

Simulation & Performance Comparison between DSR,FSR & HSR Routing Protocols in MANET Using NS2

Kuber Singh, R. K. Singh
B.T.K.I.T. Dwarahat (Almora)
Dehradun, UK, India
Email: spritekuber@gmail.com,
rksinghkecl1@rediffmail.com

Sanjeev Singh Bisht
Sanjeev Singh BishGEHU,
Bhimtal

Monika Bartwal
B.T.K.I.T. Dwarahat
(Almora)

Abstract—Mobile Ad-hoc Networks (MANETs) are a combination of various mobile nodes where these mobile nodes are communicate to each other. These mobile nodes are controlled by without any central node. Mobile ad-hoc networks have various set of applications such as- it is diverse, ranging from small, mobility, high bandwidth and highly static & dynamic networks. A mobile ad-hoc network has some basic needs such as – a distributed algorithm to establish a structure & organization of a network, link scheduling between mobile nodes, and packet switching technique. Author proposed a comparison simulation work of different types of routing protocols such as Dynamic state routing(DSR), Fisheye State Routing(FSR) and Hierarchical State Routing(HSR) protocols by a network simulator (NS-2). In this paper, routing protocols (DSR, HSR & FSR) are discussed and compared in different points such as packets delivery technique, average routing head and throughput.

Index Terms—Mobile ad-hoc network, DSR, FSR, & HSR routing protocol

I. INTRODUCTION

Mobile Ad-hoc networks are a collection of various wireless mobile nodes, where these wireless mobile nodes are organized and configured by themselves. The structure of the network can change dynamically as shown in fig. 1 considering bus topology. A bus topology, all mobile nodes are connected via network and utilize the same wireless channel by randomly. In bus topology, every node works as a host node and routers, which routes the data from one node to other node. A mobile ad hoc network can transmit a data packet from sender to receiver node without using any fixed network like LAN, MAN and topologies. The main objective of MANET is, each mobile node works as a router and to search a best routing path between source nodes to destination node for a message transmission. Every mobile node in a MANET is free to move independently in any location, and change its links to other devices. MANET protocols provide an emerging, powerful and reliable technology for various areas such as civilian, military, education and communication applications. Basically mobile ad-hoc network is a Latin word where it means in networking "for this purpose".

The basic challenges in MANET is, each mobile node continuously maintain the information and properly route the traffic between sender and receiver. This network may be connected to the large network like internet and operated by them. A mobile ad-hoc network has a routable networking environment, where a link layer of OSI model is used on top of ad-hoc network [1].

A. Wireless Mobile Network Models

A wireless networks are divided into two parts, a first part is known as infrastructure networks, where every mobile node acts as a base station. In wireless communication system, every mobile node can transfers the message to neighbour mobile node with the fix range; this node is called base station. Wireless Local Area Networks (WLANs) is a best example of wireless network. In an infrastructure network, all mobile nodes can communicates to each other via any inter connection network such as bus & ring topology, LAN and WAN as shown in fig. 1. Infrastructure network means, any new node can join network, communication between two nodes can change with time, and any existing node can leave this network [2].

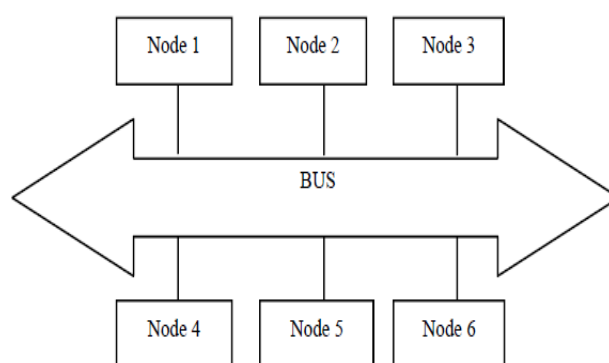


Fig.1 Infrastructure Network

The second part of Wireless network is called as infrastructure less mobile network, it is also known as an Ad hoc Network. Without any infrastructure or base network, all nodes can move freely from one place to another place. A topology may change the nodes dynamically over time and these nodes have their own infrastructure or base as shown in Fig. 2. Example of MANET applications widely used in various field such as, military applications, disaster relief applications, seminar or conferences, wireless communication, digital communication and logistics etc [10]. In ad-hoc network, it is a very difficult task to find a best route between two nodes using routing protocol due to their high dynamic topology and without any central node. Routing protocol structure depends upon various factors like throughput, mobility, high bandwidth, scheduling, and packet delivery etc. There are many purposes of a routing protocol such as fully distributed system, stable network, and a loop less transmission and reduced the collisions in network.

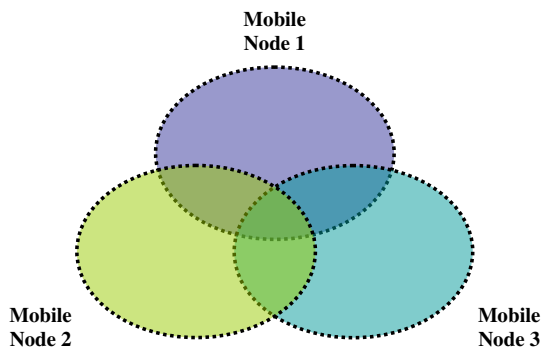


Fig.2. Infrastructure less Network

B. Objective of this paper

The objective of this paper is, to simulate the performance comparison between different routing protocols (DSR, FSR & HSR) based on their performance such as throughput, average routing head and packet delivery. This simulation work could be done through network simulator NS-2. This simulation work to implement a wireless network system, routing protocols and also to search the many problems during message routing such as packet delay, looping, link scheduling and minimum collisions. In ad hoc network, data packets may travel from one node to another node until they reach their destination. A routing protocols to perform a stable, correct and shortest routing path between two mobile nodes in ad-hoc network. A mobile ad-hoc network have some important areas [4]:

- Structure of a mobile ad-hoc network.
- Security purpose in mobile ad hoc network.
- Implementation and simulation of routing protocol.
- To proposed the performance comparison through simulation.

II. RELATED WORK

A. MOBILE ADHOC NETWORK (MANET) ROUTING PROTOCOLS

A routing protocol is to discover and maintain the minimum routing path from source to destination in ad-hoc network. The main objective of ad-hoc network is, to perform a shortest, accurate and efficient connection between two mobile nodes and, it also to perform a correct and timely delivery of message between source node to destination. In ad-hoc network, a routing protocol finds a shortest path for data packet delivering and also delivers it to ccorrect destination. A routing protocol has following three types [2]:

- Table driven
- On-demand
- Hybrid

B. TYPES OF MANET PROTOCOLS

There are three main routing protocols used in mobile ad-hoc network (MANET) such as- **Table driven, On demand & Hybrid protocol**. But according to the network structure a routing protocol can be divided as- Flat routing, Hierarchical routing and Geographic routing [2].

1. Table driven (Proactive Protocol): This protocol is also known as proactive protocol, for ex. FSR and WRP protocols. These protocols are also known as linked state protocol, because every mobile node contains the routing information about any other network node using by a periodic routing technique. Proactive routing protocols are generally used with very high average overhead due to the routing. Some protocols are comes in this category for ex. - Destination Sequenced Distance Vector (DSDV), Wireless Routing Protocol (WRP), and Optimized Link State Routing (OLSR) etc. [4].

i. Destination-Sequenced Distance-Vector (DSDV): DSDV protocol is a table-driven protocol. A modified version of the Distributed Bellman-Ford (DBF) Algorithm is known as DSDV protocol. DSDV protocol (DBF algorithm) is successfully used in data packet switching techniques. In DSDV, a mobile node must be send a series number to neighbour node and this serial number is continously incremented by two other mobile nodes and passed along with other routing update messages to all nearest mobile nodes.

ii. Wireless Routing Protocol (WRP): A wireless routing protocol is also known as distance vector protocol; it is used to send a message between two mobile nodes in wireless network system. Wireless protocol explain the distance routing system between source to destination by using three techniques- :

- WRP protocols transfer a message rather than interchange the entire routing table, when there is no link

changes. In wireless protocol, a distance, destination, and the predecessor node ID contains by the path-vector tuples.

- It can improve a reliability in data packet switching, where every nearest node must be send acknowledgments for received data packets. If any case acknowledgements are not received within the fixed time period then data packets will be retransmitted.
- A source to destination path is calculated recursively by the predecessor node by using ID information [7].

iii. **Fisheye State Routing (FSR):** FSR protocol is also known as link state proactive protocol. FSR protocol explain a network (topology or LAN) map or ad-hoc network at every node level. A network (topology) map is to used to decrease the overhead incurred process using control data packets. Fisheye routing protocol improves the algorithm of a link state routing techniques by using following methods- :

- In FSR, only nearest nodes can trasmit the link state information to next node.
- A link state information can transmit in time-triggered procees. And it can be transmits the all linked based information at every node level.
- It can be used different time slots in data transmission for the different accesses in the routing list.

iv. **Hierarchical State Routing:** Hierarchical State Routing (HSR) is a combination of logical partitioning and multilevel clustering of mobile nodes. In HSR protocol, a network is devided into various clusters where a cluster-head selected as in a cluster-based algorithm. A cluster-head contains its cluster's information and it can send the information to nearest cluster-heads by using interconnection network like gateway. Cluster-head is a member of cluster at a higher level and it can transmit their link information at the summarized lower-level.

2. **On-demand (Reactive Protocol):** On-demand Protocols are also called as reactive protocols. These types of protocols does not contain a permanent routing table in data routing techniques, because all data path are generated by the source node on demand. Reactive protocols are examine the routing paths, when data transmsion techniques are required. Ex.– AODV, DSR.

i. **Ad Hoc On-demand Distance Vector (AODV)** protocols are also called as unicast reactive routing protocol for MANET. AODV protocol contains the routing information about the active paths as a reactive routing protocol. In AODV, routing tables used the routing information at each node level, where each node keeps the information to a next data routing table, it generates the information from source to destination for a route discovery operation[12]. If a routing table has not been used or reactivated for a pre-specified expiration, it will be expired. If a mobile node wants to send a message to the next node but a path is not available on

network, then it can perform a operation for data packet transmission called route discovery. [3].

Dynamic Source Routing (DSR) is followed by the source routing concept. Dynamic protocol is a pure reactive routing protocol. DSR protocols have two important phases: route discovery and route maintenance [8].

In DSR, when a sender node wants to transmit a data packet to receiver mobile node; at first this sender node performs a route cache operation for data transmission. If a route is available on the network, then data packets will be transmitted. Otherwise, sender node generates a routing process by using a broadcasting route request techniques called route discovery operation.

3. **Hybrid Protocols:** A hybrib routing protocol is a combination of active and passive routing protocols, and it is also known as hierarchical routing. Hybrid protocol is generally used in clustered network application. In HSR protocol, all nodes of a network are combined into various small clusters form a small network to large network. A cluster routing are used by two cluster methods intra cluster and inter-cluster. When all nodes of a network are usually used in proactive protocol called intra cluster routing. An inter-cluster routing is generally used by on-demand protocol for ex. Zone Routing Protocol (ZRP) [5].

Zone Routing Protocol (ZRP) is a common hybrid routing protocol. This protocol is a combination of two (proactive and reactive) routing protocols. In zone routing protocol, a network distributes into small networks called routing zones, where every switching device works like a central device. The whole network is a collection of various overlapping zones. An overlapping zone has two zones- Intrazone Routing Protocol (IARP) and IntErzone Routing Protocol (IERP). Intrazone Routing Protocol (IARP) is works as a proactive routing protocol and it's containing the information of the topology of zone. IntErzone Routing Protocol performs the responsibility and detects the universal data path with a destination node besides the routing. ZRP protocols reduce the latency caused in reactive protocols by using route discovery and also reduce the control overhead of proactive protocols [5]. A ZRP protocol has three routing zone protocols:

- BRP(Border cast Resolution Protocol)
- IARP
- IER

III.PROPOSED PROBLEM AND SOLUTION

Simulation Parameters

In this simulation, we have selected 10 nodes for 500x500 square meter with two dimensional (2D) rectangles areas. All mobile nodes are represented in 2D grid with X-axis and Y-axis, where X-axis and Y-axis is represented the range (0,500). In ad-hoc network, a mobile node can moves from one location to another location at a constant speed. And a

mobile node can moves from one location to another location at a constant speed. And a mobile node can also disconnect the data transmission with a fix pause time (.01 sec.). In a random destination point router node select the next transmission function of mobile node. The simulation parameters are shown below

TABLE 1 PARAMETERS FOR SIMULATION WORK

Simulation Parameter	Value
1. Mobile nodes	10
2. Simulation Timing	500 sec
3. Size of network	500*500
4. Pause Time	0.01 sec.
5. Traffic	Constant Bit
6. Data Packet Size	512 bytes
7. Routing Protocols	DSR, FSR, HSR

- 1) Numbers of nodes (10) – We have select 10 nodes for this simulations work where each node is constant
- 2) Total simulation time (500 sec.) –We have analyze the total simulation time 500 sec. between starting and ending of simulation .
- 3) Routing protocol – DSR, FSR & HSR.
- 4) Network size (500*500) – Network size represents number of nodes with the size of 500*500 square area that nodes are moving one place to another place. Network size defined the connectivity between two nodes.
- 5) Pause time (0.01 sec) – Node's pause time is .01 sec..
- 6) Traffic type – Constant Bit Rate.
- 7) Packet size- 512 bytes.

IV. COMPARISON BETWEEN DSR, FSR AND HSR PROTOCOLS

This simulation work is focusing on the performance comparison of DSR, FSR and HSR routing protocol. We simulates these protocols according to various data transmission factors such as- average overhead, best routing speed or throughput and data transmission ratio.

1. Average Routing Head (ARH): In average routing head, we have proposed a random direction model for routing to generate the highest routing average overhead as compared to other mobility model.
2. Packet Delivery Ratio: In data transmission ratio or (PDR), a Random data model performs a good performance in data switching technique from source to destination by using the given pause time (.01 sec), where this model (random) can change their location at every time.

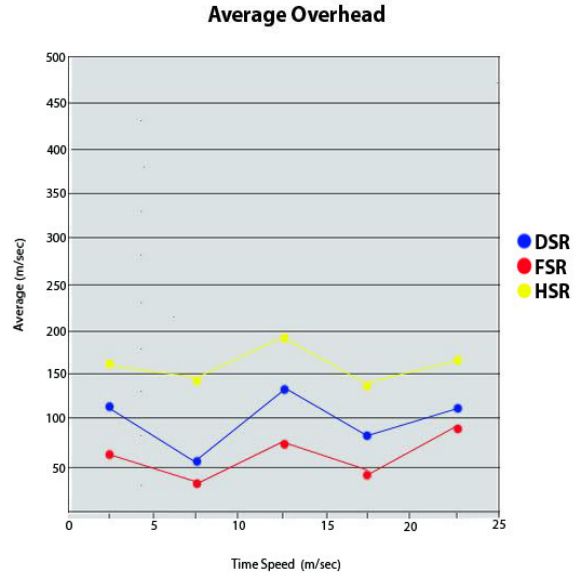


Fig.4. Average Routing Head

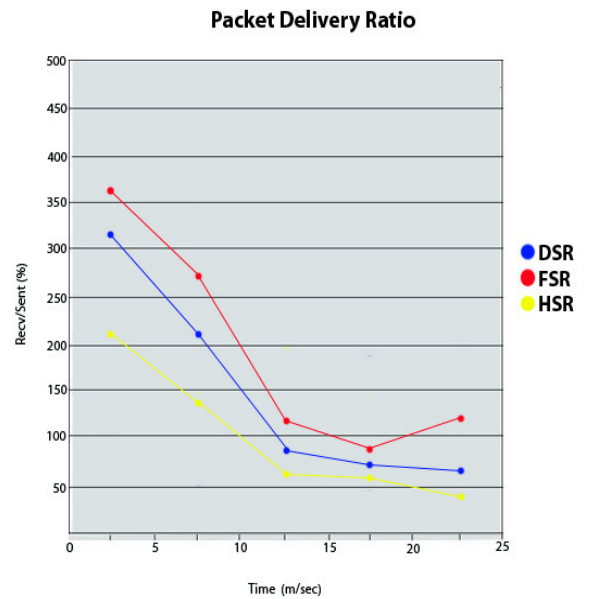


Fig.5. Packet Delivery Ratio (PDR)

3. Throughput: In throughput metrics, routing performance of DSR, FSR, and HSR routing protocols is related to the pause time parameter (0.01 sec.), where FSR protocols is gives best throughput as compared to other protocols (HSR & FSR).

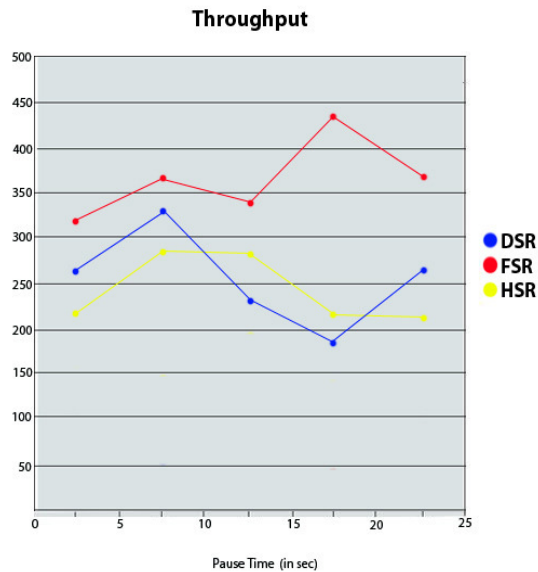


Fig.6. Throughput

V. CONCLUSIONS

In this paper, we have proposed a comparison among DSR, FSR and HSR routing protocols with various metrics such as- packet delivery ratio (PDR) between two nodes, throughput and average routing head (ARH). We have selected a scenario of 10 nodes. This simulation work of these protocols is done by NS2 simulator. We have observed that FSR protocol perform the better performance in throughput parameter than the DSR and HSR protocol and packet delivery ratio of HSR protocol is to be best in case of average routing head. We have analyzed that throughput and reliability are main parameters for selection and in this simulation FSR protocols gives the better outputs and results as compared to other protocols because its throughput is best among other protocols (HSR & FSR).

REFERENCES

- [1] M. Sreerama Murty and M. Venkat Das "Performance Evaluation of MANET Routing Protocols using Reference Point Group Mobility and Random Waypoint Models" in International Journal of Ad hoc, Sensor & Ubiquitous Computing (IJASUC) Vol.2, No.1, pp. 33-43 March 2011.
- [2] Meenakshi, Vinod Kumar Mishra , Kuber Singh, "Simulation & Performance Analysis of Proactive, Reactive & Hybrid Routing Protocols in MANET" in International Journal of Advanced Research in Computer Science and Software Engineering, Vol. 2, Issue 7, pp. 1-5, July 2012.
- [3] Harminder S. Bindra1, Sunil K. Maakar and A. L. Sangal, "Performance Evaluation of Two Reactive Routing Protocols of MANET using Group Mobility Model" in International Journal of Computer Science Issues IJCSI, Vol. 7, Issue 3, No. 10, May 2010.
- [4] Anil Kumar Sharma and Neha Bhatia, "Behavioural Study of MANET Routing Protocols by using NS -2" in IJCEM International Journal of Computational Engineering & Management, Vol. 12, pp. 100-104, April 2011.

- [5] B. Soujanya, T. Sitamahalakshmi, "Study Of Routing Protocols In Mobile Ad-Hoc Networks" in International Journal of Engineering Science and Technology (IJEST), Vol. 3, No. 4, pp. 2622-2631, April 2011.
- [6] Chai Keong Toh, Anh-Ngoc Le and You-Ze Cho, "Load Balanced Routing Protocols for Ad Hoc Mobile Wireless Networks" in IEEE Communications Magazine, pp. 2-9, August 2009.
- [7] Poonam Saini and Swati Kapoor, "Hybrid Routing algorithm against Routing attacks in Mobile Adhoc Networks (MANETs) in International Conference on Computing, Communication and Automation (ICCCA2015).
- [8] Basu Dev Shivahare, Amar Deep Gupta, Anil Sajnani, Swati Vashisht, "Performance Metrics For Table Driven And On Demand Routing Protocols In Mobile Adhoc Network Using Ns-2", in 2015 1st International Conference on Futuristic trend in Computational Analysis and Knowledge Management (ABLAZE-2015).
- [9] Ku!deep Singh and Ani! Kumar Verma, "Experimental Analysis of AODV, DSDV and OLSR Routing Protocol for Flying Adhoc Networks (F ANETs), in 978-1-4799-6085-9/15/\$31. 00©20 15 IEEE.
- [10] Piruthiviraj P, Sarvotham Prasad R, Dr. Preeta Sharan, Dr. Nagaraj R "Multimedia Data Transfer from IPV4-IPV6 in an Optical Network by Using Routing Table" in 978-1-4799-8047-5/15/\$31.00 2015 IEEE.
- [11] Changbin Liu, Ricardo Correa, Xiaozhou Li, Prithwish Basu, Boon Thau Loo, and Yun Mao, "Declarative Policy-Based Adaptive Mobile Ad Hoc Networking" in IEEE/Acm Transactions On Networking, Vol. 20, No. 3, pp. 770-783, June 2012.
- [12] Chi Ma and Yuanyuan Yang, "A Battery-Aware Scheme for Routing in Wireless Ad Hoc Networks" in IEEE Transactions On Vehicular Technology, Vol. 60, No. 8, pp. 3919 -3932, October 2011.
- [13] Jinhua Zhu and Xin Wang, "Model and Protocol for Energy-Efficient Routing over Mobile Ad Hoc Networks" in IEEE Transactions On Mobile Computing, Vol. 10, No. 11, pp. 1546-1557, November 2011.
- [14] Naveen Biliandi, Lokesh Sachdeva, Aakash Setia, Suresh Kumar, "Performance Analysis Of Proactive And Reactive Routing Protocols In MANET" in International Journal of Advanced Research in Computer Science and Software Engineering ,Vol. 2, Issue 5, pp. 106-110, May 2012.
- [15] P. Manickam, T. Guru Baskar, M.Girija and D. Manimegalai, "Performance & Comparisons Of Routing Protocols In Mobile Ad Hoc Networks" in International Journal of Wireless & Mobile Networks (IJWMN), Vol. 3, No. 1, pp. 98-106, February 2011.
- [16] R. Balakrishna, U. Rajeswar Rao, Dr.Geethanjali M. S. Bhagyashekar, "Comparisons of SAODV and TAODV, DSR Mobile ad hoc network Routing Protocols" in Int. Journal of Advanced Networking and Applications ,Vol. 02, Issue 01, pp. 445-451 , 2010.
- [17] Ziming Zhao, Hongxin Hu, Gail-Joon Ahn and Ruoyu Wu, "Risk-Aware Mitigation for MANET Routing Attacks" in IEEE Transactions On Dependable And Secure Computing, Vol. 9, No. 2, March/April 2012, pp. 250-260.
- [18] David B. Johnson David A. Maltz Josh Broch, "DSR: The Dynamic Source Routing Protocol for Multi-Hop Wireless Ad Hoc Networks" in Computer Science DepartmentCarnegie Mellon UniversityPittsburgh, PA 15213-3891.
- [19] Rutvij H. Jhaveri, Ashish D. Patel, Jatin D. Parmar and Bhavin I. Shah, "MANET Routing Protocols and Wormhole Attack against AODV" in International Journal of Computer Science and Network Security (IJCSNS), Vol.10, No.4, April 2010, pp. 12-18.
- [20] Anurag Malik, Shivanshu Rastogi and Sajendra Kumar, "Performance Analysis of Routing Protocol in Mobile Ad Hoc Network using NS-2" in International Journal of Computer Science & Information Technology, Vol. 1, No. 1, pp. 47-50, Jan. 2011.
- [21] Md. Anisur Rahman, Md. Shohidul Islam, Alex Talevski, "Performance Measurement of Various Routing Protocols in Ad-hoc Network" in International Multi Conference of Engineers and Computer Scientists, Vol.1, pp.978-988, March 18-20, 2009.
- [22] Jamal Toutouh, José Garcia-Nieto, and Enrique Alba, "Intelligent OLSR Routing Protocol Optimization for VANETs" in IEEE Transactions On Vehicular Technology, Vol. 61, No. 4, May 2012.
- [23] M. Wang, L. Lamont, P. Mason and M. Gorlatova, "An Effective Intrusion Detection Approach for OLSR MANET Protocol" in IEEE, pp.55-60, 2005.

- [24] Tanu Preet Singh, Neha, Vikrant Das, "Multicast Routing Protocols In MANETS" in International Journal of Advanced Research in Computer Science and Software Engineering, Vol. 2, Issue 1, January 2012.
- [25] Umang Singh, "Secure Routing Protocols in Mobile Adhoc Networks- A Survey and Taxonomy" in International Journal of Reviews in Computing, Vol. 7, pp. 9-17, 30th September 2011.
- [26] B. Soujanya, T. Sitamahalakshmi, "Study Of Routing Protocols In Mobile Ad-Hoc Networks" in International Journal of Engineering Science and Technology (IJEST), Vol. 3, No. 4, pp. 2622-2631, April 2011.
- [27] M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.
- [28] Xiaoyan Hong, Kaixin Xu, Mario Gerla "Scalable Routing Protocols for Mobile Ad Hoc Networks", University of California, Los Angeles, CA 90095.
- [29] Kimaya Sanzgiri, Bridget Dahilly, "A Secure Routing Protocol for Ad Hoc Networks" in 10 th IEEE International Conference on Network Protocols (ICNP'02) 2002.
- [30] Xin Ming Zhang, En Bo Wang, Jing Jing Xia, and Dan Keun Sung, "An Estimated Distance-Based Routing Protocol for Mobile Ad hoc Networks" in IEEE Transactions On Vehicular Technology, Vol. 60, No. 7, September 2011.
- [31] Zehua Wang, Yuanzhu Chen, Cheng Li, "CORMAN: A Novel Cooperative Opportunistic Routing Scheme in Mobile Ad Hoc Networks" in IEEE Journal On Selected Areas In Communications, Vol. 30, No. 2, February 2012.
- [32] Zhiguo Wan, Kui Ren, and Ming Gu, "USOR: An Unobservable Secure On-Demand Routing Protocol for Mobile Ad Hoc Networks" in IEEE Transactions On Wireless Communications, Vol. 11, No. 5, May 2012.
- [33] Zhijiang Chang, Georgi Gaydadjiev, Stamatias Vassiliadis, "Routing Protocols for Mobile Ad-hoc Networks Current Development and Evaluation" in Computer Engineering laboratory, EEMCS, Delft University of Technology Mekelweg 4, 2628 CD Delft, the Netherlands.
- [34] Shabana Mehfooj and Sumit Kumar, "Energy Aware Probabilistic Broadcasting for Mobile Adhoc Network" in 978-9-3805-4416-8/15/\$31.00@ 2015 IEEE.
- [35] Emilio Hugues-Salas, Georgios Zervas, Dimitra Simeonidou, Evangelos Kosmatos, "Next Generation Optical Nodes: The Vision of the European Research Project IDEALIST" in IEEE Communication Magazine February 2015.
- [36] www.cse.wustl.edu/