Modeling and Analysing a Novel Restricted Angle Scenario Model in MANET

N Vetrivelan[1]
[1]Research Scholar, NIT, Trichy, India
Assistant Professor, Dept. of Computer Applications
Periyar Maniammai University, Thanjavur, India,
nvetri@yahoo.com

Dr. A V Reddy[2]
[2]Professor, Department of Computer Applications
National Institute of Technology, Trichy, India
reddy@nitt.edu

Abstract- **In this work, we have modeled a novel Restricted Angle Scenario model for Mobile Adhoc networks. The direction movement of the nodes are significantly specified with given angles. We have compared and analysed our novel Restricted angle scenario model and the impact of mobility on MANET protocols. The parameter metrics Packet Delivery Fraction, Routing load, and Latency have been taken into account. Our simulation result shows that the functioning of our Restricted Angle Scenario model has greatly influenced the performance of Routing Protocols in MANET environment. The result reveals the fact that the Reactive routing protocol DSR outperforms than the Proactive routing protocol DSDV. Our Novel Restricted Angle Scenario Model has performed well when we compare it with existing Waypoint mobility model while setting many source-destination connections.**

Keywords- Mobility, DSR, MANET, Restricted Angle and Simulation.

I. INTRODUCITON

In Mobile Adhoc networks (MANET), a group of mobile nodes communicates with one another without a central control infrastructure. A Mobile Adhoc Network represents a system of wireless mobile nodes that can freely and dynamically self-organize into arbitrary and temporary network that communicates without any pre-existing communication architecture. The trajectories of mobile nodes strongly influence MANET performance. An Ad hoc routing protocols is a convention or standard that controls how nodes come to agree with a way to route packets between computing devices in a mobile adhoc network, nodes do not have a prior knowledge of topology of network around them, they have to discover it. The basic idea is that a new node announces its presence and listens to broadcast announcements form its neighbors. The node learns about new near nodes and ways to reach them and announces that it can also reach those nodes. Mobility models are used in simulation to imitate mobile node movement. The Random Waypoint Mobility Model [1] is the 'bench mark' mobility model that is widely used in the current simulation environment. Nevertheless, RWMM [1][2] cannot accurately imitate all authentic mobility patterns in MANET. The most common way to study mobile ad hoc networks is through simulations. Even though real world deployment is essential to understand the effectiveness and performance of ad hoc networks, simulations [12] have some advantages. Simulations are fast and repeatable, and it is possible in simulators to isolate parameters affecting the performance of a design. Therefore a variety of mobility models [3] and communication pattern have been developed in the simulators for performance evaluation of a design. It is important to use realistic mobility models so that the evaluation results will have a close correlation to the performance when actually deployed. We show from our simulations results that Restricted Angle Scenario Model has a considerable effect on the performance of these routing protocols [8] [9].

In Section II, the related works have been discussed. Brief description of Restricted Angle Scenario model on Node Mobility has been presented in Section III. Protocol descriptions have been given in Section IV. The Protocol performance Metrics have been given in Section V. In Section VI, the Simulation Model and Parameter Values have been described. Results and Discussion presented in Section VII. The conclusion has been presented in Section VIII.

II. RELATED WORK

Mobility model for simulations has been one of the important topics of research in this field. One of the early contributions was made by Broch et al., where they evaluated DSR, AODV, DSDV [8] and TORA using the Random Waypoint model [1]. They concluded that mobility has its impact on the performance of routing protocols. To evaluate these protocols over a wider range of scenarios, Johansson et al. proposed the scenario-based performance analysis. In this paper, they proposed mobility models for disaster relief, event coverage and conferences. Haas et al., introduces a mobility model in which the current velocity of a node may depend on its previous velocity. Hong et al. proposed the RPGM model. One of the main applications of this model is in battlefield communications. The authors give several other applications of RPGM. While defining their framework they proposed to evaluate the protocols under a richer set of mobility models. Apart from using the RW and RPGM, they used two other mobility models, i.e., the FW and MH model. Tracy Camp, Jeff Boleng [1] surveyed the mobility models that are used in the simulations of Ad hoc networks. Authors described several mobility models that represent mobile nodes whose movements are independent of each other (i.e, entity mobility models) and several mobility models that represent mobile nodes whose movements are dependent on each other (i.e. group mobility models.) Per Johansson, Tony Larsson et al., compared three routing protocols for wireless mobile ad hoc network. They have done simulation on a scenario where nodes move randomly. Furthermore, three realistic scenarios were introduced to test the protocols in more specialized contexts.

III. A RAS MODEL ON NODE MOBILITY

There exist several mobility patterns that try to capture the behavior of the mobile devices under different circumstances. In this sense, RAS model has been proposed. In the RAS model, at the start of simulation the initial function first creates the initial random position for the given number of nodes within the coverage area. While the simulation run is in progress, the update function chooses the random speed and pause time to select the random location for each node as destination with specified angle. After reaching the destination, the new location is calculated by trigonometry function. The obtained value is added to previous value to get the new position. If the new location is going beyond the simulation grid, the value is subtracted to the previous value to get the new position. The preceding process is repeated until the simulation termination condition is reached

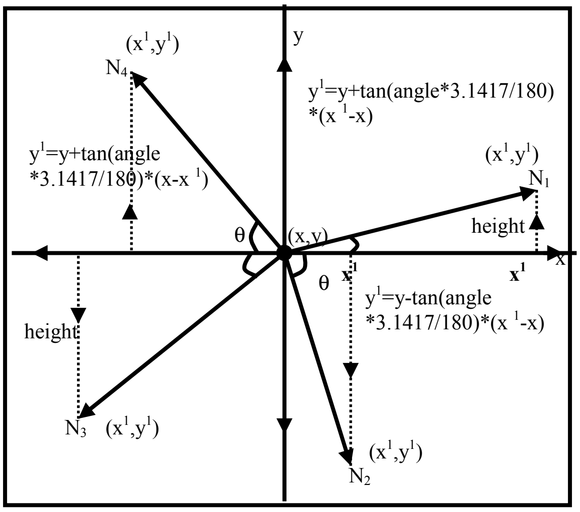

Figure 1. A RAS Model on node Mobility

In Figure 1. If the destination x value is greater than old x value, the destination y value is calculated using trigonometry formula and the value is added to old y value.

$$y^1 = y+\tan(\theta)*(x^1-x) \quad (1)$$

If the destination y value is greater than maximum y value, the destination y value is calculated using trigonometry formula and the value is subtracted to old y value.

$$y^1 = y-\tan(\theta)*(x^1-x) \quad (2)$$

If the destination x value is lesser than old x value, the destination y value is calculated using trigonometry formula and the value is added to old y value.

$$y^1 = y+\tan(\theta)*(x-x^1) \quad (3)$$

If the destination y value is greater than maximum y value, the destination y value is calculated using trigonometry formula and the value is subtracted to old y value.

$$y^1 = y-\tan(\theta)*(x-x^1) \quad (4)$$

A. Mobility Parameters

- V_A: the speed of MN_A
- V_B: the speed of MN_B with the Minimum speed S_{Min} and Maximum speed S_{Max}
- V_r : the relative velocity
- θ : angle θ is a discrete random variable
- d: the distance between two adjacent nodes
- m: minimum speed > 0
- M: maximum speed
- p: pause time
- n: number of nodes
- x : x dimension of space
- y : y dimension of space

B. RAS Movement Algorithm

Algorithm.1 Procedure developed for the node movement for Restricted Angle Scenario Model

```
Assign Position.x to old_x[index]
Assign Position.y to old_y[index]
Call update
Call random destination
If  destination.x > old_x[index]
        temp=old_y[index]+(tan(angle*3.1417/180)
            *(destination.x-old_x[index]))
        If temp>maxy
        temp=old_y[index]-(tan(angle*3.1417/180)
           *(destination.x-old_x[index]))
        endif
endif
If  destination.x < old_x[index]
temp=old_y[index]+(tan(angle*3.1417/180)
            *(old_x[index]-destination.x))
        If temp>maxy
        temp=old_y[index]-(tan(angle*3.1417/180)
           *(old_x[index]-destination.x))
        endif
endif
if temp<0
        temp=temp*-1
endif
destination.y=temp
old_x[index]=destination.x
old_y[index]=destination.y
```

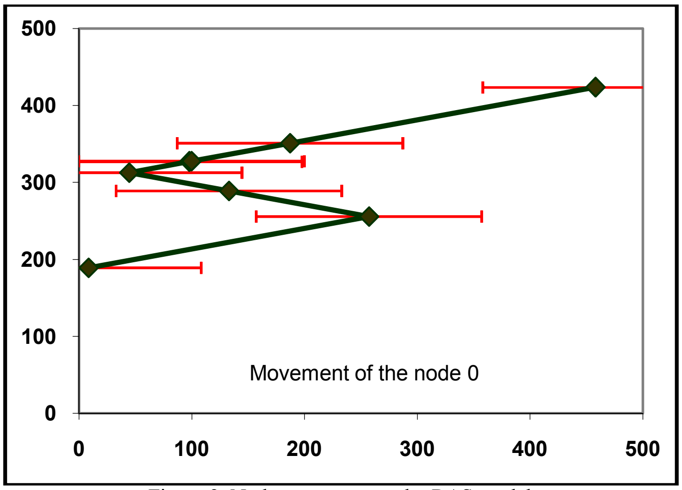

Figure 2. Node movement under RAS model

In Figure 2. The node0 is moving in the Simulation grid according to the researcher's algorithm. The input angle is set to 15 degree and simulation is run for 100 seconds.

IV. PROTOCOL DESCRIPTION

A. Dynamic Source Routing – DSR

The key distinguishing feature of DSR [8] is the use of source routing. That is, the sender knows the complete hop-by-hop route to the destination. These routes are stored in a route cache. The data packets carry the source route in the packet header. When a node in the ad hoc network attempts to send a data packet to a destination for which it does not already know the route, it uses a route discovery process to dynamically determine such a route. Route discovery works by flooding the network with route request (RREQ) packets. Each node receiving a RREQ rebroadcasts it, unless it is the destination or it has a route to the destination in its route cache. Such a node replies to the RREQ with a route reply (RREP) packet that is routed back to the original source. RREQ and RREP packets are also source routed. The RREQ builds up the path traversed across the network. The RREP routes itself back to the source by traversing this path backward. The route carried back by the RREP packet is cached at the source for future use. If any link on a source route is broken, the source node is notified using a route error (RERR) packet.

B. Destination Sequenced Distance Vector – DSDV

DSDV [4] is a hop-by-hop distance vector routing protocol. It is proactive; each network node maintains a routing table that contains the next-hop for, and number of hops to, all reachable destinations. Periodical broadcasts of routing updates attempt to keep the routing table completely updated at all times. To guarantee loop-freedom DSDV uses a concept of sequence numbers to indicate the freshness of a route. A route *R* is considered more favorable than *R′* if *R* has a greater sequence number or, if the routes have the same sequence number, *R* has lower hop-count. The sequence number for a route is set by the destination node and increased by one for every new originating route advertisement. When a node along a path detects a broken route to a destination *D*, it advertises its route to D with an infinite hop-count and a sequence number is increased by one. Route loops can occur when incorrect routing information is present in the network after a change in the network topology, e.g., a broken link. In this context the use of sequence numbers adapts DSDV to a dynamic network topology such as in an ad-hoc network. DSDV uses triggered route updates when the topology changes.

V. PROTOCOL PERFORMANCE METRICS

To evaluate the Restricted Angle Scenario model in MANET, we used three protocol performance metrics to compare and analyse the realistic movements.

A. Packet Delivery Fraction

The ratio of number of data packets successfully delivered to the destination, generated by CBR Sources. PDF = (Received Packets/Sent Packets) * 100

B. Routing Overhead

It is an important metric for measuring scalability of a protocol. The number of routing packet transmitted per data packet delivered at destination. Each hop wise transmission of a routing packet is counted as one transmission.
Routing load = Packets sent / Received packet

C. Latency

The time, it takes for a packet to cross a network connection from sender to receiver

VI. SIMULATION PARAMETERS

TABLE 1 : SIMULATION PARAMETER VALUES

Simulator	Ns2-2.34
Number of Nodes	100
MAC Layer	IEEE 802.11
Mobility Model	RAS Model
Topology x dimension	1000 m
Topology y dimension	1000 m
Transmission Range	250 m
Antenna type	Omni directional
Minimum Speed	0 m/s
Maximum Speed	10 m/s
Pause time	5 m/s
Traffic Type	Constant Bit Rate
Packet size	512
Traffic rate (pkts/s)	10
Angle	15,30,45,60,75
Simulation Duration	100 seconds
Source Destination	udp

A. Simulation Model

In this section, the network simulation was implemented using the NS-2 simulation [12] tool. The Network Simulator NS-2 was a discrete event simulator. For simulation Scenario and network topology creation it used OTCL (Object Tool Command Language). To create new objects, protocols and routing algorithm or to modify them in NS-2, C++ source code used. The simulations were conducted on Due Core processor at speed 3.0 GHz, 1 GB RAM running Linux Environment.

B. Route and Link Changes Test

Although link and route changes are considered a fundamental parameter when evaluating the mobility in a MANET. Here we have studied the mean value of link and route changes under Restricted Angle Scenario model. A route is a sequence of communication links that are formed by adjacent neighbors. Due to node mobility, these links are broken and thus, the route lifetime becomes finite. Since a path between two nodes becomes invalid as soon as one of its links is broken, the path duration is equal to the minimum of the residual life of the links that conforms that route.

TABLE 2: ROUTE AND LINK CHANGES FOR VARYING ANGLES

Angle	15^{θ}	30^{θ}	45^{θ}	60^{θ}	75^{θ}
Route	21364	8181	9188	7418	7868
Link	2983	1142	992	1397	1197

To study the effect of Route and Link changes the angle of movement of nodes are varied from 15,30,45,60,and 75 degrees .

- Number of nodes set to 100 in the Network
- Pause time - 2.0 m/s
- Maximum speed - 10 m/s
- Simulation Time - 100 Seconds
- x dimension of space-500, y dimension of space-500
- Angle - 15,30,45,60 and 75 degrees

The Network is more dynamic, when all the nodes are moving with 15 degree of angle and choosing its random location.

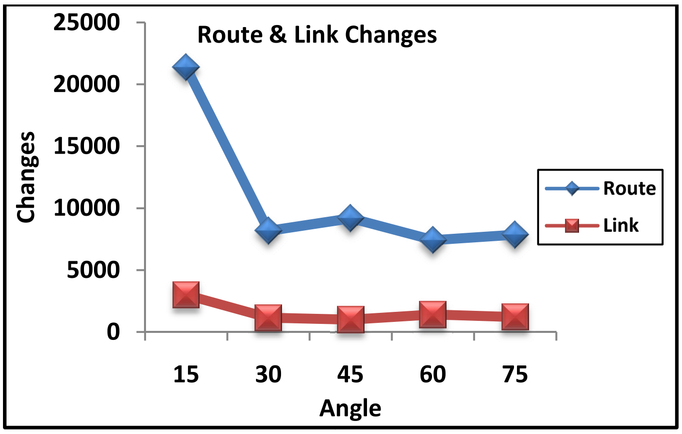

Figure 3. Route and Link changes for varying angles

VII. SIMULATION RESULTS

We have analysed the performance of DSDV and DSR under Restricted Angle Scenario model in terms of Packet Delivery Fraction, Routing Load and Latency for varying angles from 15,30,45,60 and 75 degrees under 100 nodes environment.

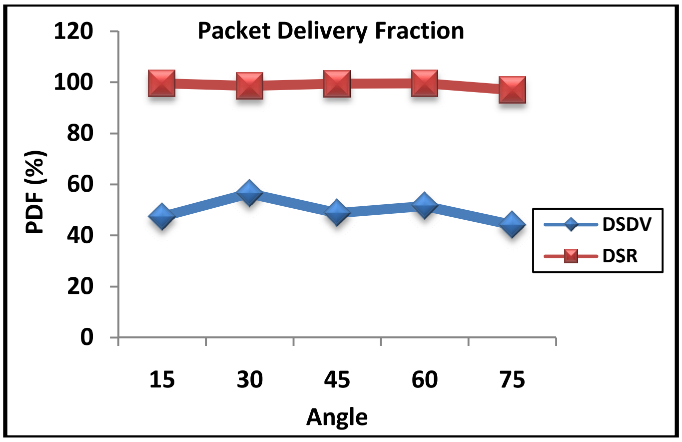

Figure 4. PDF with varied angles for routing protocols

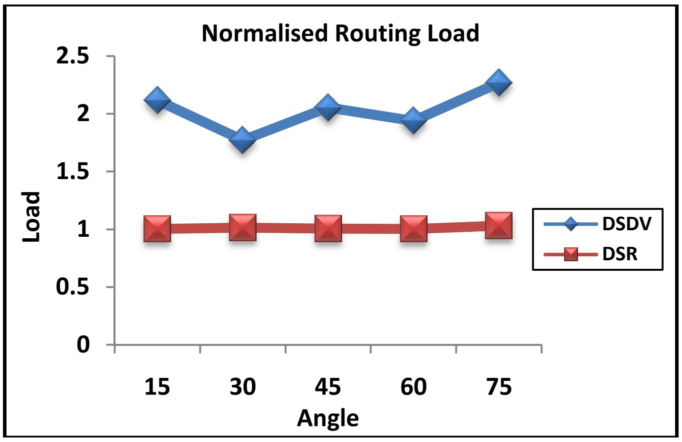

Figure 5. Routing Load with Varied angles for routing protocols

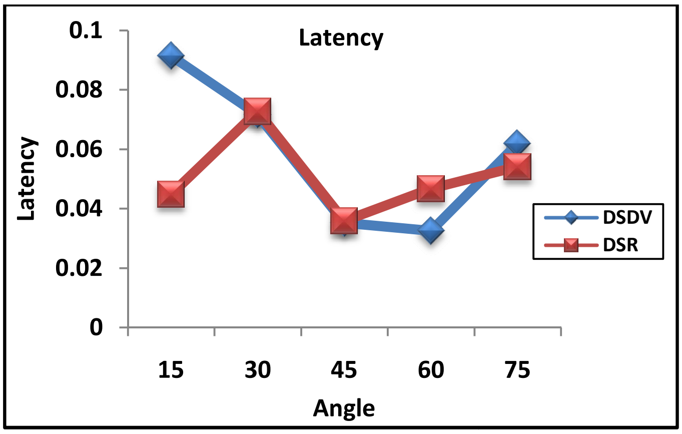

Figure 6. Latency with Varied angles for routing protocols

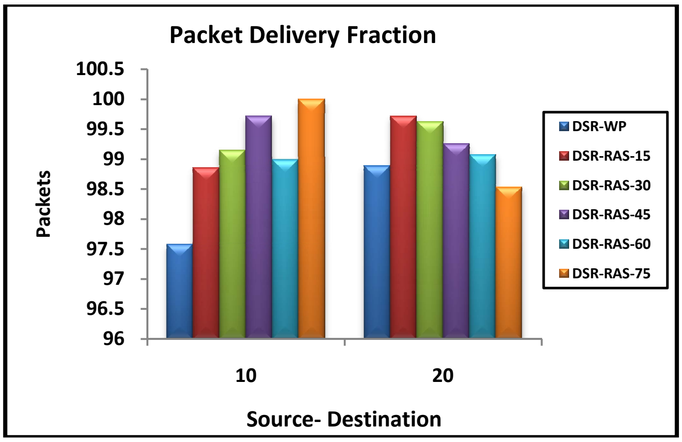

Figure 7. PDF- Comparison of RAS model with Waypoint model

As shown in the Fig. 4-6, we investigated the impact and effect of mobility on relative performance of protocols. As far as PDF, Routing Load and Latency are concerned DSR outperforms. Simulation experiments shown in Fig 4-6 confirm that for DSR under RAS, the PDF is highest between 96.94%-99.57%, Routing Load is lowest between 1.004-1.031 and Latency is very less between 0.035-0.072 seconds, in the case of DSDV under RAS, the PDF is 44.10%-56.44%, Routing Load is 1.77-2.267 and Latency is 0.032-0.091 seconds. We observed that DSR under RAS producing the highest performance. This is due to the networks with a dynamic topology, proactive protocols such as DSDV.

As far as PDF, Routing Load and Latency are concerned DSR outperforms. This is due to the networks with a dynamic topology, proactive protocols such as DSDV have considerable difficulties in maintaining valid routes, and loses many packets. It strives to continuously maintain routes to every node that increases network load as updations become larger. Route maintenance is much better in DSR as compared to DSDV. The reduction in performance can be attributed to link breakage, which is more probable as the length of the route increases. In case of DSDV re-establishment of new routes does not take place till there is a route table information packet coming from its neighbor nodes. But in case of DSR, when route breakage takes place, packets are cached and route repair takes place. This improves the overall performance of the system.

As shown in the Fig. 7-9, we run the simulator for 100 seconds with 10, 20 and 30 udp connections (flows). The result reveals that our novel RAS performs better than the existing Way Point model for DSR protocol. From the results we can see that if compared the performance of RAS with Waypoint for higher number of Source-Destination. Simulation experiments shown in Fig 7-9 confirm that for DSR under RAS and Waypoint Model, PDF is between 98.85%-100% in RAS with different angles and in Waypoint 97.57%-98.88%. Routing Load in RAS is 1.0028-1.011, Waypoint 1.011-1.02 seconds. Latency is between 0.025-0.072 in RAS and in Waypoint 0.026-0.1235 Seconds. RAS is comparatively performing better for DSR protocol

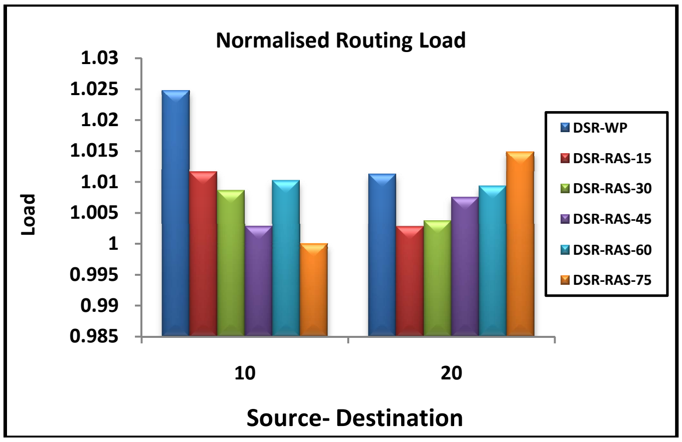

Figure 8. Routing Load – Comparison of RAS model with Waypoint model

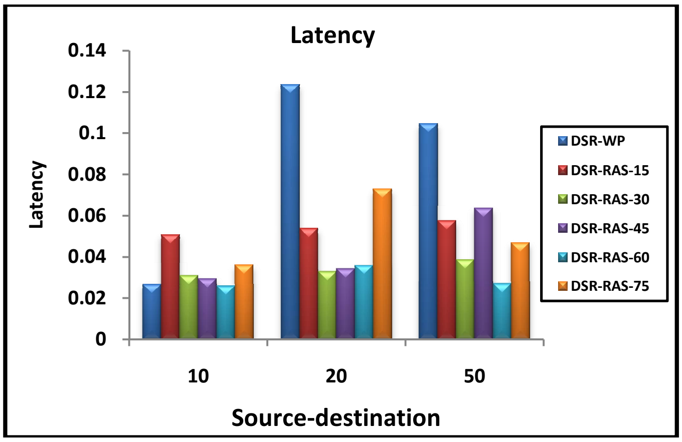

Figure 9. Latency- Comparison of RAS model with Waypoint model

The velocity of mobile nodes, which have memory less random process. i.e., Temporal Dependency. The mobile nodes are considered as an entity that moves independently of other nodes i.e., Spatial Dependency. The mobile node can move within simulation field with a restriction in accordance with the given angle. i.e., Geographic Restrictions of movement.

VIII. CONCLUSION

We modeled and analysed the performance of the Restricted Angle Scenario model with 100 nodes environment. The performance metrics PDF, Routing Load and Latency have been taken to evaluate routing protocols DSR and DSDV.The route and link changes have been analysed. In our Restricted Angle Scenario model , we have varied the angles vide 15,30,45,60 and 75 degrees for movement direction of nodes. It has been found that DSR outperforms. The DSR discovers new route faster and more effectively to the destination when the old route is broken as it invokes route repair mechanism locally also high route cache hit ratio in DSR. Whereas in DSDV there is no route repair mechanism. In DSDV, if no route is found to the destination, the packets are dropped.

While our novel Restricted Angle Scenario model is compared with the existing Waypoint model, Restricted Angle Scenario's performance is better as far as PDF, Normalized Routing Load, and Latency are concerned. The reasons are the velocity of mobile nodes are memoryless random process and move independently of other nodes also the mobile node can move a restriction in accordance with the given angle.

REFERENCE

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

[2] C. Bettsltter, G. Resta, P.Santi, " The Node Distribution of the Random Waypoint Mobility Model for Wireless Ad Networks", IEEE Transactions on Mobile Computing, July - September 2003, pp 257-269

[3] Guolong Lin, Guevara Noubir and Rajmohan Rajaraman, "Mobility Models for Ad hoc Network Simulation", In Proceedings of IEEE INFOCOM 2004, Volume 1,pp. 7-11,2004.

[4] Charles E Perkins and Pravin Bhagwat,"Highly Dynamic Destination Sequenced Distance Vector Routing (DSDV) for Mobile Computers", SIGCOMM 94,pp.234-244,1994.

[5] S.Corson and J.Macker, Mobile Ad hoc Networking (MANET): Routing Protocol Performance Issues and Evaluation considerations, RFC:2501, January 1999

[6] F. Bai, G. Bhaskara and A. Helmy, "Building the Blocks of Protocol Design and Analysis-Challegens and Lessons Learned form Case Studies on Mobile Adhoc Routing and Micro-Mobility Protocols,", ACM Computer Communication Review, Vol.34, No.3, pp. 57-70,2004.

[7] F.Bai and A Helmy, "The IMPORTANT Framework for Analysing and Modeling the Impact of Mobility in Wireless Adhoc Networks",in Wireless Ad Hoc and Sensor Networks, Kluwer Academic Publishers, 2004.

[8] David B. Johnson and David A. Maltz, Yih-Chun Hu, The Dynamic Source Routing (DSR) Protocol for Mobile Ad Hoc Networks.draft-ietf-manet-dsr-10.txt, July 2004

[9] Elizabeth M.Royer and C.K Toh "A Review of Current Routing Protocols for Ad Hoc Mobile Wireless Networks," IEEE Personeal Communications, April 1999,pp 46-55.

[10] S.Azad,A Rahman and F.Anwar,"A Performance Comparison of Proactive and Reactive Routing Protocols of Mobile Ad-hoc NET work(MANET)," Journal of Engineering and Applied Sciences 2(5),2007, pp 891-896.

[11] Perkins C.E and Royer.E.M, "Ad Hoc On-demand Distance Vector Routing" In Proceedings of the 2nd IEEE Workshop on Mobile Computing Systems and Applications,New Orleans,LA,February 1999,pp.46-55

[12] Network Simulator 2 (NS-2), www.isi.edu/nsnam/ns/

[13] Mobility Generator (version 1.0) http://nele.usc.edu/important/software.htm,

[14] BonMotion Scenario Generation. ww.informatik.unibonn.de/IVBonnMotion