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Analysis of Packets Broadcast over MANET Protocols using UDP Traffic Pattern

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Abstract

Mobile Ad Hoc Network (MANET) is collection of multi-hop wireless mobile nodes that communicate with each other without centralized control or established infrastructure. The stable routing over such a network is a very critical task as the wireless links are highly error prone and can go down frequently due to dynamic network topology. In this paper, an effort has been carried out to analyze the packets broadcast over mobile adhoc network using DSR and AODV having UDP traffic agents. The simulator used is NS 2.34. The performance of either protocol has been studied using a self created network scenario and by analyzing the packets broadcast with respect to pause time. The network size has also been varied from 15 nodes to 25 nodes and then to 45 nodes. Based on the analysis, recommendations have been made about the significance of the protocol under various situations. It has been concluded that the use of AODV protocol is a better choice over DSR protocol for efficient routing over mobile adhoc network.

Keywords: AODV, DSR, Mobile Adhoc Network, Packets

Introduction

Mobile Adhoc Network [3] is a collection of wireless mobile nodes forming a temporary network without any fixed infrastructure where all nodes are free to move about arbitrarily and where all the nodes configure themselves. Here each node acts both as router as well as host. Further, topology used over mobile adhoc network is dynamic and therefore it may change rapidly. This paper is divided into five sections. The key aspects of prominent routing protocols for MANET i.e. DSR and AODV are given in this section I. Section II presents related work carried out by the eminent researchers in the field of performance comparison of various routing protocols for mobile adhoc network. Section III depicts a simulation model having self created network scenario of 15, 25 and 45 mobile nodes that is used to study routing over mobile adhoc network using DSR and AODV protocols with UDP traffic agents. Section IV gives conclusion and future scope in the field of mobile adhoc network.

DSR is an adhoc routing protocol [2, 5] which is source-initiated rather than hop-by-hop and is based on the theory of source-based routing rather than table-based. This is particularly designed for use in multi hop wireless adhoc networks of mobile nodes. Basically, DSR protocol does not need any existing network infrastructure or administration and this allows the Network to be completely self-organizing and self-configuring. This Protocol is composed of two essential parts of route discovery and route maintenance. Every node maintains a cache to store recently discovered paths. When a node desires to send a packet to some node, it first checks its entry in the cache. If it is there, then it uses that path to transmit the packet and also attach its source address on the packet. If it is not there in the cache or the entry in cache is expired (because of long time idle), the sender broadcasts a route request packet to all of its neighbors asking for a path to the destination. The sender will be waiting till the route is discovered. During waiting time, the sender can perform other tasks such as sending/forwarding other packets. As the route request packet arrives to any of the nodes, they check from their neighbor or from their caches whether the destination asked is known or unknown. If route information is known, they send back a route reply packet to the destination otherwise they broadcast the same route request packet. When the route is discovered, the required packets will be transmitted by the sender on the discovered route. Also an entry in the cache will be inserted for the future use. The node will also maintain the age information of the entry so as to know whether the cache is fresh or not. When a data packet is received by any intermediate node, it first checks whether the packet is meant for itself or not. If it is meant for itself (i.e. the intermediate node is the destination), the packet is received otherwise the same will be forwarded using the path attached on the data packet. Since in Adhoc network, any link might fail anytime. Therefore, route maintenance process will constantly monitors and will also notify the nodes if there is any failure in the path. Consequently, the nodes will change the entries of their route cache. AODV routing protocol [2, 4] is collectively based on DSDV and DSR. It aims to minimize the requirement of system-wide broadcasts to its extreme. It does not maintain routes from every node to every other node in the network rather they are discovered as and when needed & are maintained only as long as they are required. When a node wants to send a data packet to a destination node, the entries in route table are checked to ensure whether there is a current route to that destination node or not. If it is there, the data packet is forwarded to the appropriate next hop toward the destination. If it is not there, the route discovery process is initiated. AODV initiates a route discovery process using Route Request (RREQ) and Route Reply (RREP). The source node will create a RREQ packet containing its IP address, its current sequence number, the destination's IP address, the destination's last sequence number and broadcast ID. The broadcast ID is incremented each time the source node initiates RREQ. Basically, the sequence numbers are used to determine the timeliness of each data packet and the broadcast ID & the IP address together form a unique identifier for RREQ so as to uniquely identify each request. The requests are sent using RREQ message and the information in connection with creation of a route is sent back in RREP message. The source node broadcasts the RREQ packet to its neighbours and then sets a timer to wait for a reply. To process the RREQ, the node sets up a reverse route entry for the source node in its route table. This helps to know how to forward a RREP to the source. Basically a lifetime is associated with the reverse route entry and if this entry is not used within this lifetime, the route information is deleted. If the RREQ is lost during broadcast, the source node is allowed to broadcast again using route discovery mechanism. Maintenance of routes is done using Local route repair scheme.

Literature Survey

Several researchers have worked on the performance evaluation of DSR and AODV using different performance metrics. Some of these are Georgios Kioumourtzis [7], S.Shah, A.Khandre, M.Shirole and G. Bhole [11], J. Broch, D. A. Maltz, D. B. Johnson, Y. C. Hu, and J. Jetcheva [8], D. O. Jorg [6], K. U. Khan, R. U. Zaman, A. V. Reddy [9], A. Kumar B. R., Lokanatha C. Reddy and Prakash.S.Hiremath [1], N. Vetrivelan & A. V. Reddy [10]. Most of the researchers have carried out the performance comparison of routing protocols on the basis of packet delivery fraction and average end to end delay. These two prominent on-demand routing protocols share certain salient characteristics. Specifically, they both discover routes only in the presence of data packets in the need for a route to a destination. Route discovery in either protocol is based on query and reply cycles and route information is stored in all intermediate nodes on the route in the form of route table entries (AODV) or in route caches (DSR). However, there are several important differences in the dynamics of these two protocols, which may give rise to significant performance differentials. The important differences are given below in the form of advantages and drawbacks of these protocols. These differences help in studying the mobility pattern and performance analysis of either protocol.

Advantages and Drawbacks of DSR

The advantages of DSR protocol are as under:

a. DSR uses no periodic routing messages (e.g. no router advertisements and no link-level neighbor status messages), thereby reducing network bandwidth overhead, conserving battery power, and avoiding the propagation of potentially large routing updates throughout the ad hoc network.
b. There is no need to keep routing table so as to route a given data packet as the entire route is contained in the packet header.
c. The routes are maintained only between nodes that need to communicate. This reduces overhead of route maintenance.
d. Route caching can further reduce route discovery overhead. A single route discovery may yield many routes to the destination, due to intermediate nodes replying from local caches
e. The DSR protocol guarantees loop-free routing and very rapid recovery when routes in the network change.
f. It is able to adapt quickly to changes such as host movement, yet requires no routing protocol overhead during periods in which no such changes occur.
g. In addition, DSR has been designed to compute correct routes in the presence of asymmetric (uni-directional) links. In wireless networks, links may at times operate asymmetrically due to sources of interference, differing radio or antenna capabilities, or the intentional use of asymmetric communication technology such as satellites. Due to the existence of asymmetric links, traditional link-state or distance vector protocols may compute routes that do not work. DSR, however, will find a correct route even in the presence of asymmetric links.

The drawbacks of this protocol are given as below:

a. The DSR protocol is mainly efficient for mobile ad hoc networks with less than two hundred nodes. This is not scalable to large networks.
b. DSR requires significantly more processing resources than most other protocols. In order to obtain the routing information, each node must

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spend lot of time to process any control data it receives, even if it is not the intended recipient.

c. The contention is increased if too many route replies come back due to nodes replying using their local cache. The Route Reply Storm problem is there.
d. An intermediate node may send Route Reply using a stale cached route, thus polluting other caches. This problem can be eased if some mechanism to purge (potentially) invalid cached routes is incorporated.
e. The Route Maintenance protocol does not locally repair a broken link. The broken link is only communicated to the initiator.
f. Packet header size grows with route length due to source routing.
g. Flood of route requests may potentially reach all nodes in the network. Care must be taken to avoid collisions between route requests propagated by neighboring nodes.

Advantages and Drawbacks of AODV

The advantages of AODV protocol are summarized below:

a. The routes are established on demand and destination sequence numbers are used to find the latest route to the destination. The connection setup delay is lower.
b. It also responds very quickly to the topological changes that affects the active routes.
c. It does not put any additional overheads on data packets as it does not make use of source routing.
d. It favors the least congested route instead of the shortest route and it also supports both unicast and multicast packet transmissions even for nodes in constant movement.

The drawbacks of AODV protocol are mentioned as under:

a. The 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.
b. The various performance metrics begin decreasing as the network size grows.
c. It is vulnerable to various kinds of attacks as it based on the assumption that all nodes must cooperate and without their cooperation no route can be established.
d. The multiple Route Reply packets in response to a single Route Request packet can lead to heavy control overhead. The periodic beaconing leads to unnecessary bandwidth consumption.
e. It expects/requires that the nodes in the broadcast medium can detect each others' broadcasts. It is also possible that a valid route is expired and the determination of a reasonable expiry time is difficult. The reason behind this is that the nodes are mobile and their sending rates may differ widely and can change dynamically from node to node.

The comparative study and performance analysis [2] of DSR and AODV have reflected in Table I and Table II. The first table is description of parameters selected with respect to low mobility and lower traffic. It has been observed that the performance of both protocols studied was almost stable in sparse medium with low traffic. Table II is evaluation of same parameters with increasing speed and providing more nodes. The results indicate that AODV keeps on improving with denser mediums and at faster speeds. Table III is description of other important parameters that make a protocol robust and steady in most cases. The evaluation predicts that in spite of slightly more overhead in some cases DSR and AODV outperforms in all cases. AODV is still better in route updation and maintenance process.

Table I: Metrics w.r.t Low mobility

Low Mobility and Low Traffic				
Protocol	**Routing overhead**	**Average end to end delay**	**Packet delivery ratio**	**Path optimality**
DSR	Low	Average	High	Average
AODV	Low	Average	High	Average

Table II: Metrics w.r.t High mobility

High Mobility and High Traffic				
Protocol	**Routing overhead**	**Average end to end delay**	**Packet delivery ratio**	**Path optimality**
DSR	Average	Average	Average	Low
AODV	Very High	Average	Average	Average

Table III: Evaluation w.r.t other parameters

Protocol	**Category**	**Protocol Type**	**Loop Freedom**	**Multiple routes**	**Multicast**	**Security**	**Message Overhead**	**Periodic broadcast**	**Requires sequence data**	**Expiry of routing information**	**Summary**
DSR	On Demand or Reactive	Source Routing	Yes	Yes	No	No	High	No	No	No	Route Discovery, Snooping
AODV	On Demand or Reactive	Distance Vector	Yes	No	Yes	No	High	Possible	Yes	Yes	Route Discovery, Expanding Ring Search, Setting forward path

In this research paper, analysis of two prominent on-demand routing protocols i.e. DSR and AODV has been done by carrying out simulation experiments over NS-2. The significance of either protocol has been analyzed using packets broadcast as performance metric. This metric has been studied with respect to 15, 25 and 45 mobile nodes by varying pause time and using UDP traffic agents.

Performance Metrics

The RFC 2501 describes a number of quantitative metrics that can be used to study the mobility pattern of reactive routing protocols for mobile wireless ad hoc networks. Some of these are given below:

a) PDF (Packet Delivery Fraction) / PDR (Packet Delivery Ratio)

The packet delivery fraction or packet delivery ratio is defined as the ratio of number of data packets received at the destinations over the number of data packets sent by the sources as given in equation (1). This performance metric is used to determine the efficiency and accuracy of MANET's routing protocols.

Packet Delivery Fraction =

$$\frac{\text{Total Data Packets Received}}{\text{Total Data Packets Sent}} \text{ X } 100 \qquad \text{---- (1)}$$

b) AE2ED (Average End-to-End Delay)

This is the average time involved in delivery of data packets from the source node to the destination node. To compute the average end-to-end delay, add every delay for each successful data packet delivery and divide that sum by the number of successfully received data packets as given in equation (2). This metric is important in delay sensitive applications such as video and voice transmission.

Average End-to-End Delay =

$$\frac{\sum (\text{Time Received} - \text{Time Sent})}{\text{Total Data Packets Received}} \qquad \text{---- (2)}$$

c) Network Throughput

A network throughput or simply throughput is the average rate at which message is successfully delivered between a destination node (receiver) and source node (sender). It is also referred to as the ratio of the amount of data received from its sender to the time the last packet reaches its destination. Throughput can be measured as bits per second (bps), packets per second or packet per time slot. For a network, it is required that the throughput is at high-level. Some factors that affect MANET's throughput are unreliable communication, changes in topology, limited energy and bandwidth.

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d) NRL (Normalized Routing Load)

The normalized routing load is defined as the fraction of all routing control packets sent by all nodes over the number of received data packets at the destination nodes. In other words, it is the ratio between the total numbers of routing packets sent over the network to the total number of data packets received as given in equation (3). This metric discloses how efficient the routing protocol is. Proactive protocols are expected to have a higher normalized routing load than reactive ones. The important point to note is that bigger the normalized routing load, less efficient is the routing protocol.

Normalized Routing Load =

$$\frac{\text{Total Routing Packets Sent}}{\text{Total Data Packets Received}} \quad \text{---- (3)}$$

e) PL (Packet Loss)

Packet loss occurs when one or more packets being transmitted across the network fail to arrive at the destination. It is defined as the number of packets dropped by the routers during transmission. It can be shown by equations (4) to (6).

Packet Loss = Total Data Packets Dropped ---- (4)

Packet Loss = Total Data Packets Sent – Total Data Packets Received ---- (5)

$$\text{Packet Loss (\%age)} = \frac{\text{Total Packets Dropped}}{\text{Total Data Packets Sent}} \times 100 \quad \text{---- (6)}$$

In this paper, an effort has been made to analyze the packets sent, received and dropped over mobile adhoc network using both DSR and AODV protocols. The results will be very helpful for researchers to do further innovations in the field of mobile adhoc network.

Simulation Environment

The simulation experiments are carried on Linux platform using network simulator 2 (version 2.34). A TCL script has been written using UDP traffic agents. The mobility model used is random waypoint model in a square area. The area configurations used are 670 meter X 670 meter for 15 nodes, 750 meter x 750 meter for 25 nodes and 1000 meter x 1000 meter for 45 nodes. The packet size is 512 bytes. The simulation run time is 500 seconds during analysis of 15 & 25 nodes and 650 seconds for 45 nodes. The packets start their journey from a random location to a random destination with a randomly chosen speed. An extensive simulation model having scenario of 15, 25 and 45 mobile nodes is used to study inter-layer interactions and their performance implications. Same kind of scenario has been used for analysis on the basis of packets broadcast over mobile adhoc network using DSR and AODV protocols. It has been found that even though DSR and AODV share a similar on-demand behavior, the differences in the protocol mechanics can lead to significant performance differentials. The performance of either protocol has been analyzed on the basis of packets sent, packets received and packets dropped with respect to varying pause time.

A. Packets Broadcast for 15 Nodes with UDP Traffic Agents

In figure 1 and 2, packets broadcast has been evaluated for DSR and AODV protocols using pause time as varying parameter with six UDP agents. Pause time has been varied from 100s to 500s. In this scenario, the observation is that the packets sent from source and packets received at destination using DSR protocol are almost same. Therefore, packets dropped are almost negligible when broadcast is done using DSR protocol. On the other side, packets sent from source and packets received at destination using AODV protocol are having significant difference and therefore, there is a significant packets loss during broadcast over AODV protocol. Concluding, in this case, DSR protocol outperforms than AODV in terms of efficient routing over mobile adhoc network.

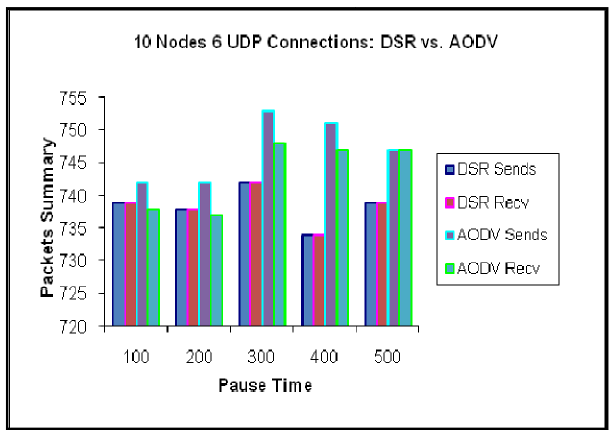

Figure 1: Sends vs. Received Packets for 15 nodes

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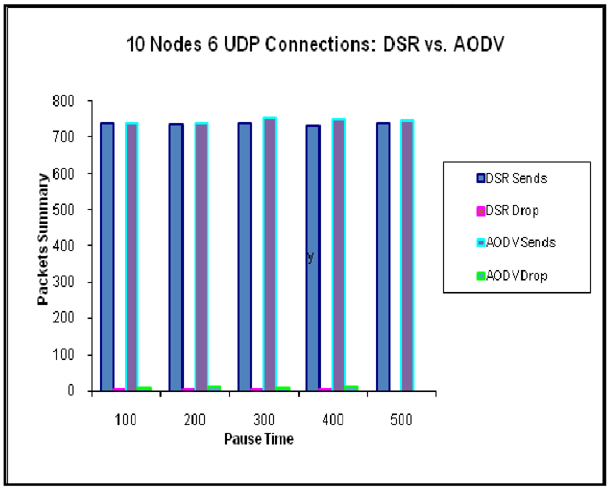

Figure 2: Sends vs. Dropped Packets for 15 nodes

B. Packets Broadcast for 25 Nodes with UDP Traffic Agents

In figure 3 and 4, packets broadcast has been evaluated for DSR and AODV protocols using pause time as varying parameter with six UDP agents. Pause time has been varied from 100s to 500s. In this scenario, again the observation is that the packets sent from source and packets received at destination using DSR protocol are almost same. Therefore, packets dropped are less when broadcast is done using DSR protocol. On the other side, packets sent from source and packets received at destination using AODV protocol are having significant difference. In this case, considerable numbers of packets are dropped when broadcast of packets is through AODV protocol. Hence DSR protocol outperforms than AODV in terms of efficient routing.

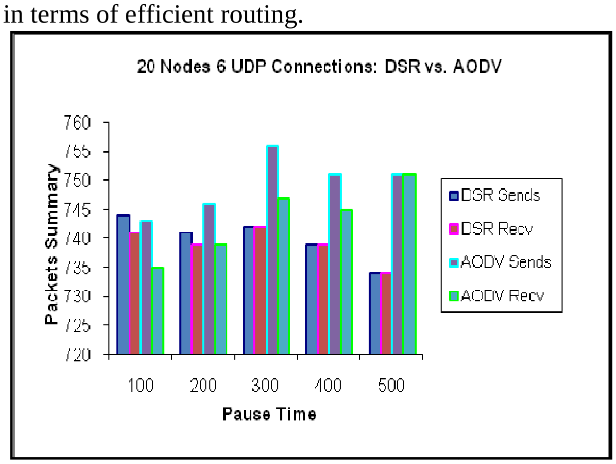

Figure 3: Sends vs. Received Packets for 25 nodes

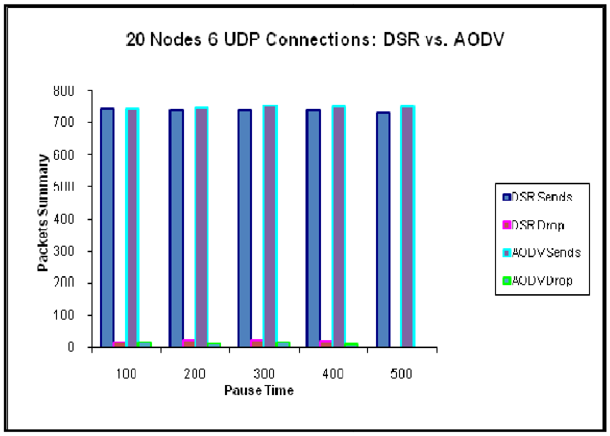

Figure 4: Sends vs. Dropped Packets for 25 nodes

C. Packets Broadcast for 45 Nodes with UDP Traffic Agents

In figure 5 and 6, packets broadcast has been evaluated for DSR and AODV protocols using pause time as varying parameter with six UDP agents. Pause time has been varied from 100s to 650s. In this case, there is a noteworthy change in results for DSR and AODV protocols. The observation is that when broadcast of packets is done using DSR protocol, lots of packets are dropped. Therefore, the packets sent from source and packets received at destination using DSR protocol are having significant difference. On the other side, packets sent from source and packets received at destination using AODV protocol are having very less difference in comparison to that of DSR protocol. This time very less numbers of packets are dropped when routing of packets is done using AODV protocol while it was not so in case of scenarios for 15 and 25 nodes. Finally, AODV protocol has started outperforming than DSR protocol in terms of efficient routing for denser medium scenarios.

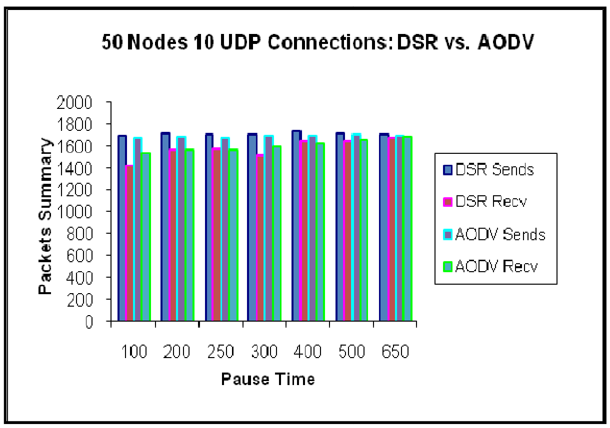

Figure 5: Sends vs. Received Packets for 45 nodes

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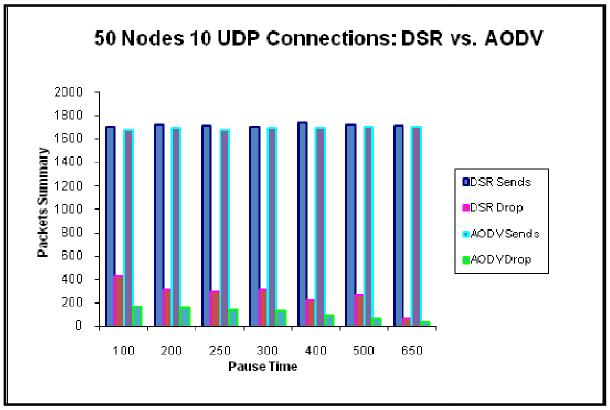

Figure 6: Sends vs. Dropped Packets for 45 nodes

Conclusion and Future Scope

In this paper, performance evaluation of DSR and AODV has been carried out on the basis of packets broadcast. It can be seen from the figures 1 to 6 that when the network size is small, the DSR protocol outperforms than AODV protocol but when the network size is high, AODV starts outperforming DSR. Concluding, in denser medium, routing using AODV is more efficient than DSR while in sparse medium, converse is true. The DSR performance decreases in denser networks disclosing that source routing cannot efficiently adapt the network topology changes that are caused by the frequent movement of the nodes. Since in real life scenario, the emphasis is on denser mediums, we can generalize that the use of AODV protocol is better choice over DSR protocol for efficient routing over mobile adhoc network. This protocol will be suited for any kind of application (voice, video, file transfer, etc.) in networks with high mobility that consist of large number of nodes. The performance of AODV under highly denser medium on the basis of packets broadcast is still to be compared with TORA, STAR and ZRP. This aspect is still under our consideration. A sincere effort will also be made to evaluate the performance of DSR and AODV using normalized routing load. Work also needs to be done in the field of energy efficient routing.

References

[1] *A. Kumar B. R., Lokanatha C. Reddy and Prakash. S. Hiremath, "Performance Comparison of Wireless Mobile Adhoc Network Routing Protocols", IJCSNS International Journal of Computer Science and Network Security, Vol. 8, No.6, June 2008.*

[2] *A. Kush and S. Taneja, "A Survey of Routing Protocols in Mobile Adhoc Network", International Journal of Innovation, Management and Technology, Vol. 1, No. 3, pp 279-285, August 2010.*

[3] *C. E. Perkins, Adhoc Networking, Addison-Wesley, March 2005.*

[4] *C. E. Perkins, E. B. Royer and S. Das, "Adhoc On-Demand Distance Vector (AODV) Routing", IETF Internet Draft, July 2003.*

[5] *D. B. Johnson, D. A. Maltz and Y. C. Hu, "The Dynamic Source Routing Protocol for Mobile Adhoc Networks (DSR)", IETF Internet Draft, April 2003.*

[6] *D. O. Jorg, "Performance Comparison of MANET Routing Protocols in Different Network Sizes", Computer Networks & Distributed Systems, 2003.*

[7] *G. Kioumourtzis, "Simulation and Evaluation of Routing Protocols for Mobile Adhoc Networks", Thesis, Master of Science in Systems Engineering and Master of Science in Computer Science*, *Naval Postgraduate School, Monterey, California, 2005.*

[8] *J. Broch, D. A. Maltz, D. B. Johnson, Y. C. Hu and J. Jetcheva, "A Performance Comparison of Multi-Hop Wireless Network Routing Protocols," Proceedings of the Fourth Annual ACM/IEEE International Conference on Mobile Computing and Networking (MobiCom'98), October 25-30, 1998, Dallas, Texas, USA, pp. 25-30.*

[9] *K. U. Khan, R. U. Zaman and A. Venugopal Reddy, "Performance Comparison of On-Demand and Table Driven Adhoc Routing Protocols using NCTUns", Tenth International Conference on Computer Modeling and Simulation, 2008.*

[10] *N. Vetrivelan and A. V. Reddy, " Performance Analysis of Three Routing Protocols for Varying MANET Size", Proceeding of the International Multi Conference of Engineers and Computer Scientists 2008, IMECS 2008, Vol. II, 19-21 March, 2008, Hong Kong.*

[11] *S. Shah, A. Khandre, M. Shirole and G. Bhole, "Performance Evaluation of Adhoc Routing Protocols using NS2 Simulation", Mobile and Pervasive Computing (CoMPC–2008), pp. 167-171, 2008.*