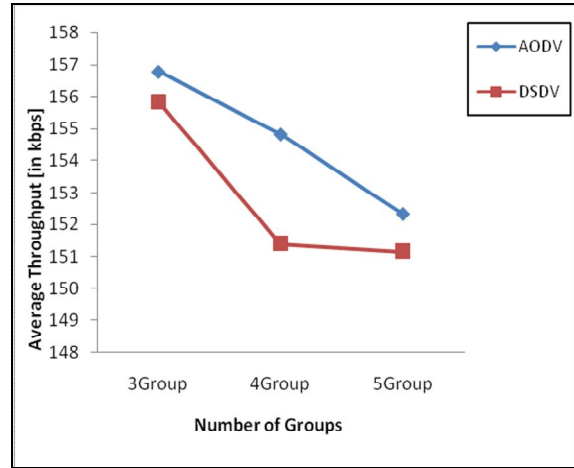The Average Throughput with Traffic Type AODV and DSDV with number of Groups is shown in the figure 1.

Figure 1: Average Throughput with Traffic Type of AODV and DSDV with Number of Groups

Figure 1 shows that Average throughput performance of both AODV and DSDV with increasing number of groups is decreases. The Average Throughput with AODV decreases nearly linear while in DSDV, Average Throughput is decreased from 3 Group to 4 Group and slightly decreased from 4 Group to 5 Group. In CBR traffic, AODV perform well over the DSDV in terms of Average Throughput.
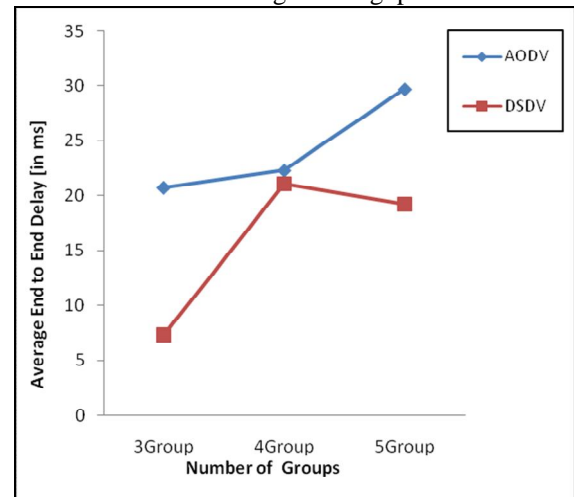

Figure 2: Average End to End Delay with CBR Traffic of AODV and DSDV with Number of Groups

Figure 2 shows that Average End to End Delay performance of AODV and DSDV with CBR traffic along with number of Groups. The Average End to End Delay with AODV slighty increases from 3 group to 4 group and increases rapidly from 4 Group to 5 Group while in DSDV The Average End to End Delay increases from 3 Group to 4 Group and decreases from 4 group to 5 group. In CBR traffic,

DSDV perform well over the AODV because it has less value.

The Packet Delivery Ratio (PDR) with Traffic Type of AODV and DSDV with Number of Groups is shown in the figure 3.
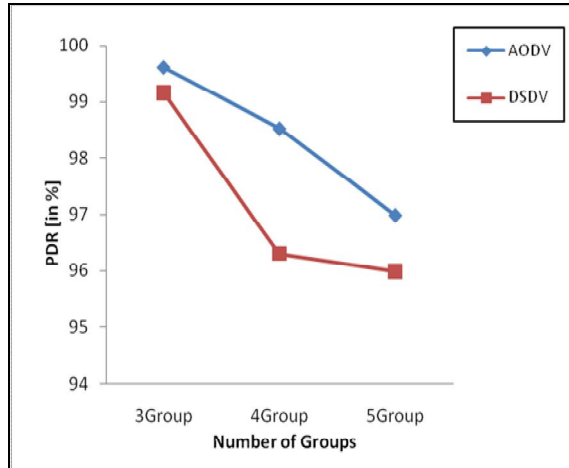

Figure 3: Packet Delivery Ratio with CBR Traffic AODV and DSDV with Number of Groups

Figure 3 shows that Packet Delivery Ratio (PDR) of both AODV and DSDV with CBR Traffic is decrease with increment in group.. In CBR Traffic, the Packet Delivery Ratio of AODV is better than DSDV with all the groups. The Normalized Routing Load with CBR traffic of AODV and DSDV with number of Groups is shown in the figure 4.
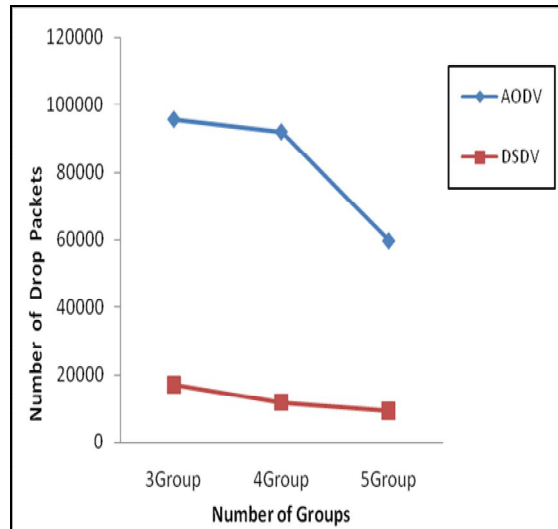

Figure 4: Normalized Routing Load with CBR Traffic of AODV and DSDV with Number of Groups

Figure 4 shows that Normalized Routing Load with CBR traffic of AODV protocol is increased with increasing group, while Normalized Routing Load with CBR traffic of DSDV protocol is decreased with increasing group. Normalized Routing Load of AODV protocol with CBR is less than DSDV protocol with 3 groups; thus AODV perform well over DSDV. The Normalized Routing Overload of DSDV protocol with

CBR traffic is less than the AODV protocol with 5 groups, so DSDV perform well over the AODV protocol.

Figure 5: Number of Drop Packets with CBR Traffic of AODV and DSDV with Number of Groups

Figure 5 shows Number of Drop Packets with CBR traffic of AODV and DSDV with number of groups. It shows that Number of Drop Packets in both AODV and DSDV protocol with CBR traffic are decreases with increasing number of groups. The Number of Drop Packets in DSDV protocol is less than AODV protocol with all groups means DSDV performs well over the AODV in terms of Number of Drop Packets due to less route discovery Process.
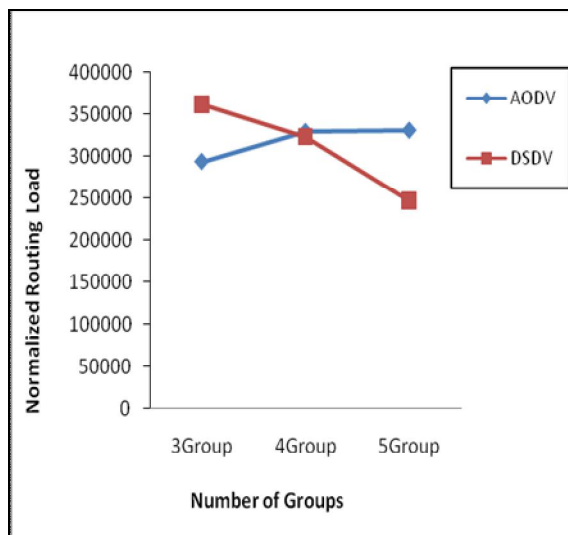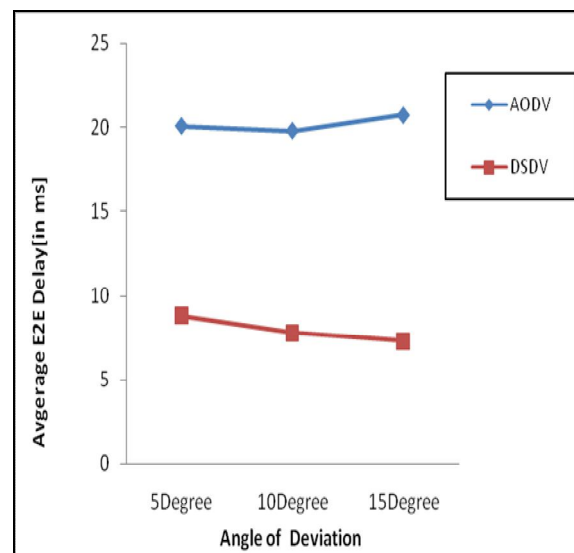

Figure 6: Average End to End Delay with CBR Traffic of AODV and DSDV with Angle of deviation

Figure 6 shows that Average End to End Delay performance of AODV and DSDV with CBR traffic along with 3 Group for deviation of angles. The average End to End delay with AODV slightly increases with increment in angle, while in DSDV slightly decreases. Overall DSDV gives better performance over AODV.
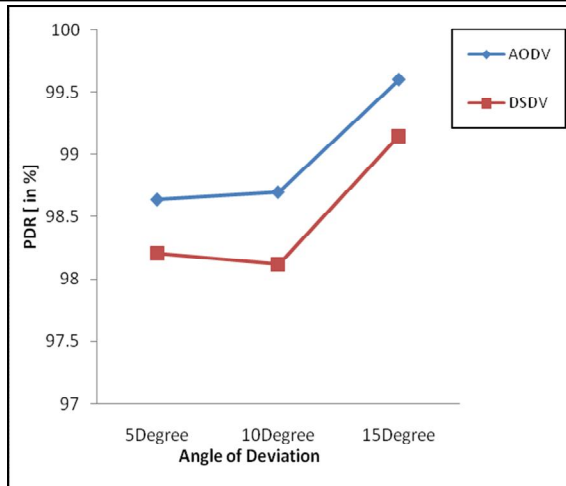
Figure 7: Packet Delivery Ratio with CBR Traffic AODV and DSDV with Angle of deviation

Figure 7 shows that Packet Delivery Ratio (PDR) of AODV with CBR Traffic slightly increases with increment in angle from 5 degree to 10 degree and rapidly increases in deviation of angle from 10 degree to 15 degree. The Packet Delivery Ratio(PDR) of DSDV with CBR Traffic slightly decreases in deviation of angle from 5 degree to 10 degree and then increases from 10 degree to 15 degree. In CBR Traffic, the Packet Delivery Ratio of AODV is better than DSDV with all the angles.
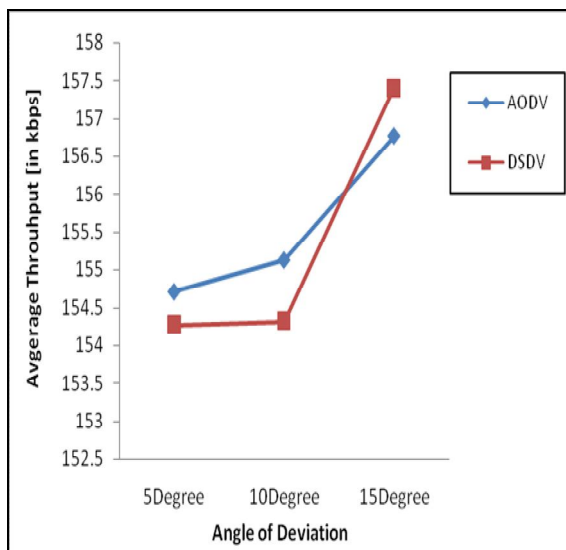

Figure 8: Average Throughput with Traffic Type of AODV and DSDV with Angle of deviation

Figure 8 shows that Average throughput performance of both AODV and DSDV with Angle of deviation. The Average Throughput with AODV increases with angle of deviation from 5degree to 15 degree while in DSDV, Average Throughput is slightly decreased from 5 degree to 10 degree and rapidly increased from 10 degree to 15 degree. In CBR traffic, AODV perform well over the DSDV in terms of Average Throughput with angle 5 degree and 10 degree while DSDV perform well over the AODV with angle 15 degree.
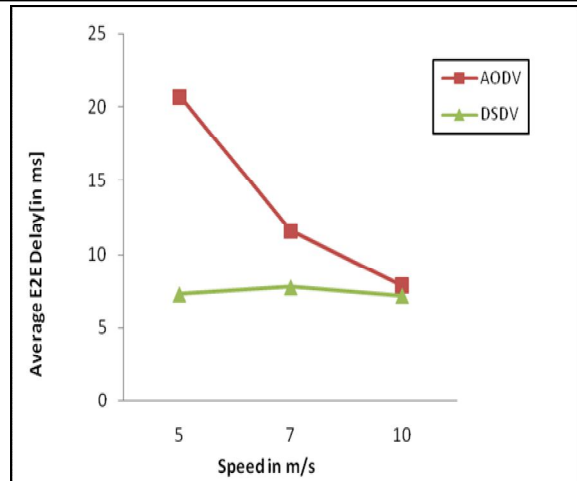

Figure 9: Average End to End Delay with CBR Traffic of AODV and DSDV with deviation in speed

Figure 9 shows that Average End to End Delay performance of AODV and DSDV with CBR traffic along with 3 Group for deviation of speed. The average End to End delay with AODV decreases with increment in speed, while in DSDV slightly increases and then slightly decreases. Overall DSDV gives better performance over AODV.
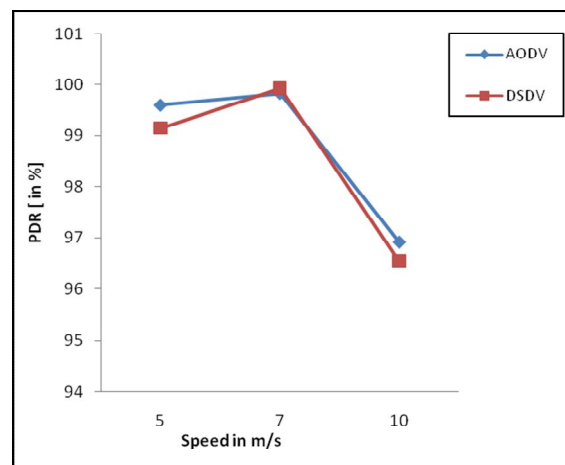

Figure 10: Packet Delivery Ratio with CBR Traffic AODV and DSDV with deviation in speed

Figure 10 shows that Packet Delivery Ratio (PDR) of AODV with CBR Traffic slightly increases with increment in speed from 5 to 7 m/s and rapidly decreases in from 7 to 10m/s. The Packet Delivery Ratio(PDR) of DSDV with CBR Traffic increases in from 5 to 7m/s and then decreases from 7 to 10m/s. In CBR Traffic, the Packet Delivery Ratio of AODV is better than DSDV with all speed.

Figure 11 shows that Average Throughput of AODV with CBR Traffic slightly increases with increment in speed from 5 to 7 m/s and rapidly decreases in from 7 to 10m/s. The Packet Delivery Ratio(PDR) of DSDV with CBR Traffic increases in from 5 to 7m/s and then decreases from 7 to 10m/s. In CBR Traffic, the Average Throughput of AODV is better than DSDV with all speed
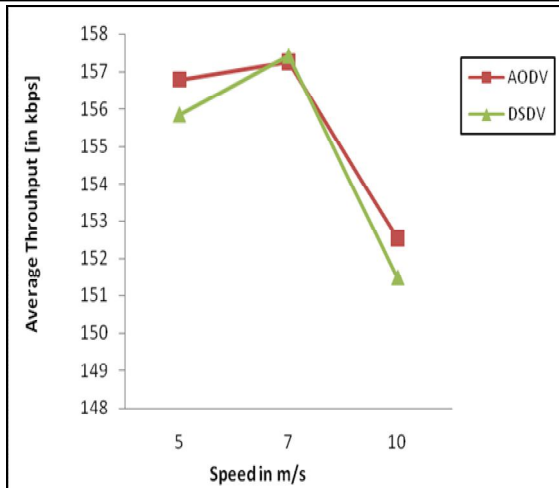
Figure 11: Average Throughput with Traffic Type of AODV and DSDV with deviation in speed

5. CONCLUSION AND FUTURE SCOPE

From the above simulation results, we observe that Average throughput performance of AODV with CBR traffic with all groups is better than DSDV, thus AODV perform well over the DSDV in terms of Average Throughput.

The Average End to End delay with CBR traffic, DSDV perform well over the AODV because it has less value. Average End to End delay of DSDV is less than AODV with all groups.

In CBR Traffic, the Packet Delivery Ratio of AODV is better than DSDV with all the groups. The Packet Delivery Ratio of AODV and DSDV is decreased with increasing number of group.

Normalized Routing Load of AODV protocol with CBR Traffic is less than DSDV protocol with 3 group, Normalized Routing Overload of DSDV protocol with CBR traffic is less than the AODV protocol with 5 groups.

The Number of Drop Packets in DSDV protocol is less than AODV protocol with all group means DSDV performs well over the AODV in terms of Number of Drop Packets.

In case of increasing Speed and Angle of Deviation AODV perform well over the DSDV in term of Average Throughput, Average End to End Delay and Packet Delivery Ratio.

These results indicate that AODV routing protocol perform well with CBR traffic in comparison of DSDV in terms of Average Throughput and Packet Delivery Ratio, while DSDV routing protocol perform well with CBR traffic over AODV in terms of Average End to End Delay and Number of Drop packets. Normalized Routing Load of AODV is less

with 3 Group while Normalized Routing Load of DSDV is less with 5 Group.

In future we will try to evaluate and measure performance of these routing protocols with more number of groups under these scenarios and other routing protocol as well. Current work is an attempt under equal number of distribution of node in each group, in future the performance should be measured in unequal number of distribution of node in each group as well.

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