Comparision Based Performance Analysis Of AODV, DSR, DSDV With PUMA MANET Routing Protocols Under CBR Traffic

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Abstract
A Mobile Ad-Hoc Network (MANET) is a collection of wireless mobile nodes forming a temporary network without using any centralized access point or administration. MANET protocols have to face high challenges due to dynamically changing topologies, low transmission power and asymmetric links of network. The widely accepted existing routing protocols designed to accommodate the needs of such self-orkl,ganized networks do not address possible threats aiming at the disruption of the protocol itself. In this paper an attempt has been made to compare the performance of two On-demand reactive routing protocols namely AODV and DSR and a proactive routing protocol namely DSDV in different scenarios. Multicasting is intended for group communication that supports the dissemination of information from a sender to all the receivers in a group. On the basis of comparison of multicasting protocols, Protocol for Unified Multicasting through Announcement (PUMA) has been chosen for initial implementation. PUMA outperforms with other multicast protocols under CBR traffic patterns considering End-to-End delay, Packet Delivery Ratio, and Throughput metrics for performance analysis and the simulator used is NS-2 in Ubuntu operating system(Linux).The simulations are carried out by varying number of nodes and pause time and the results are analyzed.

Keywords
MANET, DSDV, AODV, DSR, PUMA, CBR.

I. Introdauction

An Ad-Hoc network is a collection of wireless mobile nodes dynamically forming a temporary network without the use of existing network infrastructure or centralized administration [1, 2]. MANET is a kind of wireless network and self configuring network of moving routers associated with wireless network. The routers are free to move randomly and organize themselves arbitrarily, thus, the network's wireless topology may change rapidly and unpredictably [1, 3]. Main challenges to maintain the Mobile Ad-Hoc network are: No central controlling authority, limited power ability, continuously maintain the information required to properly route traffic.

Ad hoc networks have become increasingly relevant in recent years due to their potential applications in military battlefield, emergency disaster relief, vehicular communications etc. In ad hoc applications, collaboration and communication among a group of nodes are necessary. Instead of using multiple unicast transmissions, it is advantageous to use multicast in order to save network bandwidth and resources. Multicasting is a communication process in which the transmission of message is initiated by a single user and the message is received by one or more end users of the network.[4, 5] Routing is the process of selecting paths in a network along which to send data or physical traffic. Every routing protocol has its own algorithm on the basis of which it discovers and maintains the route. In every routing protocol, there is a data structure which stores the information of route and modifies the table as route maintenance is requires. A routing metric is a value used by a routing algorithm to determine whether one route should perform better than another [6]. Metrics can cover such information as bandwidth, delay, hop count, path cost, load, reliability and communication cost. The routing table stores only the best possible routes while link-state or topological databases may store all other information as well [3,7, 9].

The main objective of ad-hoc routing protocols is to deliver data packets among mobile nodes efficiently without predetermined topology or centralized control. The various mobile ad-hoc routing protocols have been proposed and have their unique characteristics.

II. Mobile Ad-HOC Routing Protocols

There are two main approaches for routing process in ad-hoc networks[10]. The first approach is a proactive approach which is table driven and attempt to maintain consistent, up-to-date routing information from each node to every other node in the network. Proactive protocols present low latency, but high routing overhead, as the nodes periodically exchange control messages and routing-table information in order to keep up-to-date route to any active node in the network. The second approach is re-active, source-initiated or on-demand. Reactive protocols create routes only when desired by the source node. Puma is a receiver initiated routing protocol in which receivers join a multicast group using special address. When a node requires a route to a destination, it initiates a route discovery process within the network. Reactive protocols do not maintain up-to-date routes to any destination in the network and do not generally exchange any periodic control messages. Thus, they present low routing overhead, but high latency as compared to proactive protocols. The DSDV is a proactive protocol and AODV, DSR, and TORA are reactive protocols. The mobile ad-hoc routing protocols considered in this study are AODV, DSR, DSDV and PUMA [4].

III. Description of Protocols

A. Destination Sequenced Distance Vector (DSDV)

DSDV [3,4,7] is considered to be successor of Distance Vector in wired routing protocol and guarantees a loop free path to each destination. It is based on the Bellman-Ford algorithm for calculation of shortest path. For this protocol, every node maintains routing table which contains all available destinations with associated next hop towards destination, distance and destination sequence number. Destination sequence number presents improvement of DSDV routing protocol compared to distance vector routing, and it is used to distinguish stable routes from fresh ones and avoid formation of route loops.

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In order to maintain the consistency in dynamic environment, each node periodically broadcasts its routing table to its neighbors. Broadcasting of the information is done in Network Protocol Data Units (NPDU) in two ways: full dump and incremental dump. Full dump requires multiple NPDUs, while incremental requires only one NPDU to fit in all the information, to minimize the number of control messages disseminated in the network. When an information packet is received from another node, node compares the sequence number with the available sequence number for that entry. If the sequence number is larger, entry will be updated with the routing information with the new sequence number, else if the information arrives with the same sequence number, metric entry will be required. If the number of hops is less than the previous entry, new information will be updated. Update is performed periodically or when significant change in routing table is detected since the last update. If network topology frequently changes, full dump will be carried out, since incremental dump will cause less traffic in stable network topology. When such updating takes place each update is broadcasted in the network, which leads to a heavy network load situation and affects the bandwidth. With more number of nodes, traffic load increases. DSDV takes into account only bidirectional links between nodes.

B. Dynamic Source Routing (DSR)

Dynamic Source Routing (DSR) [3][4] is an on-demand routing protocol, which is based on the concept of source-based routing. DSR is a simple pure on-demand reactive protocol that does not periodically exchange any control packets. The main concept of the DSR protocol is "source routing", in which source nodes place the complete route that the packet must follow from a source to a destination in the header of a packet. DSR applies two on-demand processes, route discovery and route maintenance. The route discovery process is used to discover new routes and maintain them in the cache of nodes. The route maintenance process detects link failures, then repair route or find alternate route. Each node "caches" the routes to any destination it has recently used, or discovered by overhearing its neighbor's transmission. When there is not such route, a route discovery process is initiated. DSR applies on demand schemes for both route discovery and route maintenance. There by reducing network bandwidth overhead, conserving battery power and avoiding large routing updates throughout the mobile ad-hoc network. DSR is a loop free protocol and supports unidirectional links.

C. Ad-HOC On-Demand Distance Vector (AODV)

Ad-hoc On-demand Distance Vector [11][13] is a reactive routing protocol, which mixes the properties of DSR and DSDV. Routes are discovered as on-demand basis and are maintained as long as they are required. Each node of AODV maintains a routing table but unlike the DSDV protocol it does not necessarily maintain route for any possible destination in network. However, its routing table maintains routing information for any route that has been recently used within a time interval; so a node is able to send data packets to any destination that exists in its routing table without flooding the network with new Route Request (ROUTE_REQ) messages.
Like DSDV it maintains a sequence number, which it increases each time it finds a change in the topology of its neighborhood. This sequence number ensures that the most recent route is selected for execution of the route discovery. All routing packets carry these sequence numbers. AODV stores routing information as one entry per destination in contrast to DSR, which cashes multiple entries per destination. Without source routing, AODV relies on routing table entries to propagate an ROUTE_REPLY back to the source and, subsequently, to route data packets to the destination. AODV supports for both unicast and multicast routing, and also supports both bidirectional and unidirectional links.

D. Protocol For Unified Multicasting Through Announcement Puma [4,5]

PUMA [5] is a reactive routing protocol which discovers route only when it is required. The most noticeable aspect of PUMA is that it uses a very simple and effective method to establish and maintain the mesh, this results in a low control overhead. Its multicast connectivity is established and maintained by means of receiver initialization approach in which the receivers joins into the multicast group by using address of core node without the need for network-wide flooding of control or data packets from all the sources of the group. Each group has exactly has one special node which is called as core node in the group. PUMA uses the shared mesh based multicast topology for constructing routes to the members of them multicast group without depending upon any unicast routing protocol. Multicast group maintenance of PUMA is achieved by using the soft state approach where in which the multicast group membership and its associated routes are refreshed periodically by flooding its Multicast Announcement (MA) packet.
PUMA[4] is a receiver initiated routing protocol in which receivers join a multicast group using special address (core in CAMP protocol or group leader in Multicast AODV protocol).The flooding of data or control packets is reduced using special address (core of the group) by all sources. Distributed algorithm is used to elect core among receivers of a multicast group. Election algorithm is same as the spanning tree algorithm to find loop-free shortest path between the core and group members. The elected core is connected to receivers in the network through all possible shortest paths. All intermediate nodes on shortest paths collectively form the mesh structure all nodes in the network keep a packet ID cache to remove data packets that are duplicated [9]. Multicast announcement acts as a single control message to perform all tasks in PUMA.

IV. Problem Statement

The objective of our work is to compare the performance of four routing protocols based on Table Driven and On-demand behavior, namely Destination Sequenced Distance Vector (DSDV), Ad-hoc On-Demand Distance vector (AODV) and Dynamic Source Routing (DSR), (PUMA) is a receiver initiated routing protocol in which receivers join a multicast group using special address for wireless ad hoc networks based on the performance. The comparison has been made on the basis of their properties like throughput, packet delivery ratio (PDR), End to End Delay with respect to two different scenarios – out by varying the number of nodes and pause time and the results are analyzed

V. Performance Metrices Considered for Studies

A. Average end-to-end delay of data packets: It is defined as the average end-to-end delay of data packets within a network. The sum of all time differences between the packet sent and received divided by the number of packets, gives the average end-to-end delay. The lower the end-to-end delay the better the application performance[1,14].
AED= Σ (Received time – sent time)/Total data packets received

B. Average Throughput: It is measured as the ratio of amount of received data to the amount of simulation time and tells about how soon an end user is able to receive data. A higher throughput implies better QoS of the network [1].

Average Throughput = Total Received Bytes / Elapsed Time

C. Packet Delivery Ratio

Packet delivery ratio is calculated by dividing the number of packets received at the destination by the number of packets originated at the source. For the best performance packet delivery ratio of routing protocol should be as high as possible [2]. If the ratio is 1, it will be the best delivery ratio of the routing protocol.

PDR= No. Of received packets/No. Of sent packets

VI. Simulation Results and Their Performance Analysis

Two On-demand (Reactive) routing protocols namely Ad hoc On-Demand Distance Vector Routing (AODV) and Dynamic Source Routing (DSR) and one Table-driven (Proactive) namely Destination Sequenced Demand Vector (DSDV) is used and (PUMA) is a receiver initiated routing protocol in which receivers join a multicast group using special address for wireless ad hoc networks based on the performance.. The mobility model used is Random waypoint mobility model because it models the random movement of the mobile nodes.

Table 1: Simulation Setup

Platform	Ubuntu
NS version	Ns-allinone-2.35
Pause time	0,40,80,120,160,200
Simulation time	200ms
Number of nodes	10,30
Traffic pattern	CBR(Constant Bit Rate)
Transmission Range	250m
Simulation Area Size	500 * 500
Node speed	20 m/s
Mobility model	Random way point
Interface type	LL

Scenario 1: In this scenario, number of nodes connected in a network at a time is varied and thus varying the number of connections, through which the comparison graphs of AODV, DSDV, DSR and PUMA is obtained.

Table 2: Various parameters used while varying number of nodes.

PARAMETER	VALUE
Number of Nodes	50,100,125,150,200
Simulation Time	100 sec
Routing Protocol	AODV,DSDV,DSR,PUMA
Simulation Model	Two Ray Ground
MAC Type	802.11
No. of connection	60
Link Layer Type	LL
Interface Type	Queue
Traffic Type	CBR
Packet size	512 MB
Queue Length	50
Pause Time	10 sec
Node speed	10 m/s

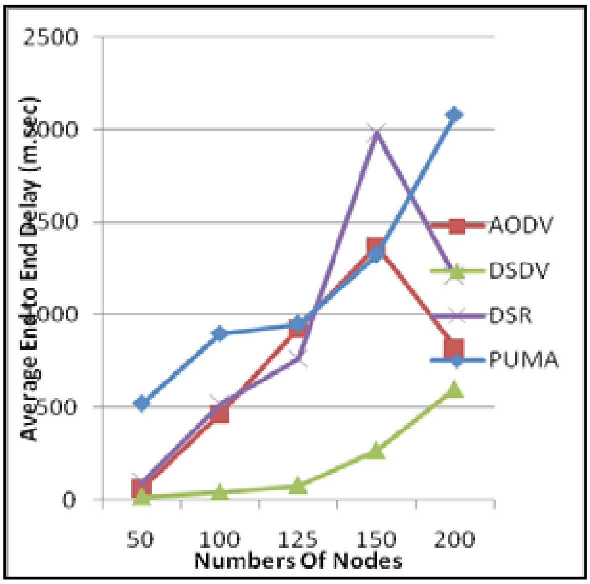

Fig. 2(a): Average End-To-End Delay for AODV, DSR, DSDV and PUMA by varying number of nodes.

Average End to End Delay: : Performance of DSDV first decrease with increasing number of nodes. It also degrades with increasing nodes for AODV & DSR. In all DSDV performs better than AODV & DSR as it again increasing with decrease of nodes. The routing of PUMA is more when compared to other multicast routing protocols. Also for increasing number of nodes, the throughput and packet delivery ratio of PUMA is higher than many other routing protocols. It performs better than all the other protocol.

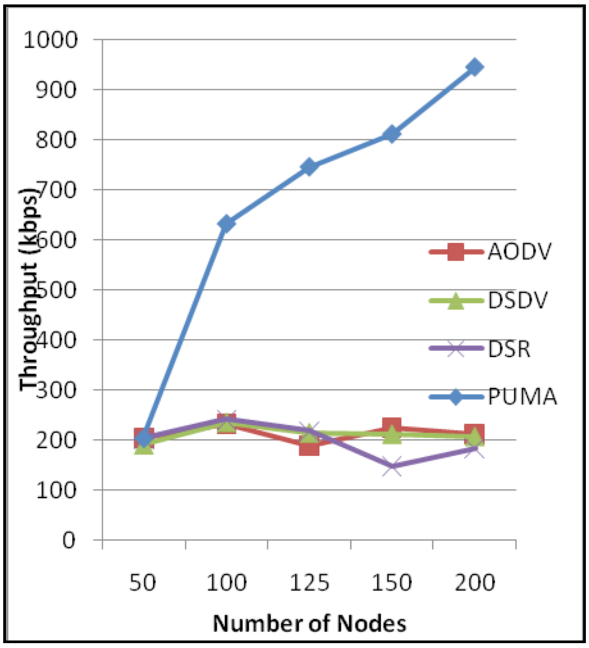

Fig. 2(b): Throughput for AODV, DSR, DSDV and PUMA by varying number of nodes.

Throughput: DSDV performs constantly same when the speed of the nodes change whereas AODV performs better than DSR. As DSR & AODV performs increase with decrease and again as nodes speed increases with number of nodes and performs same for less number of nodes. Over all DSDV shows the highest throughput and outperforms the other protocols. Increasing the number of multicast groups does not have a significant effect in PUMA, because the multicast announcements for multiple groups

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are aggregated by every node. PUMA is better and increases as the number of nodes increases.

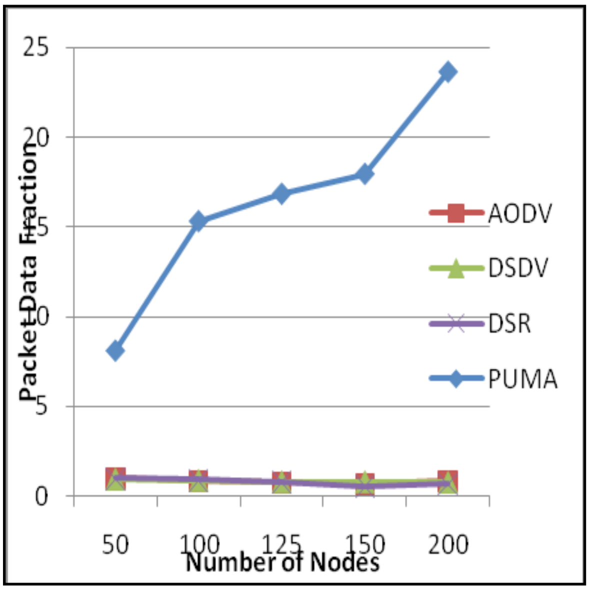

Fig. 2(c): Packet Delivery Ratio for AODV, DSR, DSDV and PUMA by varying number of nodes.

Packet Delivery Ratio DSR & AODV performs with decrease with increasing number of nodes where as DSDV performs same as with decrease with increasing number of nodes. AODV shows better than DSR & DSDV in the performance wise of the routing protocol. By overall performance PUMA ia better than all these protocol. The main goal is to perform streaming of packets over ad hoc networks. Multicast routing protocol PUMA is used to achieve scalability in the network. PUMA achieves desired packet delivery ratio with variable number of nodes.

2.2 Scenario 3: In this scenario, total number of nodes in the network at a time remains fixed and thus varying pause time of the network.

Table 3: Parameter Values For Varying The Pause Time In The Network.

PARAMETER	VALUE
Number of Nodes	50
Simulation Time	100 sec
Routing Protocol	AODV,DSDV,DSR
Simulation Model	Two Ray Ground
MAC Type	802.11
No. of connection	10
Link Layer Type	LL
Interface Type	Queue
Traffic Type	CBR
Packet size	512 MB
Queue Length	50
Pause Time	10,30,50,70,90 sec
Node speed	20 m/s

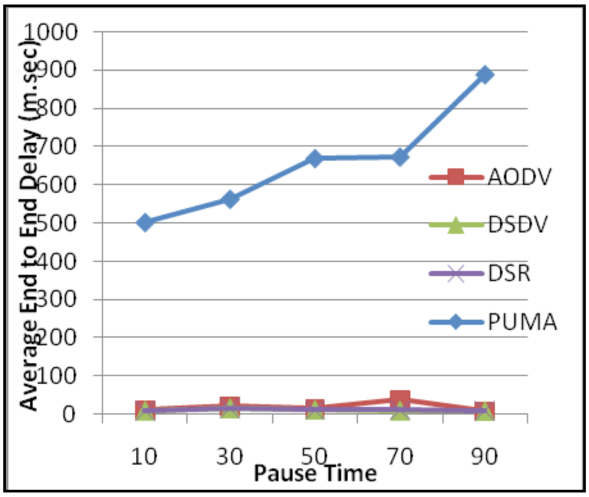

Fig. 3(a): Average End To End Delay for AODV, DSR, DSDV and PUMA by varying pause time in the network.

Average End To End Delay: DSR & DSDV performs almost same almost same where as AODV serves the best among all the protocols with decrease in increasing the variation of pause time. As PUMA is a mesh based scheme, even if there is a link failure, the packets are transmitted using the redundant path in mesh for efficient group communication. So PUMA increases when the number of nodes been higher and average end to end delay increases.

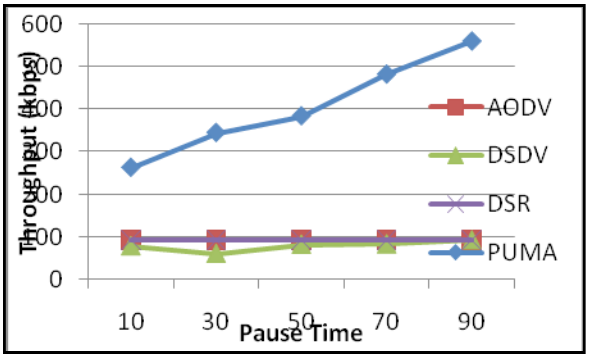

Fig. 3(b): Throughput for AODV, DSR, DSDV and PUMA by varying pause time in the network.

Throughout: AODV & DSR performs same while varying the pause time. DSDV outperforms all the protocols in all condition. AODV & DSR shows better performance than DSDV routing protocols. The throughput in PUMA is higher than many other routing protocols.

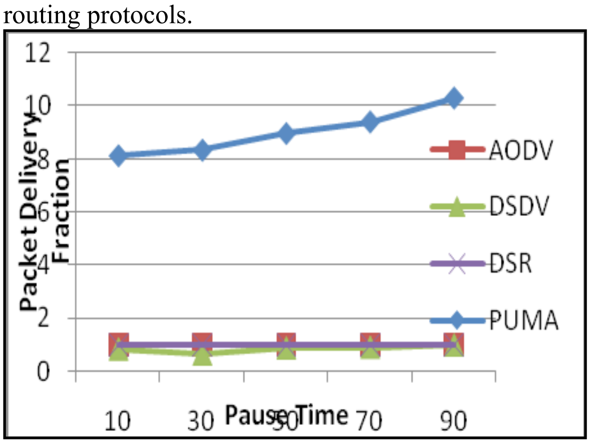

Fig. 8.3(c): Packet Delivery Ratio for AODV, DSR, DSDV and PUMA by varying pause time in the network.

Packet Delivery Ratio: AODV & DSR serves the best among the DSDV protocols while varying the pause time. It performs constantly in all condition where as DSDV performs better than both AODV & DSR routing protocols. The performance is better than all other routing protocol by streaming of packets over ad hoc networks. Multicast routing protocol PUMA is used to achieve scalability in the network. PUMA achieves desired packet delivery ratio with variable number of nodes through pause time.

VII. Conclusions and Future Work

In this research work only two scenarios and three parameters are taken for the comparison of the ad hoc routing protocols. Finally, from the above work performance of AODV is considered best for real time and TCP network. In all the parameters AODV outperforms other than two DSDV and DSR routing protocols. In MANETs, both unicasting and multicasting can be used. But according to the performance analysis, PUMA specifically for group communications, multicast routing increases the efficiency and provides better performance when compared to unicast routing. PUMA incurs far less overhead as compare to tree based multicast protocols and has higher delivery ratios because tree based protocols have to maintain tree structure so they expend too many packets which leads to congestion. Secure communication is a major concern in multicast ad hoc networks, especially because multicasting protocols are applied in many emerging applications.

In future many scenarios and parameters can be used to compare the performance of the Ad Hoc routing protocols used in the TCP network. Simulation tools other than NS2 can be used and the windows platform can be used for implementing the simulation instead of linux.

References

[1] *S.Vanthana, Dr.V.Sinthu Janita Prakash "Comparative Study Of Proactive And Reactive Adhoc Routing Protocols Using Ns2". Institute Of Electrical And Electronics Engineers. 978-1-4799-2876-7/13 © 2013 IEEE.*

[2] *Prof. Mohit Dua1, Prof. Virender Ranga,Ms. Krishma Mehra, Mr. Pawan Kardam, Ms. Snehal Mohan Bahsakhetre " Performance Evaluation Of AODV, DSR, DSDV Mobile Adhoc Protocols On Different Scenarios: An Analytical Review". Department Of Computer Engineering National Institute Of Technology, Kurukshetra (India).*

[3] *Asma Tuteja, Rajneesh Gujrl And Sunil Thalia, "Comparative Performance Analysis Of DSDV, AODV And DSR Routing Protocols In MANET Using NS2", International Conference On Advances In Computer Engineering, 2010.*

[4] *S Sumathy, Beegala Yuvaraj, E Sri Harsha "Analysis Of Multicast Routing Protocols: Puma And Odmrp" International Journal Of Modern Engineering Research (IJMER) ,Vol.2, Issue.6, Nov-Dec. 2012, Pp-4613-4621.*

[5] *Aiswarya Antony, Swarna Parvathi , Akshaya Venkatesan,"Experimental Analysis Of Streaming Over Mobile Adhoc Networks Using PUMA",Indian Jounal Of Engineering ,Volume 2 ,Number 3,ISSN 2319-7757, January 2013.*

[6] *Fasee Ullah, Muhammad Amin And Hamid Ul Ghaffar,"Simulating AODV And DSDV For Adynamic Wireless Sensor Networks" IJCSNS International Journal Of Computer Science And Network Security, VOL.10 No.7,July 2010.*

[7] *Baldev Ram Mali, N.C. Barwar," Performance Of MANET Routing Protocols Considering Impact Of Node Density Under Different Traffic Patterns", Special Issue Of International Journal Of Computer Applications (0975 – 8887) On Wireless Communication And Mobile Networks, No.6. Jan.2012*

[8] *Md. Arafatur Rahman, Farhat Anwar, Jannatul Naeem And Md. Sharif Minhazul Abedin, "A Simulation Based Performance Comparison Of Routing Protocol On Mobile Ad-Hoc Network (Proactive, Reactive And Hybrid)",International Conference On Computer And Communication Engineering (ICCCE 2010), 11-13 May 2010, Kuala Lumpur, Malaysia.*

[9] *Sapna S. Kaushik1 & P.R.Deshmukh2, "Comparison Of Effectiveness Of AODV, DSDV And DSR Routing Protocols In Mobile Ad-Hoc Network" International Journal Of Information Technology And Knowledge Management , Volume 2, No. 2, July-December 2009.*

[10]. *Pratik Gite1, Manish Sharma2 "Performance Evaluation Of Ad-Hoc Network Routing Protocols Using Ns2 Simulation" ACEEE Int. J. On Network Security , Vol. 03, No. 01, Jan 2012*

[11] *Uma Mani, Ramasamy Chandrasekaran And V.R. Sarma Dhulipala, "Study And Analysis Of Routing Protocols In Mobile Ad-Hoc Network" Journal Of Computer Science 9 (11): 1519-1525, 2013*

[12] *Kapang Lego,Pranav Kumar Singh,Dipankar Sutradhar "Comparative Study Of Adhoc Routing Protocol AODV, DSR And DSDV In Mobile Adhoc Network" Kapang Lego Et. Al. / Indian Journal Of Computer Science And Engineering Vol. 1 No. 4 364-371*

[13] *S. Corsonts, J. Macker "Mobile Ad Hoc Networking (MANET): Routing Protocol Performance Issues And Evaluation Considerations" Naval Research Laboratory, January 1999*

[14] *Rashmi Rohankar, Rinkoo Bhatia, Vineet Shrivastava, Deepak Kumar Sharma "Performance Analysis Of Various Routing Protocols (Proactive And Reactive) For Random Mobility Models Of Adhoc Networks." 1st Int'l Conf. On Recent Advances In Information Technology | RAIT-2012*

[15] *David Oliver Jorg, "Performance Comparison Of MANET Routing Protocols In Different Network Sizes", University Of Berne, Switzerland, 2003.*

[16] *Nor Surayati Mohamad Usop, Azizol Abdullah And Ahmad Faisal Amri Abidin, "Performance Evaluation Of AODV, DSDV & DSR Routing Protocol In Grid Environment", IJCSNS International Journal Of Computer Science And Network Security, VOL.9 NO.7, July 2009*