# An Estimation of Routing Protocols in Mobility Models Used For Ad Hoc Networks: Simulation Study

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## ABSTRACT
Recently, various researchers have turned into involved in Ad-hoc Networks to assemble a self- configurable network without existing communication infrastructure. This study presents the outcome of comprehensive performance estimation on several Ad Hoc Networks routing protocols in divergent mobility models working under coherent environments. The routing protocols, mobility models and other aspects are explained and discussed in order to know how to use them accurately to form practical environment. NS-2.35 and Bonnmotion be used to produce the networks, services and location personality in common.The main span of this paper is to analysis routing performance of routing protocol i.e. AODV, DSR (Reactive), and DSDV, TORA (Proactive) protocols with respect to mobility models such as RPGM, CMM and RWP. In this paper the parameters used for assessment of packet delivery fraction (PDF), average end to end delay, and through put. Further, we will analyze and compare the performance of given routing protocols below singular network scenario.The performance of the protocols can be considerably dissimilar with respect to mobility models, when more and more realistic elements are taken into account. This must express to the researches for improvement of Ad Hoc Network in the diverse services of our society.

**Keywords-** NS-2.35 simulator, Performance parameters, DSR,DSDV,AODV,TORA, Mobile Ad hoc Network, Mobility Model, BONNMOTION.

## I. INTRODUCTION
An Ad Hoc Network are self configuring, self healing networks consisting of mobile nodes coupled wirelessly to form a active topology without any network infrastucture. In an Ad Hoc networking each nodes that can comminicate by one other with out the support of any centrilized point. The routers are free to move at random and arrange themselves randomly[1,3].It is important for one node to connect the relieve of other nodes in forwarding a packet to its destination,due to the partial range of each node's trasmissions.In ad hoc network ,mobility of node is an important issue due to ad hoc charaterstics such as dynamic network topology,narrow bandwidth,multihope behavior [4,6].Thus there is requrement of able mobility management system.The significant charaterstics of Ad Hoc network are Automated Battlefield,Disater Recovery(flood,fire,earthquick etc),Moving vehicales and Conference Rooom,senser on car,Patient monitoring,Sepecial Oprations,Search and rescue in remote areas are some applications used in Ad Hoc network[1,2,5,6,7,11].

Over the last few years, different routing protocols for Ad-hoc Networks have been anticipated and enhanced to well route data packets among two nodes in a network [1, 2]. It is not obvious, however, how different protocols get in unusual environments. A protocol may be the best, one to use in one network topology and mobility position, but the bad to use in another[1,4,5]. In addition, a considered Ad Hoc network has different nature than the same mobile wireless network calculated to satisfy commercial needs .An example is the network mobility model. Saleable ad-hoc networks are to some extent "chaotic", in the sense that each node may randomly choose its own velocity and path [2, 6, 7, 8]. In a considered location, the mobility mode depends on the type of action, the size of the deployed unit; the environment [5, 7, 8]. In addition nodes move in predefined guidelines with predefined velocities and activate as prepared groups, once more depending, on the type of the method [2, 4].

The important attribute of this paper is that we have begin a simulation based study of Ad Hoc routing protocols to differentiate their actions when used in an Ad Hoc network location using NS-2.35 simulator. Thus, the performance of an Ad-Hoc network is clearly associated to the efficiency of the routing protocols in adapting to changes in the network topology and the association status [6, 9] .For the performance aspect of a routing protocols with respect to Mobility Models for an Ad-Hoc network, it is very important to use as a appropriate mobility models to simulate the movement of the nodes in the network [8, 10, 11]. An effort has been made in the present work to the performance evaluation of Ad-Hoc network protocols with respect to Mobility Models with the help of the NS 2.35 and BonnMotion framework for a Mobility Scenario Generation and Analysis Tool [22].

**Paper outline:**

In the second Part, we will study and select which of the routing protocols for ad-hoc wireless networks can be right for use in a consider background.

In the third Part, we will study and select mobility models used in the act of the routing protocols chosen in the Part two. The performance analysis of these protocols will be done using simulation software i.e ns 2.35.

In the fourth Part, we will run several simulation scenarios, taking into account the mobility models of the network, the network density, and the user traffic with the use of Boonmotion. We will present the outcome from part three and compute the performance of each tested protocols with respect to mobility models, based on the simulation results that represent the quantitative metrics of the tested protocols.

In the fifth and sixth part we will advocate which routing protocols is most suitable in a given simulation scenario with respected to mobility models, finally, in sixth part we will conclude the paper.

## II . DESCRIPTION OF THE PROTOCOL
There are several ways to categorize the MANET routing protocols, depending on how the protocols hold the packet to transport from source to destination. But Routing protocols are mostly classify as Proactive, Reactive and Hybrid protocols

[15,16].Here we are using only DSR,AODV,DSDV,TORA protocols.The narrative of these protocols is given below.

(a) DSR (Dynamic Source Routing):

The Dynamic Source Routing (DSR) is a reactive routing protocol that utilizes source routing algorithm [11, 16, 21]. DSR is a easy and well-organized routing protocol calculated completely for use in multi-hop wireless ad hoc networks of mobile nodes. The sender knows the complete hop by hop route to the destination. These routes are stored in a route cache [8, 9]. This protocol is collected of the two main mechanisms of "Route Discovery" and "Route Maintenance", which work jointly to allocate nodes to establish and maintain routes to random destinations in the ad hoc network. Further advantages of the DSR protocol hold only accurate loop-free routing, maintain for use in networks containing unidirectional links, use of just "soft state" in routing, and extremely fast enhancement when routes in the network change. The DSR protocol is measured frequently to work fine with very high rates of mobility [23].

When a source node wants to send a packet, it first consults its route cache [7]. If the essential route is accessible, the source node sends the packet along the path, if not; the source node initiates a route innovation procedure by broadcasting route request packets. Receiving a route request packet, a node checks its route cache. If the node doesn't have routing in sequence for the requested destination; it appends its personal address to the route record ground of the route demand packet. Then, the request packet is forwarded to its neighbors. If the route request packet reach the destination or middle node has routing information to the destination, a route answer packet is generated. When the route reply packet is generated by the destination, it comprises addresses of nodes that have been traversed by the route request packet. Otherwise, the route reply packet comprises the addresses of nodes the route request packet has traversed concatenated with the route in the middle node's route cache. Whenever the data link layer detects a link disconnection, an OUTE_ERROR packet is sent in the direction of the back to the source in order to retain the route information [12, 16]. After receiving the ROUTE_ERROR packet, the source node initiates another route innovation process. Also, all routes containing the broken link should be detached from the route caches of the instant nodes when the ROUTE_ERROR packet is transmitted to the source. The advantage of this protocol is go down of route innovation position overheads with the use of route cache and the disadvantage is the mounting size of packet header with route period due to source routing.

### *(b) Ad Hoc On Demand Distance Vector (AODV):*

In AODV, when a source node has to communicate with a destination node such that it has no routing information in its table, it primary initiates route finding process. The node broadcasts a route request (RREQ) packet to every its neighbors. The route demand packets contains source address, source chain number, broadcast ID, destination address, destination sequence number and hop count. The source address and broadcast ID uniquely identifies a RREQ. The source sequence number is for maintaining the newness of information about the reverse route to the source. The destination sequence number specifies how new a route to the destination must be before it can be acknowledged by the source. If a neighbor knows the route to the destination, it replies with a route respond organize message RREP that propagates from end to end the reserve path, or else, the neighbor will re-broadcast the RREQ until an active route is found or the maximum number of hops is reached [24].

The AODV routing protocol is designed for MANET with populations of tens to thousands of mobile nodes and can handle low, moderate and relatively high mobility rates, as well as a variety of data traffic levels. AODV has also been designed to reduce the dissemination of control traffic and eliminate overhead on data traffic, in order to improve scalability and performance. Another main advantage of this protocol is that routes are established on demand and destination sequence numbers are used to find the latest route to the destination and the connection setup delay is lower.

One of the disadvantages of this protocol is that intermediate nodes can lead to inconsistent routes if the source sequence number is very old and the intermediate nodes have a higher but not the latest destination sequence number, thereby having stale entries. Also multiple RREP packets in response to a single RREQ packet can lead to heavy control overhead. Another disadvantage of AODV is that the periodic beaconing leads to unnecessary bandwidth consumption. In the other hand, as a reactive distance-vector protocol, the connection association delay is quite high and significantly more than in the case of new reactive protocols like DSR.

### *(c) Temporally-Ordered Routing Algorithm (TORA):*

It is an adaptive routing protocol for multi-hop networks. A key model in the protocol's design is an effort to decouple the invention of extreme getting control message propagation from the dynamics of the network topology. The fundamental, principal algorithm is neither distance-vector nor link-state; it is a element of a class referred to as link-reversal algorithms [7].The protocol builds a loop-free multipath routing construction that is used as the basis for forwarding traffic to a given destination. The protocol can simultaneously support both source-initiated, on-demand routing for a few destinations and destination initiated, and proactive routing for other destinations. It that possesses the following attributes-

- Distributed implementation
- Loop free routing
- Multipath routing
- Reactive or proactive route organization and repairs.
- Minimization of communication overhead through localization of algorithmic feedback to topological changes.

TORA is distributed; routers require only maintain information about neighboring routers. Like a distance-vector routing approach, TORA maintains state on a per-destination basis. However, TORA does not continuously execute a shortest path computation and thus the metric used to create the routing arrangement does not represent a distance. The destination oriented nature of the routing structure in TORA supports a mix of reactive and proactive routing on a per-destination basis. During reactive operation, sources begin the institution of routes to a given destination on-demand. This mode of procedure may be beneficial in dynamic networks with fairly sparse traffic patterns, since it may not be necessary (nor attractive) to maintain routes between every source/destination pair at all times. At the same time, chosen destinations can begin proactive process, similar to conventional table-driven routing approaches. This allows routes to be proactively maintained to destinations for which routing is always or regularly required.TORA is designed to minimize the communication overhead connected with adapting to network topological changes [26]. The scope of TORA's control messaging is usually localized to a very small set of nodes close to a topological change. A secondary mechanism, which is independent of network topology dynamics, is used as a means of route optimization and soft-state route authentication. The design and give of TORA allow its process to be unfair towards high reactivity i.e low time complexity and bandwidth maintenance i.e low communication complexity, rather than routing optimality making it potentially fit suitable for use in dynamic wireless networks.

TORA rapidly creates and maintains loop-free multipath routing to destinations for which routing is necessary, while minimizing communication overhead. It rapidly adapts to topological changes, and has the capability to detect network partitions and remove all unacceptable routes within an unlimited time. As mentioned earlier, the protocol is designed to decouple the generation of extensive control message transmission from the dynamics of the network topology. Therefore, here is no distance estimate or link-state information propagation. A negative effect of this design choice is clear: over time, as the link-reversal process proceeds, the destination-oriented DAG may become less optimally directed than it was leading formation. TORA can be appropriate in high density networks, but when the traffic is high and some packets are lost, TORA may perceive the packet loss as link breakage and reacts to it sending more renew messages and causing smooth more blocking. So even TORA is designed to decrease overhead and deliver as fast as probable, it becomes reasonable to changes in the amount of data sent and network size reacting forever to it by the creation of a vast amount of routing load.

*(d) Destination Sequenced Distance Vector (DSDV):*

It is a proactive protocol based in the distance vector. DSDV is one of the most well known table-driven routing algorithms for MANETs [7]. In distance vector protocols, every node i maintains for each destination x a set of distances dij(x) for each node j that is a neighbor of i. Node i treats neighbor k as a next hop for a packet destined to x if dik(x) equals min j dij(x). The succession of next hops chosen in this manner leads to x along the shortest path. In order to keep the distance estimates up to date, each node monitors the cost of its outgoing links and periodically broadcasts to all of its neighbors its current estimate of the shortest distance to every other node in the network [6,7]. The distance-vector which is periodically broadcasted contains one entry for each node in the network which includes the distance from the advertising node to the destination. The distance vector algorithm described above is a classical Distributed Bellman-Ford (DBF) algorithm. DSDV is a distance-vector algorithm which uses sequence numbers originated and updated by the destination, to avoid the looping problem caused by stale routing information. In DSDV, each node maintains a routing table which is constantly and periodically updated (not on-demand) and advertised to each of the node's current neighbors. Each entry in the routing table has the last known destination sequence number. Each node periodically transmits updates, and it does so immediately when significant new information is available [7, 8]. The data broadcasted by each node will contain its new sequence number and the following information for each new route: the destination's address, the number of hops to reach the destination and the sequence number of the information received regarding that destination, as originally stamped by the destination [25].

No assumptions about mobile hosts maintaining any sort of time synchronization or about the phase relationship of the update periods between the mobile nodes are made. Following the traditional distance-vector routing algorithms, these update packets contain information about which nodes are accessible from each node and the number of hops necessary to reach them. Routes with more recent sequence numbers are always the preferred basis for forwarding decisions. Of the paths with the same sequence number, those with the smallest metric (number of hops to the destination) will be used.

As a proactive protocol it requires regular updates of its routing tables, which uses up battery power and a small amount of bandwidth even when the network is idle. This limits the number of nodes that can join the network [7,8]. Whenever topology of the network changes, a new sequence number is necessary before the network re-converges and DSDV is unstable until update packets propagate through the network. For this reason DSDV is not suitable for highly dynamic networks [23]. DSDV is effective for creating ad-hoc networks for small populations of mobile nodes. Even if the number of nodes is advanced, DSDV can perform well if the topology does not change quickly. Also, as there is no need to ask for the route every time data needs to be sent its delay is considerably small.

# III.EXPLANATION OF MOBILITY MODELS USED

The mobility model is considered to explain the movement pattern of mobile users, and how their position, speed and acceleration change over time. Since mobility patterns may play a significant role in determining the protocol performance, it is desirable for mobility models to emulate the movement pattern of targeted real life applications in a reasonable way. In this section, paper investigates which mobility models are used for performance analysis. Here, we discuss reference point group mobility model and random waypoint mobility model.

*(a) Reference Point Group Mobility Model(RPGM):* Reference Point Group Mobility (RPGM) Model is proposed in [1,2,10,11] This model is described as another way to simulate group behavior in [18], where each node belongs to a group where every node follows a logical center i.e group leader, that determines the group's motion activities. The nodes in a group are usually randomly distributed around the reference point. The different nodes use their own mobility model and are then added to the reference point which drives them in the route of the group. At each moment, every node has a speed and direction that is derived by randomly different from that of the group leader [7, 8, 14]. This general description of group mobility can be used to create a variety of models for different kinds of mobility applications. Group mobility as such can be used in military battlefield communications [16, 17]. One example of such mobility is that a number of soldiers may move jointly in a group. Another example is during disaster relief where various rescue crews i.e. firemen, policemen form dissimilar groups and work considerately.

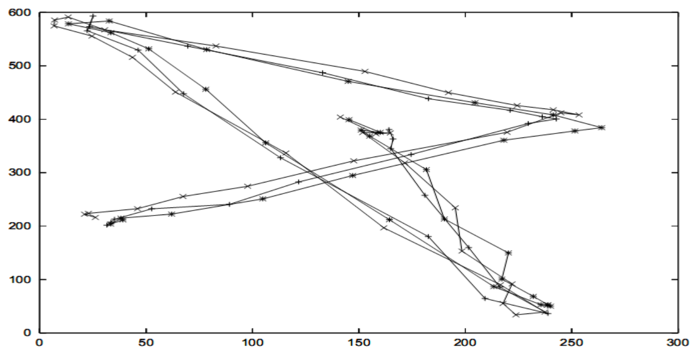


**Figure 1: Traveling pattern of one group using the RPGM model.**

*(b)Random Way Point Mobility Mode (RWP):* The random way point model is a random based mobility model used in mobility management schemes for mobile communication systems [8, 9 ,27]. This proposed to explain the movement pattern of mobile user which consists of how their location, mobility and acceleration change over time [17,18]. The random way point model, first proposed by Johnson et al.; [19,20,21], soon became a “benchmark” mobility model to evaluate the because of its straightforwardness and wide convenience. Random Way point mobility model is similar to the Random Walk Mobility Model if pause time is zero. The Radom Way point is the simplest model whose node trace is generated by the stardust tool by CMU Monarch group, included in NS-2 simulator. The Random Waypoint Model assumes each Mobile

Node (MN) is firstly placed on a uniform-randomly selected manage within the network area [10, 11]. The node selects, frequently and randomly, a target location within the network to travel. The velocity to move to this location is also selected regularly and randomly from the range [Vmin...Vmax] where Vmin and Vmax characterize the minimum and maximum possible node velocities. Once the Mobile Node (MN) moves to the selected location, it waits at that position for a different amount of time called the pause time. The above process of choosing a random target location and random velocity to move is frequent a waiting a predefined simulation time is reached.

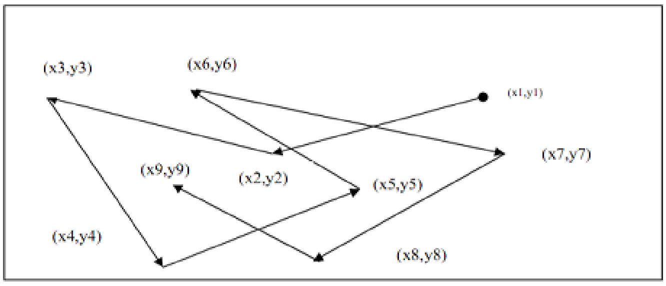


**Figure 2: Random Waypoint Model viewing node Movement.**

### *(c) Column Mobility Model (*CMM*):*

The Column Mobility Model proves helpful for scanning or searching purposes [1, 2, 7]. This model represents a set of MNs that move around a given column, which is moving in a forward direction e.g. a row of soldiers marching together toward their enemy. A small medication of the Column Mobility Model allows the individual MNs to chase one another e.g. a group of young children walking in a single-file line to their classroom.

For the implementation of this model, an initial reference grid i.e forming a column of MNs, is defined [14, 15]. Each MN is then positioned in relative to its reference point in the reference grid; the MN is then allowed to move randomly about its reference point via an entity mobility model [16].

## IV. SIMULATION AND PERFORMANCE METRICS

### *(A) Analyzing the results:*

The network simulations have been carried out using Network Simulator NS-2.35 and its related tools for animation and study of results. We chose a Linux platform i.e. UBUNTU 12.00, as Linux offers a number of programming progress tools that can be used with the simulation method. We analyzed the experimental results contained in generated output draw files by using the AWK command. We have generated mobility scenarios for Reference Point Group Mobility Model and random way point model using the BONNMOTION [22] tool and have enhanced generated scripts to the supported ns2.35 format so that they can be incorporated into TCL scripts. Random traffic acquaintances of Constant Bit Rate (CBR) can be setup among mobile nodes using a traffic-scenario creator script [11].

### *(B) Simulation Constraint:*

The parameters used for carrying out simulation are summarized in the table 1, which is given as under

**Table 1: Simulation parameters**

| Parameter | Value |
|---|---|
| Channel type | Channel/Wireless channel |
| Simulator | NS 2 (Version 2.35) |
| protocols | AODV,DSDV,TORA,DSR |
| Simulation duration | 400s |
| Number of nodes | 25,50,75,100 |
| Transmission range | 250m |
| Movement Model | RPGM, RWP,CMM |
| MAC Layer Protocol | 802.11 |
| Pause Time (s) | 15 ± 3 s |
| Maximum speed | 20 |
| Minimum speed | 0.5 |
| Packet Rate | 4 packet/s |
| Traffic type | CBR(Constant Bit Rate) |
| Data Payload | 512 bytes/packet |
| Max of CBR connections | 10,20,40,60 |
| Environment Size | 800m * 800m |

### *(C) Performance Parameters:*

The presentation of routing protocols is using the following important Quality of Services (QoS) metrics:

1. Packet Delivery Ratio (PDR): Packet delivery ratio is an important metric as it describes the loss rate that will be seen by the transport protocols, which run on top of the network layer. Thus the packet delivery ratio in turn reflects the highest throughput that the network can support. It is defined in [20,21] as the ratio between the number of packets originated by the application layer Constant Bit Rate(CBR) sources and the number of packets received by the Constant Bit Rate(CBR) sink at the final destination. It is the ratio of data packets delivered to the destination to those generated from the sources. It is calculated by dividing the number of packets received by destination through the number packet originated from the source.

PDF = (Pr /Ps)*100

where Pr is total Packet received & Ps is the total Packet sent.

2. Throughput:

It is the average number of messages successfully delivered per unit time number of bits delivered per second [21, 22].

$$\text{Throughput} = \frac{\text{Total Received Packets}}{\text{Total Simulation Time}} \quad (\text{kbits/sec})$$

where N is the number of data sources.

3. Average End-to-End Delay: This includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue, retransmission delays at the MAC, and propagation and transfer times [8,21]. It is defined as the time taken for a data packet to be transmitted across an Ad Hoc from source to destination.

D = (Tr –Ts), Where Tr is receive Time and Ts is sent Time.

## V. SIMULATION RESULTS AND ANALYSIS

These simulations are using three mobility models that will be tested on routing protocols scheme. The simulation time for every scenario is performing in 400 sec. and the simulated mobility network region is 800 m x 800 m rectangle with 250m transmission range. The simulation will conducted in two unusual scenarios to achieve a good result and shows the differences of the performance for every mobility model.

**RESULTS:**

In Figure1, 2, 3,4,5,6,7,8,9, the simulations are focusing in analyzing the performance on routing overhead, throughput and packet delivery ratio. The results also compared with three mobility models that we had chosen .The result will show the performance for protocols with respect to mobility models that had been selected.

(a). AVERAGE END TO END DELAYS:

Average end to end Delay (AED) of AODV in case of RPGM and CMM is best, In Case of DSDV for RPGM and CMM is on Average and in case of RWP it is slightly enhanced with respected to increasing in Node, and In case of TORA it gives best performance in CMM, In case of DSR performance is good at RPGM, CMM.

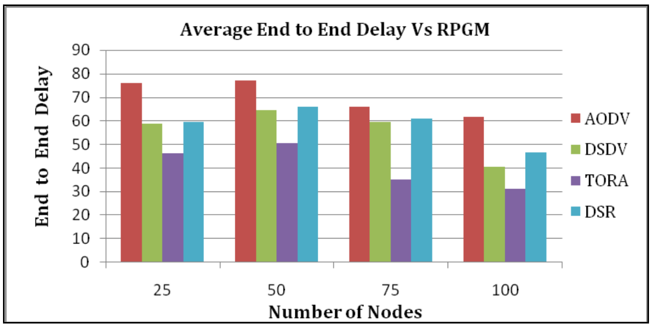


**Figure 3: Routing AED versus Number of Nodes (RPGM)**

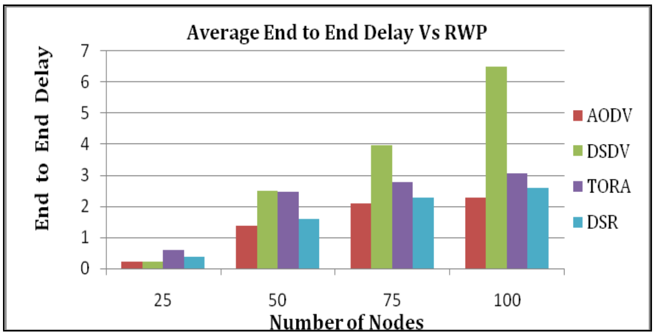


**Figure 4: Routing AED versus Number of Nodes (RWP)**

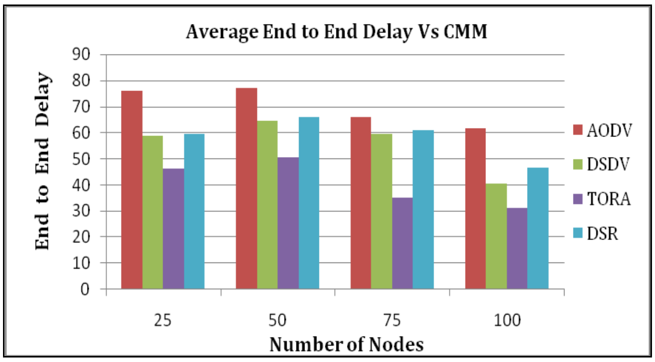


**Figure 5: Routing AED versus Number of Nodes (CMM)**

( b). PACKET DELIVERY RATIO (PDR):

AODV performed better in delivering packet data to destination in all define model, decreased with very low rate as increasing of the number of nodes .DSDV performed same like AODV in CMM model but in RPGM its performance is significantly low as compare to AODV.TORA and DSV performance is not appreciable with respect to this parameter, so We can conclude that AODV performance in Packet Delivery Data is considerably high.

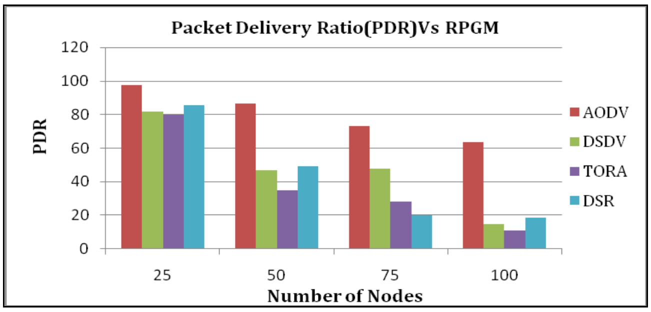


**Figure 6: PDF versus number of nodes (RPGM)**

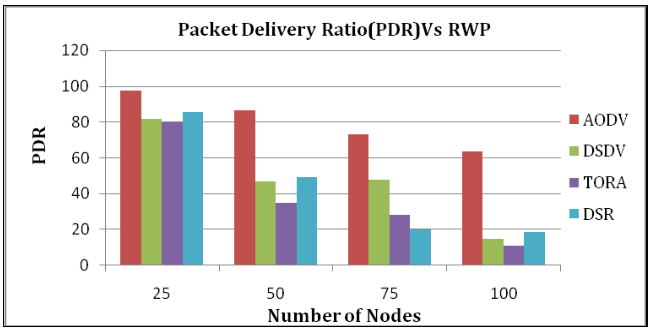


**Figure 7: PDF versus number of nodes (RWP)**

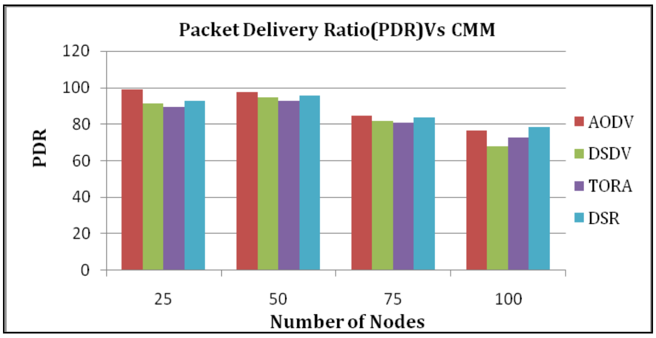


**Figure 8: PDF versus number of nodes (CMM)**

(C). THROUGHPUT:

The high throughput is contributed the lower delay because of the lower number of hop.AODV performance comparatively better to generate through put in all consider model. In AODV, routing table is maintain whomsoever a source node has to communicate with a destination node such that it has no routing information in its table. The node broadcasts a route request (RREQ) packet to all its neighbors .The group maintenance characteristic of RPGM make it to perform well through ADVO protocol. DSDV performed well in RWP.

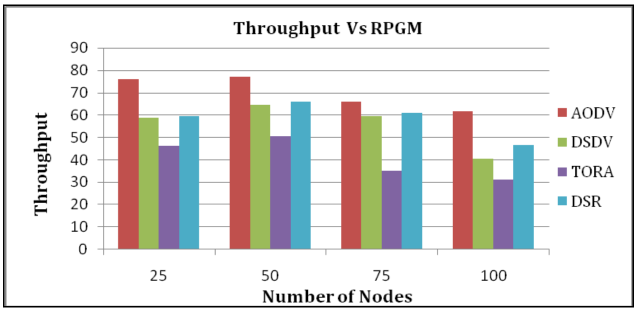


**Figure 9: throughput versus number of nodes (RPGM)**

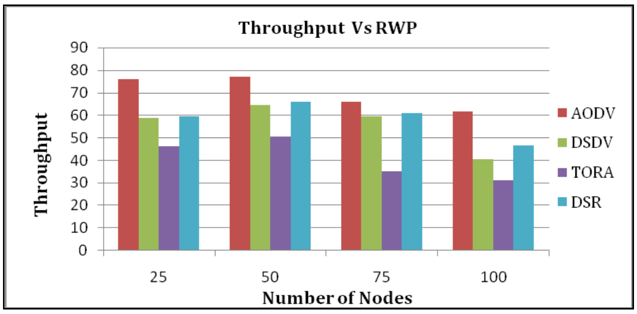


**Figure 10: throughput versus number of nodes (RWP)**

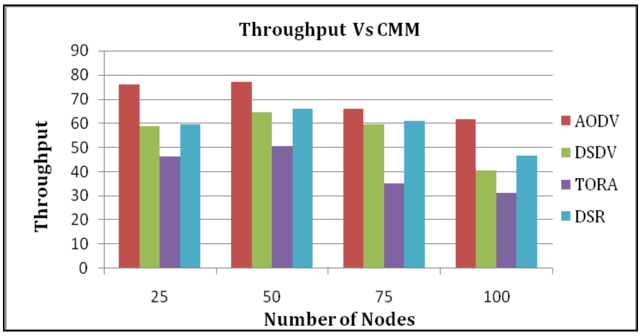


**Figure 11: throughput versus versus number of nodes (CMM)**

## VI. CONCLUSION

Three mobility models (RPGM, CMM, and RWP) have been evaluated with special reference to performance concerned to routing protocols AODV, DSDV, DSR, and TORA under the three mobility models. The earlier research on mobility models and comparison of the performance of protocols using NS-2.35 simulator has been done which clearly indicate the significant impact on node mobility pattern on routing performance. These routing protocols were compared in the manner of PDR. Average end to end delay and Throughput when subjected to change in numbers of nodes. Our simulation results show that a Reactive protocol is much better than proactive in the manners of PDR, an End-to-End delay and throughput. In this paper we look increase the number of nodes has impact on all protocols under these mobility models In this research our results is made into how well AODV, DSDV, DSR and TORA work to different network conditions in Ad Hoc Network.

The delay of DSR is less and in the TORA is worst. Throughput is high in case of AODV. In DSR delay is greater than the AODV and TORA. In the case of packet dropper the DSDV perform better and consistently well with increase number of nodes while the AODV is worst. On the other hand DSR perform better when the numbers of nodes are less but it will fails when the numbers of nodes increase but DSR showed high end to end delay due to formation of temporary loops within the network . TORA is very poor and not reliable for the Ad Hoc Network. In future, we can evaluate the performance of these four routing protocols under three mobility models by varying it to the speed, pause time.

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