Novelty Journals

ISSN 2394-7314

International Journal of Novel Research in Computer Science and Software Engineering
Vol. 2, Issue 2, pp: (57-65), Month: May - August 2015, Available at: www.noveltyjournals.com

Comparative Performance Analysis of AODV, DSDV and OLSR Routing Protocols in MANET Using OPNET

Ms. Sunita Sharma[1] Ms. Shruti Thapar[2]

[1,2] Assistant professor, Arya Institute of Engineering &Technology Kukas, Jaipur, India

Abstract: **Manet (Mobile Ad-Hoc Network) refers to a network that is designed for a specific purpose only and employ where it is difficult to set-up a centralized network. It is a collection of mobile devices forming a communication network without using any pre-established infrastructure. Because of the dynamic nature like node mobility, resource constrained environment and routing using wireless media of Manet networks routing protocols play a significant role to measure the efficiency and performance of the network. Some typical application areas of Manet consider some efficiency parameters. Generally it includes packet delivery ratio, throughput and shortest available path. This paper evaluates and analyzes the performance of three Manet routing protocols namely, AODV, DSDV and OLSR using simulation. On the basis of detailed simulation results and analysis, a suitable routing protocol can be indentified to meet the specified network conditions and the targeted goals.**

Keywords: **Manet, AODV, DSDV, OLSR, Routing Protocol, simulation, OPNET.**

I. INTRODUCTION

With the extensive use of smaller, cheaper, portable and powerful devices, wireless technology becoming a part of daily-life, we can access the internet using these devices where the physical connectivity between devices is not possible like airplanes, cars and taxies. Manet represent a distributed peer-to-peer network in which each node acts as both as an end system and as a router to process and forwards the data packets towards the destination.

Development of Ad-Hoc networking focuses on multi-hop relaying due to limited radio range of individual nodes. Wireless Ad-Hoc networks are easy to deploy without using any infrastructure by using radio waves as transmitting medium. In such a network nodes can moves freely in any direction but still the rapid growing technology pay attention in many areas such as routing, bandwidth, security, power consumption, simulation and topology control due to moving node [4, 5]. The main target of mobile Ad-Hoc networking is to facilitate efficient communication mechanism in wireless technology by adopting routing strategies between moving nodes.

The remaining part of the paper is organized as follow: Section II includes the definition of Manet, classification of routing protocols. Descriptions of three protocols which are used in research study are presented in section III. Section IV gives details of simulation environment and performance metrics and the results and analysis part of the work done are presented in section V. Section VI concludes the paper and future scope the related work are presented in section VII.

II. MOBILE AD-HOC NETWORKS

Manet denotes a complex distributed peer to peer system of mobile nodes creating a temporary network without aid of fixed infrastructure. In Manet participating node can leave and join the network arbitrarily and network topology change over time. The nodes in Manet are generally come with limited capacities including mobile phones, laptop PDA’s etc.

2.1 Routing in Manet's:

Manet is a collection of nodes with high degree of mobility without centralized point of observation. Each node work as an end system as well a router to process and forward data packets. Due to this highly dynamic nature designing of routing protocol in Manet is a complex task. It requires a routing protocol capable to handle topological changes and functional problems of nodes. If a node either leaves the network or goes out of its range and causes to link breakage, affected nodes can easily request for new routes and will get another available path.

2.2 Classification of routing protocols:

Routing protocols in Manet can be classified on the basis of many factors but most of routing classes dependent on routing methodologies and network structure. According to the routing methodologies routing protocols are of two types.

1. Proactive (table-driven) routing protocol

2. Reactive (On-demand) routing protocol

A. On-Demand or Reactive protocols:

A network using reactive nature of routing protocols, does not maintain prior routing information on all nodes to all times. When a sender node want to transmit data to a desired node, a route discovering procedure is performed to gaining the route availability information. It means we can say that the reactive protocols works on on- demand approach. To use already maintained route a route maintenance step is performed using hello messages to check the nest hop availability, route maintenance is required due to node mobility that leads the topological changes and to ensure the validity of maintained route. Reactive protocols are bandwidth efficient because it

reduces the control overhead that are generated only when they are needed, but it suffers from high latency compare than proactive protocols due to route discovery mechanism [12]. Examples of some reactive protocols are

1) Dynamic Source Routing Protocol (DSR).

2) Temporarily Ordered Routing Algorithm (TORA)

3) Ad-Hoc on-Demand Distance-Vector Routing Protocol (AODV)

B. Proactive protocols or Table-driven protocols:

Proactive protocols maintain all routing information on all nodes at all times before start to communication. This can be performed in various ways, thus protocols are categorized into two subclasses: Event-driven and periodic updated protocols.

Action or event-driven protocols will not generate and exchange any routing updates until no change is occurring in network topology. If a node receiving a message related to the topological changes in network, through its neighbor-set, it informs the other nodes as per the methodology adopted by routing protocols [13]. Some event-driven protocols are:-

1) Destination-Sequenced-Distance –vector routing protocol (DSDV)

2) Cluster-Based routing protocol (CBRP)

Periodic updated routing protocols always send their topological information to other nodes after a specified interval of time. Examples of periodic updated routing protocols

1) FSR (Fish-Eye-Routing protocol)

2) OLSR (Optimized-Link-State Routing Protocol

III. DESCRIPTION OF AODV, DSDV AND OLSR

A. Ad-Hoc on-demand Distance-vector (AODV) routing protocol:

An Ad-Hoc On-Demand Distance Vector (AODV) employ multi-hop routing between participating nodes in the network willing to communicate to each other and maintain an ad-hoc network. It is a reactive protocol based upon the distance vector algorithm, conceptually, AODV is an improved version of DSDV routing algorithm. It inherits the properties form both DSDV and DSR, periodic updates from DSDV and hop by hop routing from DSR. AODV routing mechanism provides a robust and secure transmission of data packets in Manet. Due to reactive nature AODV discover a route only when it is required and does not maintain routes to destination that are not active in the communication process [2].

The algorithm uses different messages to route determination and maintain links. When a node wants to transmit data and does not have the route information, it broadcasts Route Request (RREQ) to all its neighbors. The RREQ flow throughout the network until it reaches to the destination or a node with route information to the destination. Then the route is established by unicasting a RREP back to the sender [11].

The algorithm uses hello messages that are periodically broadcasted among the immediate neighbors set. These hello messages are used for neighbor sensing and indentify the link breakages in the network.

If hello are not received from a particular node, the neighbor can assume that the node has moved away and mark that link to the as broken and inform all the affected set of nodes by sending a RERR error message. The key steps followed by AODV are

Route Discovery:

When a node has some data to send it check own routing table for route to desired destination, it route is available it start the transmission. If destination is unknown and previous route is not valid it broadcast a Route Request (RREQ) to find the route to destination. After broadcasting it wait for a Route Reply (RREP). If it not received the reply packet within a specific time period, the node may rebroadcast the RREQ or assume that there is no path available for the intended destination.

When the RREQ reaches a node that either the destination or a node with enough route information to destination, a RREP is generated or unicasted to the source node back. While the RREP is forwarded, a route is created to the destination and when the RREP reverted back to the original sender a path is established from source to destination [9].

Route Maintenance:

When a node found that a particular route to a neighbour is no longer available, it delete that routing entry from the routing table and send a error notification(RRER) ,a triggered route reply message to all those neighbours that use stale routes actively informing them that this route is no longer available. AODV uses an active neighbour list to keep track the routes using by the neighbours. The nodes receives error messages repeat this procedure for the removable of invalid routes and alert them to request new routes using RREQ.

Merits of AODV:

1) No loop formation

2) Less routing overhead

3) Optimal multicast

Demerits of AODV:

1) Bi-directional connection required to support unidirectional link

2) Introduce delay during route discovery

B) Destination-Sequenced-Distance-Vector (DSDV) routing protocol:

DSDV is a proactive protocol and use the bellman-ford algorithm to find the best shortest path among the all the available paths. Each node periodically exchange own routing information with the all neighbour node sets in the network. The advantage of DSDV over wired distance vector protocols is that it guarantees routes with no loop formation.

DSDV uses the concept of sequence number to indicate the freshness of a route. Each node received the route update message from one of its neighbour and update own routing information according to the sequence number, updates are made only when the sending node have the higher sequence number than receiving node. If the sequence numbers are same then route with minimum hop count is considered as fresh route and make changes in its routing table [3].

In order to reduce the amount of overhead generated due to periodic updates there are two types of update packets are used, Full dump and incremental dump. The full dump packets all the available routing information whereas incremental dump packet stores the information changed since last full dump. DSDV basically is distance vector with small degree of adjustments makes it suitable for Ad-hoc networking [9, 10].

Merits of DSDV:

1) Guarantees loop free paths reduce the count-to-infinity problem.

2) Use of incremental update packets reduces the network overhead.

3) DSDV maintains the best single path to destination that saves the space in the routing table.

Demerits of DSDV:

1) Does not support multipath routing.

2) Tedious to estimate delay for routes advertising.

3) Unnecessary route advertising consumes bandwidth.

C) Optimized-Link-state-Routing (OLSR) protocol:

The proactive OLSR works on the traditional link state protocols concept for wireless Ad-Hoc networking. Due to its proactive tendency, it uses periodic updates to maintain the topological information at each node. In the link state routing methodology, the link state packet contains entire database of its neighbour list that leads large amount of control overhead, furthermore, broadcasting of these packets throughout the network which does not suit the bandwidth-constrained feature of wireless network.

One key idea is to reduce the generated overhead by limiting the number of broadcasts as compared with pure flooding process. The basic concept to employ this idea is the use of multipoint relays (MPR). MPR indicate the specific routers that can

OLSR perform three functions they are, packet forwarding, neighbour sensing and topology determination. Packet forwarding and neighbour sensing are used to gaining information about neighbours and offer an efficient way of message flooding using MPRs in the OLSR networks. The neighbour sensing operation spread out the local information to the entire network by using routers. Topology discovery operation is carried out to calculate the routing tables and find the topological structure of the network. To handle all over routing forward broadcast messages during the flooding process. In order to reduce the size of broadcast messages, Each MPR maintains a small set of neighbours. The protocol is scalable and suitable for dense networks. [7]. OLSR uses four types of messages they are, Hello messages, Topology Control (TC), Multiple Interface Declaration (MID) and Host and Network Association (HNA) message. Hello messages are used to collect the information about the neighbours and link stability. Control messages (TC) used to broadcast own advertised neighbours information that include at least the MPRs selector-list. Hello messages are broadcasted to only one-hop neighbour whereas TC messages are broadcasted to the entire network.MID messages are for informing to other hosts that the announcing host can contain multiple OLSR interface addresses. HNA messages provide the information regarding external routing like network and netmask addresses, so that OLSR host can consider that the announcing host can work as a gateway for the specified set of addresses [6].

Merits of OLSR:

1) Overcome the generated overhead by using the MPRs concept.

2) Suitable for large and dense networks.

3) Easy to integrate with existing operating systems.

International Journal of Novel Research in Computer Science and Software Engineering
Vol. 2, Issue 2, pp: (57-65), Month: May - August 2015, Available at: www.noveltyjournals.com

Demerits of OLSR:

1) Bandwidth consuming due to constant use.

2) No guarantee of shortest path due to use of MPRs.

3) The size of routing tables increase nonlinearly and the actual packets can be blocked by control packets.

IV. SIMULATION ENVOIRNMENT

4.1 Simulator:

The simulation process is carried out using OPNET **(**Optimized Network Engineering Tool) Modeler 14.5 simulator. OPNET is a provider of Network Engineering, planning and operations, Application performance management and network research that are used to provide solutions for managing applications and networks. It is a commercial discrete event driven simulator used to network modeling and simulation. It uses the object-oriented approach to create and map the network graphically. It can be used to design and study the communication networks, applications and network devices with a high degree of flexibility. Its graphical editors provide a clear view of network and network components. One reason for choosing OPNET is as a result of its key attributes such as integrated GUI based debugging, customizable and scalable wireless simulation and modeling.

4.2 Simulation parameters:

The simulation scenario is consists with 50 fixed nodes operate at a speed of 10 m/sec. The simulation scenario divides into three categories, namely

1) Category First- AODV routing protocol with heavy load, consists with 50 fixed nodes.

2) Category Second- DSDV routing protocol with heavy load, consists with 50 fixed nodes.

3) Category Third- OLSR routing protocol with heavy load, consists with 50 fixed nodes.

The above scenario simulated the behavior of AODV, DSDV and OLSR routing protocols. The aim of simulation is to verify the reliability of the results. Our target is to study and analyses the behavior exhibited by the routing protocols under network load and speed. Table 1 show the parameters used in this simulation study.

Table 1 Simulation parameter

Parameter	**Values**
Traffic type	TCP
Simulation time	3,600 sec
No. of Nodes	50
Node speed	10 m/s
Area of network	1 km * 1 km
Packet size	512 to 1024 bytes
Mobility Model	RWP
Protocols	AODV,DSDV,OLSR

4.3 Performance Matrices:

Various performance parameters are used to evaluate the performance exhibited by the routing protocols. They have different characteristics to measure the overall network performance. We evaluate the three matrices used for comparisons to study their effects on the overall network performance. The used matrices are End-to-End Delay, Packet Delivery Ratio and Network Throughput.

A) Network Throughput:

Throughput is considered as an important parameter to measure the robustness of a network. It refers the average rate at which data packets are successfully transmitted from source to destination. Throughput is measured in bits per second (bps) or packet per time slot, some factors can affect the throughput in Manet's like unreliable communication, changes in topology and constrained energy and bandwidth. A network with high throughput is desirable.

B) End-to-End Delay:

End-to-end delay of a network can be defined as the time taken by the network to transmit a packet from source to destination. It considered all the amount of delays encountered throughout the network at every hop passing to reach the destination. It includes delays such a buffer queues, transmission time, delay introduced by routing activities and MAC control overhead. A routing protocol with minimum delay represents the reliability of a network.

C) Packet delivery ratio:

It refers the ratio of the total number of data packets received by the receiver to the total number of data packets generated by the sender. It is also an important performance metric used to measure the efficiency of a routing protocol, because it is used to calculate the packet dropped rate. A high packet delivery ratio is desired in a network.

V. RESULTS AND ANALYSIS

The comparison is made between three routing protocols AODV, DSDV and OLSR to measure the performance through simulation under network load and speed.

A. Packet Delivery Ratio:

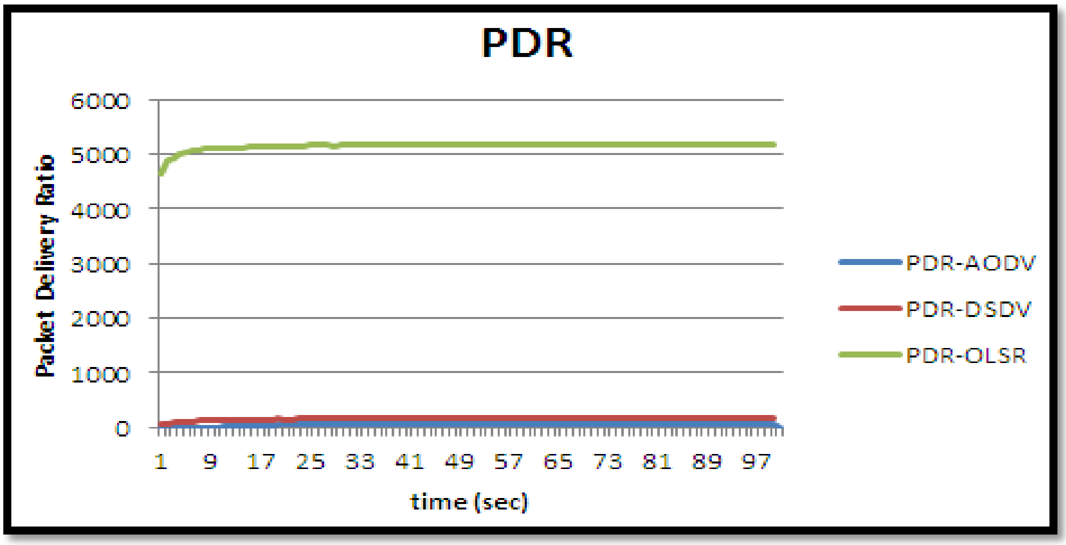

Figure 1: Packet Delivery Ratio

In figure 1, packet delivery ratio is being shown between AODV, DSDV and OLSR routing protocols, using fixed 50 nodes for FTP application. The OLSR routing protocol gives higher packet delivery ratio with as compared to DSDV and AODV. As OLSR is a proactive protocol with link optimization and stability feature perform best within fixed mobility scenario as compared to DSDV routing protocol. In addition to hello messages OLSR uses the TC (Topology Control) messages to exchange the updated route information that reduces the possibility of stale routes. Thus OLSR delivered more packets with increasing load in comparison to DSDV. AODV performs worst due to its reactive nature under static mobility.

B. Packet End-to-End Delay:

In figure 2, plots are being drawn between AODV, DSDV and OLSR protocols comparison on the behalf of end-to-end delay factor. The results exhibits that the OLSR gives minimum delay as compared to DSDV and AODV. As AODV performs worst in this scenario due to its reactive nature and takes time in route discovery mechanism within fixed node mobility scenario.

International Journal of Novel Research in Computer Science and Software Engineering
Vol. 2, Issue 2, pp: (57-65), Month: May - August 2015, Available at: www.noveltyjournals.com

As DSDV is based on periodic broadcasts and it takes fraction of time to converge before using a route whereas OLSR reduces the size of control packets by reducing the number of links used for forwarding the link state packets. It generally stores and updates its routes, so it provides the route immediately without introducing any initial delay whenever the route request is encountered.

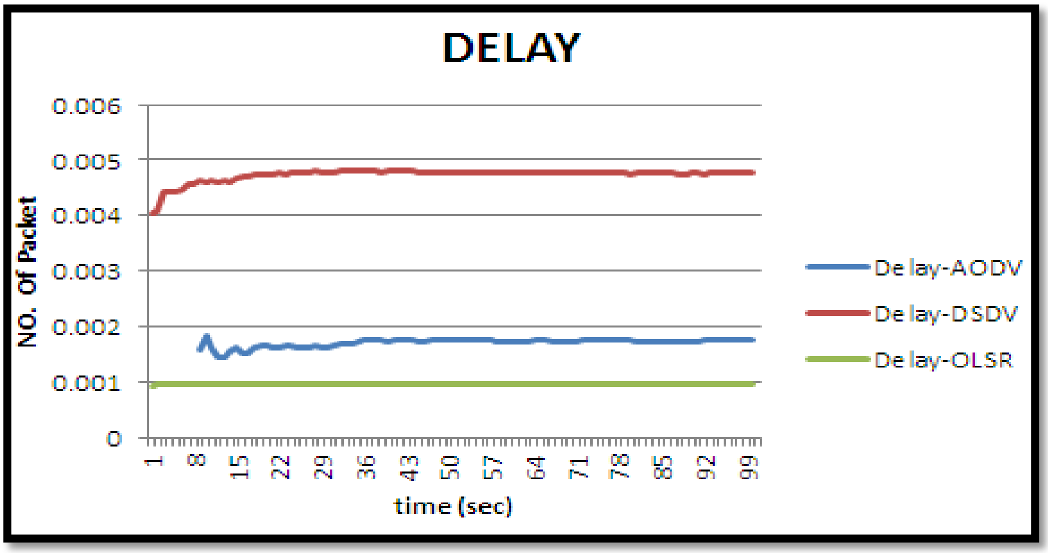

Figure 2: End-to-End Delay

C. Network Throughput

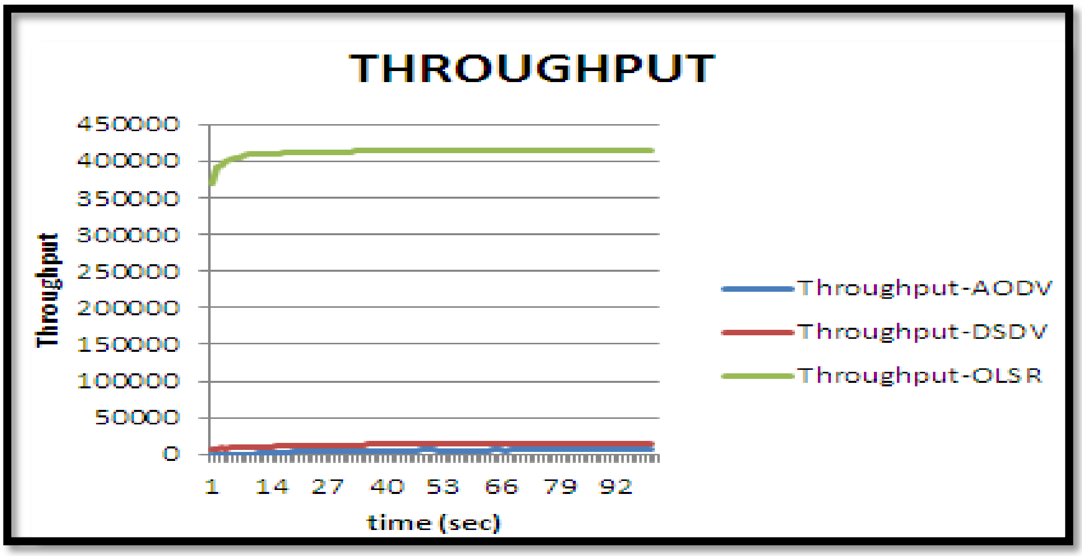

Figure 3: Throughput

In figure 3, the factor on which plots are being compared between AODV, DSDV and OLSR routing protocols is throughput. The plots represent that OLSR routing protocols perform well in terms of throughput as compared to DSDV and AODV routing protocols with 50 nodes for ftp application. As DSDV performs well than AODV because DSDV routing protocol is a proactive protocol, in which source node already knows about its neighbour nodes properly. So without wasting time it transmit the packet to its destination properly. As OLSR uses the concept of MPR's and performs hop by hop routing and eliminates the possibility of stale routes using TC messages and makes efficient utilization of bandwidth than DSDV. AODV is based on reactive routing protocol, in which source node starts its work, when any packet is been given to source node to transmit it to destination node. So basically, time is the important factor for AODV routing protocol.

VI. CONCLUSION

In this research work, we have evaluate the performance of three routing protocols, namely, AODV,DSDV and OLSR by taking End-to-End Delay, Network Throughput and Packet Delivery Ratio as performance metrics parameters. In a network, it is desirable that the routing protocols should be both efficient as well as reliable. In this research, we used FTP traffic with all the sources sending traffic to a common destination.

OLSR outperforms than AODV and DSDV routing protocols in the performance metrics used in this research Whereas AODV has shown the worst performance. Factors considered in this research affecting the performance of ad-hoc protocols are nodes and network load. Network load has a profound effect on the performance whereas nodes affect the performance only in some instances.

Finally, whether a routing protocol is proactive or reactive has profound effects on how the performance of the protocols in various scenarios. Differences occur in performance in the way of route establishment and maintenance strategies. In our research DSDV and OLSR both are of proactive protocols but OLSR gives better results than DSDV same as AODV is a reactive protocol but performs worst compare than proactive protocols so we can say the choice of a particular routing protocol is dependent on the intended use of network.

From this study we can conclude that in the fixed mobility scenario proactive protocols perform better than reactive protocols. In our scenario OLSR outperforms than AODV and DSDV routing protocols under high network load with fixed node mobility and OLSR is a good choice for large and dense networks due to reduction in control packets with less converge time.

VII. FUTURE SCOPE

However, a variety of challenges are encountered in efficient routing protocols design. A central challenge is to design the flexible routing mechanism to adopt the dynamic behavior of an Ad-hoc network environment. Therefore in order to further establish and improves the functionality of new and existing routing protocols, it is desirable to study and examine the various other qualitative and Quantitative performance matrices such as energy- consumption, Fault tolerance and jitter with throughput, end-to-end delay and packet delivery ratio in various mobility and traffic models.

REFERENCES

[1] Jaya Jacob AND V.Seethalakshmi, "Performance analysis and enhancement of routing protocols in MANET", International Journal of Modern Engineering Research (IJMER) Vol.2, Issue.2, Mar-Apr 2012 pp-323-328.

[2] M. Shobana and S. Karthik, "A Performance Analysis and Comparison of various Routing Protocols in MANET", Proceedings of the 2013 International Conference on Pattern Recognition, Informatics and Mobile Engineering (PRIME) February 21-22.

[3] Harpreet singh and Manpreet kaur, "Simulation and Performance Analysis of AODV, TORA & OLSR Routing Protocols", International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-2, Issue-5, November 2013.

[4] Ammar Odeh, Eman Abdel Fattah and Muneer Alshowkan, "Performance evaluation of AODV and DSR routing protocols in Manet networks", International Journal of Distributed and Parallel Systems (IJDPS) Vol.3, No.4, July 2012.

[5] Malek Najib Omar, Ibrahim Thorig, Mazleena Salleh and Mohammad Abdur Razzaque, "Performance and Security Analysis for Proactive and Reactive Protocols in Mobile Ad-hoc Network ", 1st International Conference of Recent Trends in Information and Communication Technologies IRICT 2014 Proceeding 12th -14th September, 2014.

[6] Salim EL KHEDIRI, Nejah NASRI, Awatef BENFRADJ, Abdennaceur KACHOURI and Anne WEI, "Routing Protocols in MANET: Performance Comparison of AODV, DSR and DSDV Protocols Using NS2", 978-1-4799-5874-0/14/22.76 C©2014 IEEE.

[7] Reza Malekian, Aleksandar Karadimce and Abdul Hanan Abdullah, “AODV and OLSR Routing Protocols in MANET”, 2013 IEEE 33rd International Conference on Distributed Computing Systems Workshops 978-0-7695-5023-7/13 $25.00 © 2013 IEEE DOI 10.1109/ICDCSW.2013.14.

[8] Praveen Goyal, “Simulation Study of Comparative Performance of AODV, OLSR, FSR & LAR, Routing Protocols in MANET in Large Scale Scenarios” , 978-1-4673-4805-8/12/$31.00 c 2012 IEEE.

[9] Sabina Baraković, Suad Kasapović, and Jasmina Baraković, “Comparison of MANET Routing Protocols in Different Traffic and Mobility Models”, Telfor Journal, Vol. 2, No. 1, 2010.

[10] Ahmed Al-Maashri and Mohamed Ould-Khaoua, “Performance Analysis of MANET Routing Protocols in the Presence of Self-Similar Traffic”, 1-4244-0419-3/06/$20.00 ©2006 IEEE.

[11] Awadhesh Kumar, Prabhat Singh, Vinay Kumar and Dr. Neeraj Tyagi, “Performance Analysis of AODV, CBRP, DSDV and DSR MANET Routing Protocol using NS2 Simulation”, I. J. Computer Network and Information Security, 2013, 9, 45-50.

[12] Jagdeep Singh and Dr. Rajiv Mahajan, “Performance Analysis of AODV and OLSR Using OPNET”, International Journal of Computer Trends and Technology (IJCTT) – volume 5 number 3 –Nov 2013.

[13] Ashish K. Maurya, Dinesh Singh, and Ajeet Kumar, “Performance Comparison of DSR, OLSR and FSR Routing Protocols in MANET Using Random Waypoint Mobility Model”, International Journal of Information and Electronics Engineering, Vol. 3, No. 5, September 2013.

[14] Ashima Mehta and Prof. Anju Gupta, “Retrospection and Comparison of DSDV and AOMDV Routing Protocols in Manet Using Ns-2”, 978-1-4799-2900-9/14/$31.00 ©2014 IEEE.

[15] K. Natarajan and Dr. G. Mahadevan, “A Succinct Comparative Analysis and Performance Evaluation of MANET Routing Protocols”, 2013 International Conference on Computer Communication and Informatics (ICCCI -2013), Jan. 04 – 06, 2013, Coimbatore, INDIA 978-1-4673-2907-1/13/$31.00 ©2013 IEEE.

[16] Idris Skloul Ibrahim, Peter J.B King and Robert Pooley, “Performance Evaluation of Routing Protocols for MANET”, 2009 Fourth International Conference on Systems and Networks Communications 978-0-7695-3775-7/09 $26.00 © 2009 IEEE DOI 10.1109/ICSNC.2009.86.

[17] Fu Yongsheng, Wang Xinyu and Li Shanping, “Performance comparison and analysis of routing strategies in Mobile ad hoc networks”, 978-0-7695-3336-0/08 $25.00 © 2008 IEEE DOI 10.1109/CSSE.2008.799.

[18] Qutaiba Razouqi, Ahmed Boushehri, Mohamed Gaballah and Lina Alsaleh, “Extensive Simulation Performance Analysis for DSDV, DSR and AODV MANET Routing Protocols”, 978-0-7695-4952-1/13 $26.00 © 2013 IEEE DOI 10.1109/WAINA.2013.239.