IJCTA, 9(26) 2016, pp. 275-283

Comparative Performance Analysis of Mobile Ad-Hoc Network Routing Protocols

D. Shanmugasundaram[1] and A.R. Md. Shanavas[2]

ABSTRACT

Mobile Ad-Hoc Network (MANET) routing protocols plays very important role. Because, it is infrastructure less, self-configure and self-organize network. MANET has several routing protocols to find the optimal path. This paper mainly deals with the comparison of proactive & reactive protocols. Whenever a comparison is made, it is help to determine optimal solution. This work illustrates the performance of four different ad-hoc routing protocols. It pertains to four distinct categories, they are Ad hoc on-demand distance vector (AODV),Destination-sequenced distance vector (DSDV), Dynamic source routing (DSR)and Dynamic MANET On-Demand Routing Protocol (DYMO), Optimized Link State Routing (OLSR).

1. INTRODUCTION

MANET is a collection of self-governing mobile nodes that communicate over relatively bandwidth and power constrained wireless links. The physical arrangement of the network changes dynamically due to nodes mobility, path loss and interference. Nodes in these networks use the same random access wireless links, each node engaging themselves in multi-hop forwarding. The node acts as hosts as well as routers that route data from node to other nodes in network. The nodes are self-governing to move in any path, there cause frequent link breakage. In the past few years Mobile Ad-hoc NETwork (MANET) is the very hot topic in infrastructure less wireless network. Lot of research teams invent new ideas for routing protocols, services, and security applicable for these types of networks. Research approach is to choosing one of the secure routing protocols among all according to its effectiveness.

The mobility of the mobile device in MANET and the wireless links established between the mobile devices are exposed to different types of attacks. Mobile node and wireless link is the main part of MANET shown in figure 1. The characteristics of the MANET are categorized based on following component. Free

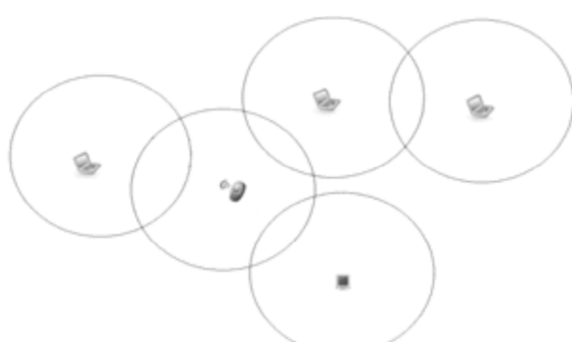

Figure 1: MANET

[1] Assistant Professor, Department of Computer Science, H.H. The Rajah's College, *E-mail: pudukkottaidshhrc@gmail.com*

[2] Associate Professor, Department of Computer Science, JMC, Trichy.

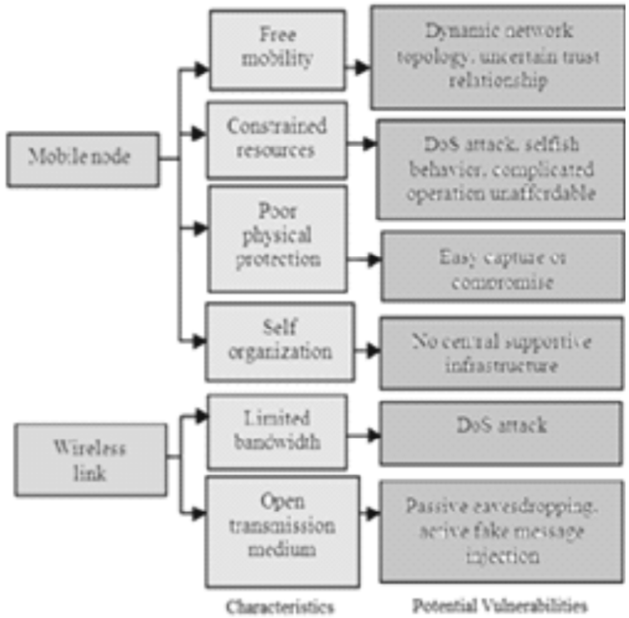

Figure 2: MANET Characteristics and vulnerabilities

mobility, constrained resources, poor physical protection and self-organization are the characteristics stated by the mobile node. Limited bandwidth and open transmission medium are the uniqueness reconnoitered by wireless link. Such an individuality of MANET exploits the vulnerabilities is substantiated in Figure 2.

2. MANET CHALLENGES

1. Limited Bandwidth

Wireless link continue to have lower capacity than infrastructure networks. In addition, the recognized throughput of wireless communication after accounting for the influence of multiple access, fading, noise, and interference conditions, etc., is often much less than a radio's maximum transmission rate.

2. Dynamic Topology

Dynamic topology association may disturb the trust relationship among nodes. The trust may also be disturbed if certain nodes are detected as compromised.

3. Routing Overhead

In wireless adhoc networks, nodes often change their location inside network. So, some routes are generated in the routing table which leads to unnecessary routing overhead.

4. Hidden Terminal Problem

The hidden terminal refers to the collision of packets at a receiving node due to the concurrent transmission of those nodes that are not within the direct transmission range of the sender, but are within the transmission range limit of the receiver.

5. Packet losses due to Transmission Errors

Mobile Ad hoc wireless networks experiences a much higher packet loss owing to factors such as increased collisions due to the presence of hidden terminals, presence of interference, uni-directional links, and common path breaks due to mobility of nodes.

6. Mobility-induced Route Changes

The network topology in anMobile ad hoc wireless network is highly dynamic due to the movement of nodes; therefore an on-going session suffers repeated path breaks. This situation often leads to frequent route changes.

7. Battery Constraints

Devices used in these networks have limitations on the power source in order to sustain portability, size and weight of the device.

8. Security threats

The wireless mobile ad hoc nature of MANETs brings new security challenges to the network design. As the wireless medium is weak to eavesdropping and mobile ad hoc network functionality is established through node cooperation, mobile ad hoc networks are essentially exposed to numerous security attacks.

3. ROUTING PROTOCOLS IN MANET

The MANET routing protocols are divided into three classifications depending to their performance and functionality: Table-driven (Proactive) and On-demand (Reactive) routing protocols and Hybrid routing protocols.

Proactive Routing Protocols

The routing data of MANET protocols is organizedin tables stored by each nodes. The tables must be updated since the network topology is changing dynamically. These protocols are employed where the route necessities are frequent. FSR, STAR, GSR, DSDV, OLSR, CGSR and WRP are the examples.

Reactive Routing Protocols

These routing protocols select routes to other situations only when they are needed. A route discovery process is established when a node wants to communicate with another node for which it does not possess any route table access. AODV, DSR, CBRP,LAR, TORA and ARA are the examples.

Hybrid Routing Protocols

These MANET protocols employ functionality of both the on demand and table driven protocols. For illustration, proactive protocols could be employed between networks and on demand protocols inside the networks. DST, ZRP, DDR, ZHLS are the examples.

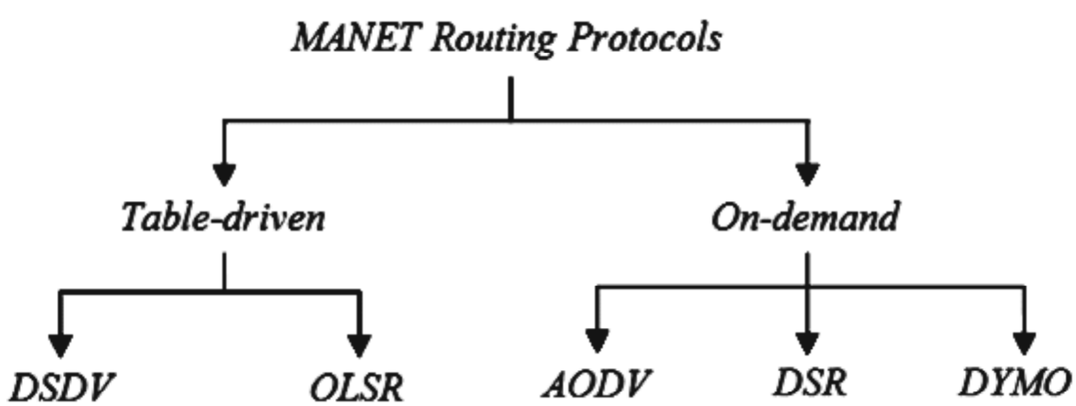

Figure 3: MANET Routing Protocol

3.1 Ad-hoc On-Demand Distance Vector Routing Protocol (AODV)

AODV is a MANET routing protocol which employs an on-demand method to find routes, that is, a route is discovered only when it is needed by a source statin. AODV uses sequence numbers is retained the freshness of routes. AODV employs route request (RREQ) packets broadcasted through the group of links to discover the paths needed by a source station. it allows stations to find routes very fast for new receiver, and does not need node to store routes to destinations which are not moving. AODV aids stations to work in reply to an alteration in network topology and link breakages quickly and the AODV operation is loop-free. When a route to a new node is demanded, the source broadcasts a RREQ packet to discover a route to the needed receiver. A transitional node that captures a RREQ replies to it using a route reply packet only if it has a route to the destination station whose similar destination sequence number is greater or equal to the one presented in the RREQ packet. Alternative important point to indication is that the RREQ also contains the most latest sequence number for the destination of which the source node is approachable. A station capturing the RREQ packet can broadcast a route reply (RREP) packet if it is either the destination node or if it possesses a route to the destination node with equivalent sequence number greater than or like to that seemed in the RREQ packet. In this case, it communicates (unicasts) a RREP reverse to the source station. Then, it broadcasts again the RREQ message. Nodes store track of the RREQ s source IP address and broadcast ID.

3.2 Dynamic Source Routing (DSR)

Dynamic Source Routing (DSR) is a wireless mesh networks routing protocol. Its implementation is based on a technique named “source routingî. DSR supports the network to be completely self-configuring and self-organizing.

The Dynamic Source Routing protocol possesses two main techniques route discovery and route maintenance. In the route discovery process a source node wanting to drive a packet to a destination node, as assured a source route to the destination node. In route maintenance procedure a node which wants to send a message to a destination is capable to perceive, while engaging a source node route to the destination, if the network topology has changed such that it can no longer make use of its route to destination node. In case when Route Maintenance shows a source route is no longer work, source node can try to employ any other route, or it can lunch route discovery mechanism launch again to determine a fresh route for following packets to destination station.

3.3 Dynamic MANET On-Demand Routing Protocol (DYMO)

DYMO uses large variety of mobility patterns by finding dynamically routes on-demand. It also succeeds a wide selection of traffic arrangements. The essential functionality of DYMO is route discovery and route maintenance.

In the route discovery, a DYMO router establishes a Route Request packet (RREQ) to find a route to a destination node. During the hop-by-hop broadcasting technique, each and every intermediate DYMO router receiving the RREQ packet and stores a route to the originator station. When the destination DYMO router captures the RREQ packet, it stores a route to the initiator station and unicasts using a Route Reply (RREP) hop-by-hop through the initiating DYMO router. Each transitional DYMO router that captures the RREP packet makes a route to the target node, and then the RREP packet is unicast hop-by-hop through the originator. When the originators DYMO router receives lastly the RREP packet, routes have been established between the destination DYMO router and initiating DYMO router in two directions. Route maintenance is collected of two operations. To maintain routes in use, DYMO routers rise life of route upon successfully forwarding a packet. To operate in response to the changes in network arrangement, DYMO routers screen traffic being forwarded. When a packet is received to be forwarded and a route for the destination node is not determined or the route is broken down, hence the DYMO router of the source node of the packet is notified. A Route Error (RERR) is broadcasted to point out the route to one or more interrupted destination addresses is misdirected or broken. When the source's DYMO router captures the RERR packet, it considers the route as damaged. Before the DYMO router can forward a message to the same destination node, it must initiate the route discovery mechanism again for the destination station.

3.4 Destination Sequenced Distance Vector (DSDV) Protocol

DSDV is one of the examples of proactive protocol. DSDV adds a novel parameter, sequence number, to each route table at each station. Each node sustains a routing table at its personal and which aids in packet transmission. For the transmission of packets each node stores routing table. The routing owns the data for the connectivity to many nodes. These nodes provide all the number of stations (hops) and the available destinations node needed to get each destination station in the routing table. The routing entry is tagged with a sequence number which is initiated by the receiver node. Each station sends and updates its routing table periodically. The messages is flooded between nodes show a list of accessible nodes and the number of stations needed to get that particular node. Routing data is broadcast periodically by broadcasting or multicasting the packets. Each and every mobile station in DSDV protocol must distribute its routing table data to its neighboring nodes. As the information in the table may change regularly, the announcement should be done on the continuous basis so that every node can locate its neighbors in the network. It guarantees the shortest number of nodes (hops) required from source station to a destination station.

The information flooded by each and every node will contain its new sequence number of parameter and the following information for each fresh route: the number of hops count required to reach the destination, the new sequence number and the destination address.

3.5 Optimized Link State Routing (OLSR) Protocol

OLSR protocol is a pure link state protocol. Whenever there is any change in the topology then change information is flooded to all nodes. This reasons overheads and such overheads are reduced by Multipoint relays (MPR). Two types of control messages are engaged in OLSR; they are topology control and hello messages. It is also Multiple Interface Declaration (MID) packets which are employed for declaring other nodes that the stating node can have several OLSR interface addresses. The MID message is broadcasted throughout the network only by MPRs. Likewise there is a "Host and Network Association" (HNA) packet which gives the external routing information by providing the opportunity for routing to the external addresses.

4. LITERATURE SURVEY

Rajeshkumar*et al*: [1] The paper presents a study of the performance of routing protocols, used in MANETs, in high mobility case under low, medium and high density situation. We vary the number of nodes from 30 (low density) to 50 (high density) in a fixed topography of 1000*1000 meters. Moreover, since Random Waypoint Mobility Model has been used in this study to generate node mobility. Find that the performance varies widely across different number of nodes and different types of speed in node mobility. AODV performance is the top considering its capability to maintain connection by periodic exchange of data's.

Manish Sharma *et al.*

[2] In this paper, the comparison of four MANET protocols such as OLSR, AODV, DSDV and DSR are

discussed with its types of routing. The assessment is based upon the different parameters and performance metrics. In protocol performancecomparition, OLSR best in terms of Packet delivery fraction, Throughput & End-to- End delay. AODV has improved performance in networks which has high mobility and size. DSR/DSDV performs better than DSDV with large no. of nodes. For real time scenario traffic AODV is proposed over DSR and DSDV. For less number of nodes and less mobility, DSDV's performance is better.

Mohamed Elboukhari *et al.*

[3] this paper deals several MANET routing protocols like as AODV, DSR, DSDV, OLSR and DYMO. With the help of NS simulation we compared these protocols under different type of network conditions. By varying Number of Nodes, measure Average Throughput, the Packet Delivery Ratio, Standardized Routing Load and Average End to End Delay as matrices. In terms of Packet Delivery Ratio, AODV, DSR have greater value than other protocols (DSDV, OLSR and DYMO). As table-driven (Proactive) protocols, DSDV and OLSR show the lowest Average End to End Delay compared to on-demand (reactive) protocols (AODV, DSR and DYMO). DSR determines the lowest Normalised Routing Load than other protocols. In almost all situations, AODV and DSR outperform other protocols (DSDV, OLSR and DYMO) in terms of Average Throughput.

5. IMPLEMENTATION OF AODV

There are many AODV routing protocol implementations AODVUCSB, AODV-UU, Kernel-AODV, and AODV-UIUC. Each implementation was developed and designed separately, but they all perform the similar operations. The first release of AODV-UCSB (University of California, Santa-Barbara) used the kernel alteration. AODV-UU has the same design as AODV-UCSB. The main protocol logic is inside the user-space daemon; in addition, AODV- UU (Uppsala University) contains Internet gateway support. AODV-UU except it explicitly separates the routing and forwarding operation. Routing protocol logic takes place in the user-space, while packet forwarding is handled by the kernel.

This is professional because forwarded packets are controlled immediately and fewer packets traverse the kernel to user-space border. All of the implementations talk about the use HELLO messages to determine local connectivity and detect link breaks.

5.1 Methodology

In order to analyze the performance of the AODV routing protocols, with respect to the following metric:

Throughput or packet delivery ratio

It is calculated by the numbers of packets sent out by the sender application and the number of packets received by the corresponding peer application.

Average end-to-end delay

This suggests the delay a packet suffers between leaving the dispatcher application and arriving at the receiver application.

Packet Delivery Ratio

It can be defined as the ratio of total number of data packets delivered to the destination to the total number of data packets generated by the initiator. It is calculated as P = (number of packets received)/(number of packets sent) × 100

5.2 OMNeT++

OMNeT++ is an object oriented discrete event simulation environment developed by Andr´asVarga at the Technical University of Budapest. Its major use is in simulation of network communications. The developers of OMNeT++ predict that one might use it as well for simulation of compound IT systems, queuing networks or h/w architectures, since OMNeT++ is built generic, flexible and modular. As the architecture is modular, the simulation kernel and models can be embedded easily into an application. C++ is the programming language used for the modules in OMNeT++.

5.3 Simulation Parameters

Table 1
Simulation Parameters

Parameters	*Values*
Network Size	1000m X 1000M
Number of Nodes	0-100
Max. Speed/Mobility	10.0ms/s
Pause Time	0-100s
Traffic Model	CBR
Routing Protocol	AODV,DSR,DSDV, OLSR and DYMO.
Simulation Time	600s

6. RESULT AND DISCUSSION

Table 2
Packet Delivery Ratio

No. of nodes	*AODV (%)*	*DSR (%)*	*DSDV (%)*	*OLSR (%)*	*DYMO (%)*
10	98	100	67	91	98
20	97	100	60	81	96
30	98	98	67	92	95
40	95	100	94	98	97
50	94	97	75	93	93
60	97	100	90	100	94

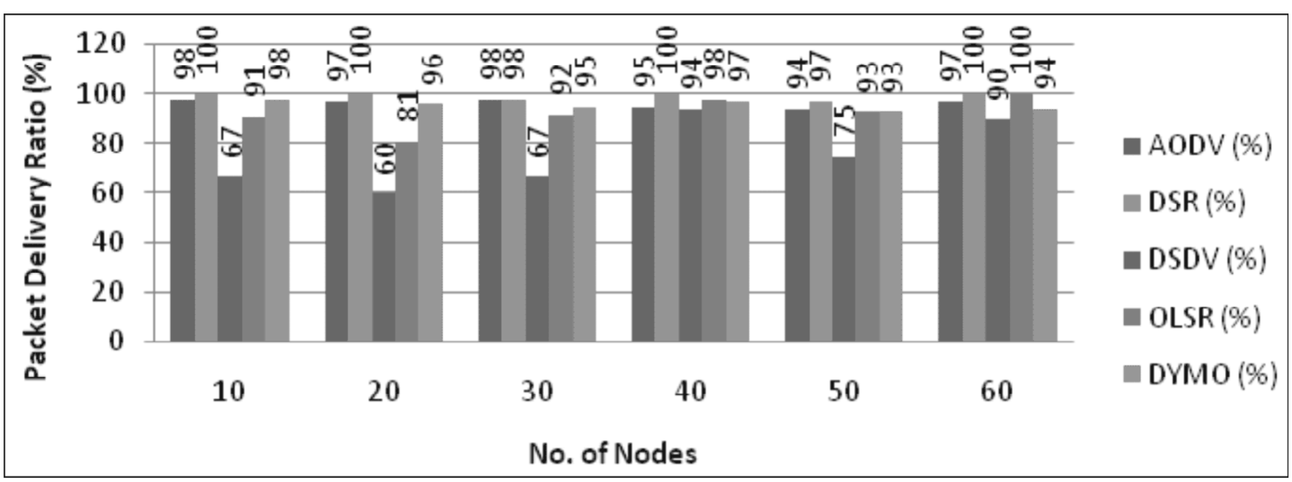

Figure 4: Packet Delivery Ratio

Note that DSDV protocol has the lowest Packet Delivery Ratio compared to other protocol (AODV, DSR, OLSR and DYMO). DSR and AODV demonstrate good performance (height Packet Delivery Ratio), but DSR is better than AODV. In comparing on-demand protocols, DSR shows the highest and DYMO the lowest Packet Delivery Ratio. As table-driven protocols, OLSR outperforms DSDV in terms of Packet Delivery Ratio.

AODV protocol has the highest value of Average End to End Delay (low performance) compared to other protocols. This figure does not precise the behavior of the protocols: DSR, DSDV, OLSR and DYMO. For this reason we elaborate the Figure 5. From this figure, the performance of DSR and DYMO as on-demand protocol are approximately the same. It seems as table-driven protocols have the lowest Average End to End Delay than on-demand protocols when we vary the Number of Nodes. OLSR and DSDV as table-driven protocols have routing tables and they do not need to discover the route for the same destination (low value of Average End to End Delay).

Table 3
End to End Time Delay

No. of nodes	*AODV (ms)*	*DSR (ms)*	*DSDV (ms)*	*OLSR (ms)*	*DYMO (ms)*
10	9.4	9.5	11.7	9.6	11.9
20	8.1	8	10.7	9.1	10.1
30	7.2	7.5	12.2	8.9	11.6
40	7.3	7.1	7.3	7.8	9.8
50	11.5	15.9	11.6	9.4	11.2
60	8	9.8	9.9	8.1	10.9

7. CONCLUSION

In terms of Packet Delivery Ratio, AODV, DSR have higher value than other protocols (DSDV, OLSR and DYMO). As table-driven (Proactive) protocols, DSDV and OLSR show the lowest Average End to End Delay (good performance) compared to on-demand (Reactive) protocols (AODV, DSR and DYMO). DSR demonstrates the lowest Normalised Routing Load than other protocols. In almost all situations, AODV

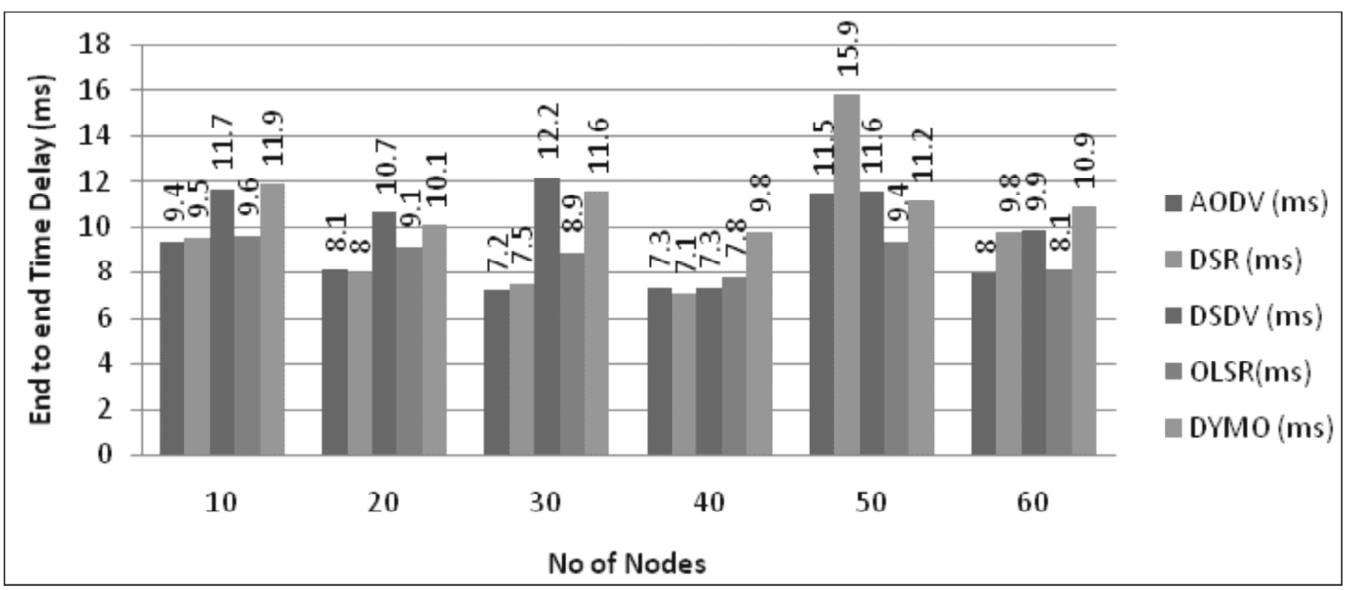

Figure 5: End to End Time Delay

and DSR outperform other protocols (DSDV, OLSR and DYMO) in terms of Average Throughput. Our attention in the future work is to extend the set of the experiments by taking into consideration other simulations parameters.

REFERENCES

[1] V. Rajeshkumar, P.Sivakumar, "Comparative Study of AODV, DSDV and DSR Routing Protocols in MANET Using Network Simulator-2", *Scinzer Journal of Engineering,* Vol 1, Issue **1**, (2015): 23-29.

[2] Manish Sharma, JaspreetKaur, "Comprehensive Study and Review Various Routing Protocols in MANET",*International Journal of Innovative Research in Computer and Communication Engineering,*Vol. 3, Issue 3, March 2015, 1915-1918.

[3] Mohamed Elboukhari, Mostafa Azizi and Abdelmalek Azizi, "Performance Comparison of Routing Protocols In Mobile Ad Hoc Networks", *International Journal of Ubi Comp (IJU),* Vol. 6, No. **2**, April 2015.

[4] R. F. Sophia Pearlin and G. Rekha, "Performance Comparison of AODV, DSDV and DSR Protocols in Mobile Networks using NS-2", *Indian Journal of Science and Technology*, Vol 9(8), February 2016.

[5] Rakesh Kumar Jha, PoojaKharga, "A Comparative Performance Analysis of Routing Protocols in MANET using NS3 Simulator" *I. J. Computer Network and Information Security,* 2015, **4**, 62-68.

[6] Bharath Chandra Mummadisetty, AsthaPuri, Shahram Latifi, "Performance Assessment of MANET Routing Protocols "International Journal of Communications, Network and System Sciences, 2015, **8**, 456-470.

[7] B. Karthikeyan,Dr.S.Hari Ganesh and Dr. JG.R. Sathiaseelan , "*High Level Security with Optimal Time Bound Ad-Hoc On-demand Distance Vector Routing Protocol (HiLeSec-OpTiB AODV)*",International Journal of Computer Science Engineering(E-ISSN: 2347-2693),Vol. 4, No. **4**, April 2016, pp.156-164.