



## Ant Colony Based Dynamic Source Routing

Smriti Sofat\*, Anuj K. Gupta

Department of CSE & RIMT-IET

India

**Abstract-** Routing in a MANET is challenging because of the dynamic topology and lack of an existing fixed infrastructure. Many protocols have been developed for ad-hoc mobile networks, which results in high throughput, end to end delay, delay jitter, packet delivery fraction and low normalize routing load and energy. This paper outlines the experience with the implementation of Ant colony Technique on reactive routing protocol DSR and improves the performance of it. In this paper, the comparative analysis of the two routing protocols, namely DSR and ANT-DSR (ADSR) has been shown. By simulation using network simulator shows that this method improves the performance of DSR.

**Keywords-** NS-2, ACO, DSR, ADSR, Performance Metrics.

### I. Introduction

Mobile Ad Hoc network (MANET) is a spontaneous network which is infrastructure less, self-organized and multi-hop network with rapidly changing topology causing the wireless links to be broken and reconstruct on-the-fly. Any node can be a sender, a receiver as well as a router where it takes part forwarding other node's packets. As an ad-hoc network connected to networks such as the internet, a lot of applications are being developed and required in MANET. Examples include networks deployed for military operations, relief work in disaster, conferencing, home networking, locality monitoring, supermarket inventory monitoring, and personal area networks (PAN). Depending upon the mechanism and functionalities MANET routing protocols can be classified into three categories: *table driven* or proactive, *on-demand* or reactive and *hybrid* routing protocols. In proactive and reactive type there is also two type of protocols like link state and distance vector. In proactive type link state protocols are OLSR, GSR, TBRPF and distance vector protocols are DSDV and WRP. Similarly in reactive type link state protocol is DSR and distance vector are AODV, TORA, ABR.

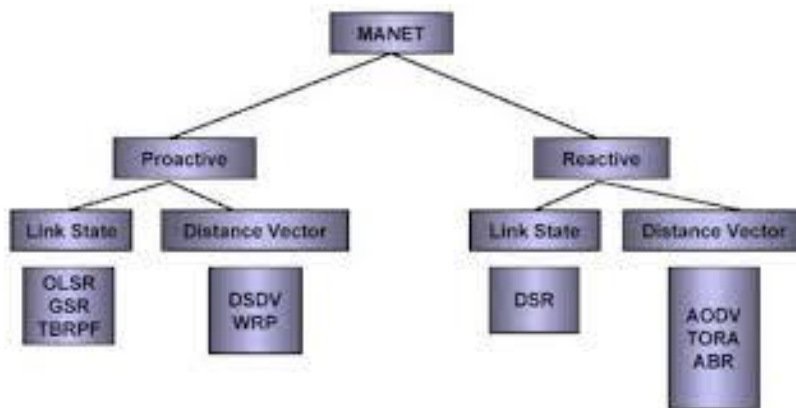


Figure: 1 MANET Routing Table

### II. DSR Protocol Detail

Dynamic Source Routing protocol gets its name from the concept of source route, where the source node - S - includes list of all intermediate nodes (through which the packet would traverse) in the packet itself, whenever it desires to send the packet to a destination node - D - in an ad hoc network. In case there is no route available in the cache, S initiates a Route Discovery procedure. Each route discovery may discover multiple routes and all routes are cached at the source node. The DSR protocol consists of two basic mechanisms: Route Discovery and Route Maintenance.

#### Route Discovery

Route discovery is used only when a source node attempts to send a packet to a destination node and does not already know a route to it. To initiate the Route Discovery, the source node transmits a "Route Request" with a unique ID. In figure 2 source at node 1 send data to destination which is node 8. When some intermediate node receives this Route Request, at first it determines whether it has seen the Route Request or not. If the node has already seen the Route Request earlier, it will discard the packet; otherwise it will check its Route Cache whether there is a route to the destination of the packet. If it has the route to target in its routing cache, it returns a "Route Reply" to the initiator route

request of the Route Discovery, giving a copy of the accumulated route record from the Route Request; otherwise it transmits the Route Request until the Route Request is received by the target. In route reply node 8 which is destination node select the shortest way for route reply which is 8-5-2-1 as shown in figure 3.

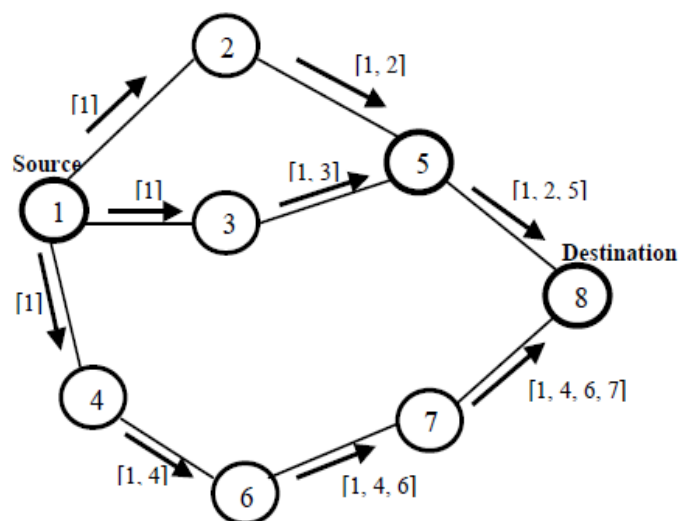


Figure: 2 Route Request in DSR

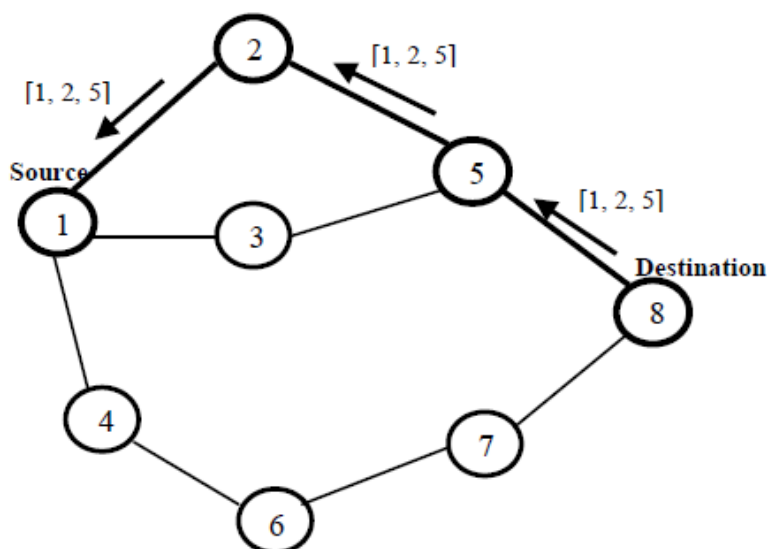


Figure: 3 Route Reply in DSR

### Route Maintenance

DSR protocol implements the route maintenance mechanism while communicating the packets from Source to destination. But when the communication link between the source and the destination is broken or else a change in network topology is noticed. From the above figure 1 and 2 we can say that failure in path of 1-2-5-8. It will lead to failure of the communication between source node 1 and destination node 8. If failure detected then chooses another path for transferring data which may be 1-3-5-8 or 1-4-6-7-8. In this scenario DSR protocols uses the route mechanism, to detect any other possible known route towards the destination to transmit data. If the route maintenance fails to find an alternative known route to establish the communication then it will invoke the route discovery to find the new route to destination.

### III. ACO Based Technique

AntNet is an adaptive routing algorithm inspired by ant colonies to solve routing problems in wired networks. An AntNet node maintains probabilistic entries in the routing table, indicating the *goodness* of path. Each node periodically sends a forward ant packet to find paths to a random destination. Forward ants find the network for a feasible and lowcost path, recording every node it visits. Once it arrives at the destination, it is converted into a backward ant. The backward ant returns to the source node following the path in reverse. Each intermediate node updates its routing tables with the information from the backward ant. Ants interact and communicate indirectly by updating the routing tables, thus collaboratively solve the global network routing optimization problem.

1.1 Antnet Algorithm

- At regular intervals, from every network node, a forward ant is launched with a randomly selected destination node. While travelling towards their destination node.
- The forward ants store their paths and the traffic conditions. At each node, each forward ant chooses the next node.
- If all the neighboring nodes have not been visited, then the next neighbor is chosen among the nodes that have not been visited.
- If all the neighboring nodes have been visited previously, then the next node is chosen uniformly among all the neighbors. The forward ant is forced to return to a previously visited node.
- With a small probability, the next node may be chosen uniformly among all the neighboring nodes.
- If a cycle is detected, that is, if the ant is forced to return to an already visited node.
- When the destination node is reached, the forward ant generates a backward ant. The backward ant takes the same path as the corresponding forward ant, but in the opposite direction.
- Arriving at a node coming from a neighbor node, the backward ant updates the routing table Tr, for all the entries corresponding to the destination node.

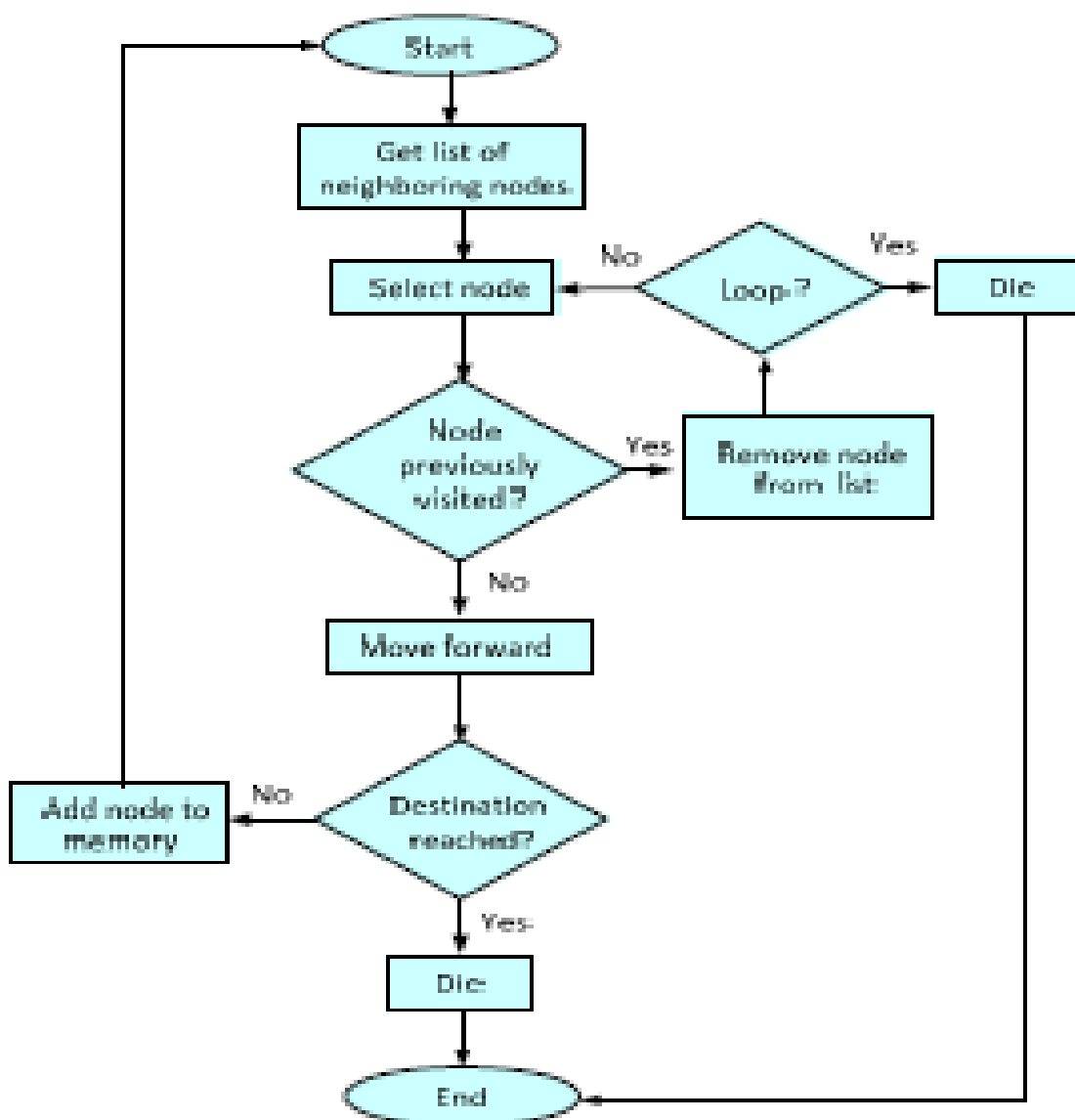


Figure: 4 Antnet Algorithm Flow Chart

IV. ADSR

Ant Dynamic Source Routing (Ant-DSR) is a reactive protocol that implements a proactive route optimization method through the constant verification of cached routes. When antnet algorithm apply on DSR protocol the performance metrics improved. This approach increases the probability of a given cached route express the network reality. Mobile nodes are required to maintain route caches that contain the source routes of which the mobile is aware. Entries in the route cache are continually updated as new routes are learnt. The protocol consists of two major phases: route discovery

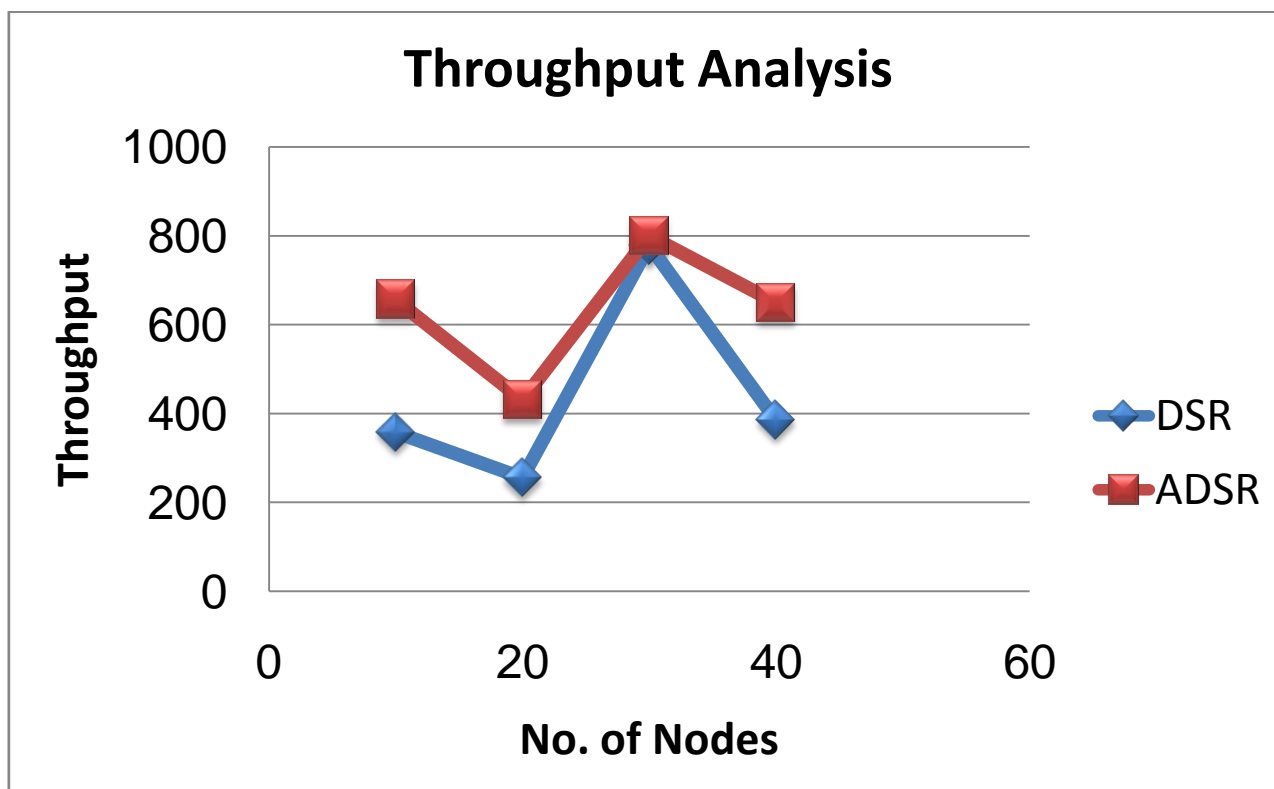
and route maintenance. In Ant DSR (ADSR) the Forward ant(FANT) and backward ant (BANT) packets are added in the route request and route reply of DSR respectively. Forward ants are used to explore new paths in the network. Ants measure the current network state for instance by trip times, hop count or Euclidean distance travelled. Backward ants serve the purpose of informing the originating node about the information collected by the forward ant.

**Table: 1 Comparison table of DSR and ADSR**

Parameters	DSR	ADSR
Type	On-Demand Routing Protocol	On-Demand Routing Protocol
Route Discovery Procedure	RREQ and RREP are used	Pheromone value is used
Path Discovered	Single, partially multipath	Multipath
Link failure detection	RERR	Decrease of Pheromone Value
Type of Agents	TCP	FANT, BANT
Throughput	Low	High
Packet Delivery Fraction	High	Low
End to End Delay	High	Low
Normalize Routing Load	High	Low
Delay Jitter	High	Low
Energy	Low	High

### V. Comparison and experimental results

This section presents an overall comparison of ad hoc routing reactive protocol DSR and various ant based routing protocols ADSR for ad hoc networks. This section represents some results which are shown below: Figure 5 to 10 shows the results of performance metrics of both the DSR and ADSR protocol. The performance metrics taking are throughput, delay jitter, packet delivery fraction, energy, normalize load, end to end delay.



**Figure: 5 Comparison of DSR and ADSR using Throughput**

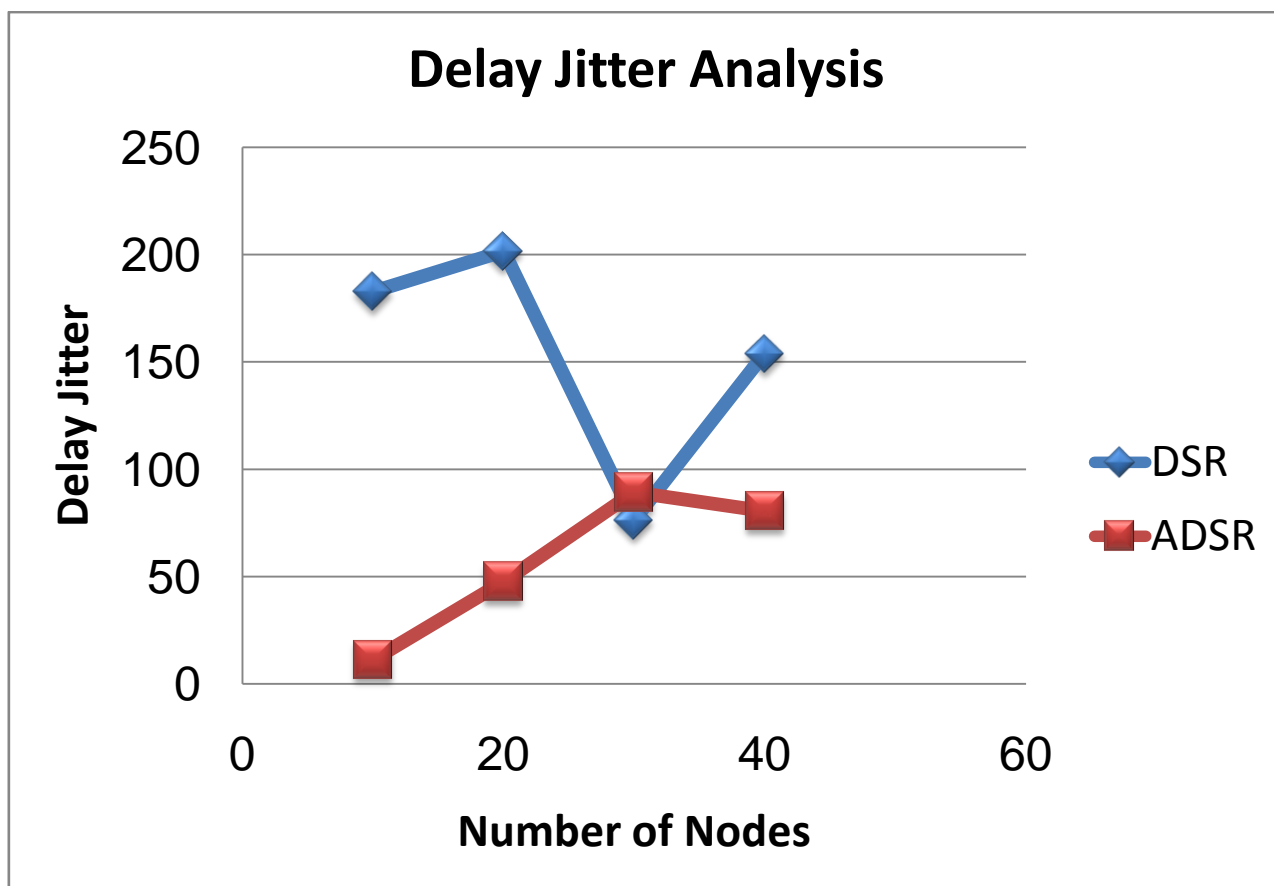


Figure: 6 Comparison of DSR and ADSR using Delay Jitter

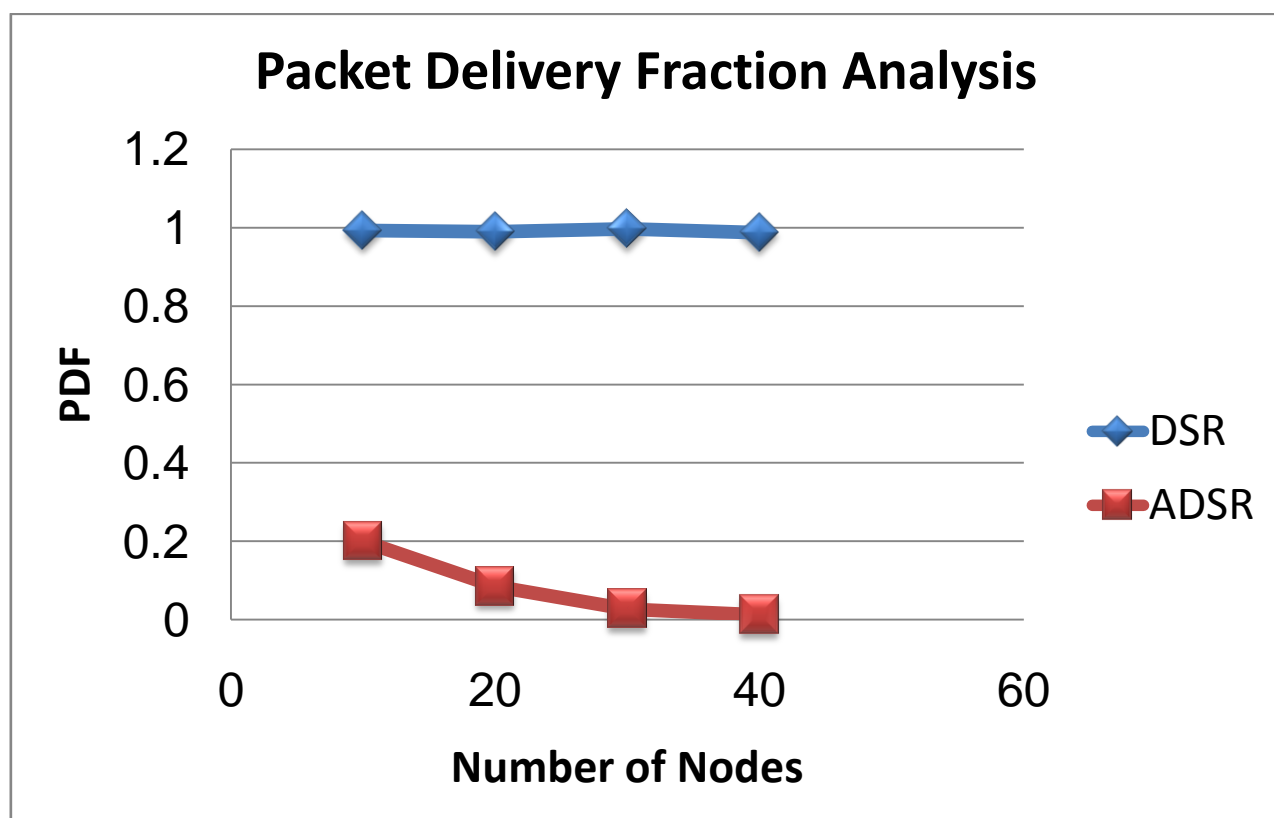


Figure: 7 Comparison of DSR and ADSR using Packet Delivery Fraction

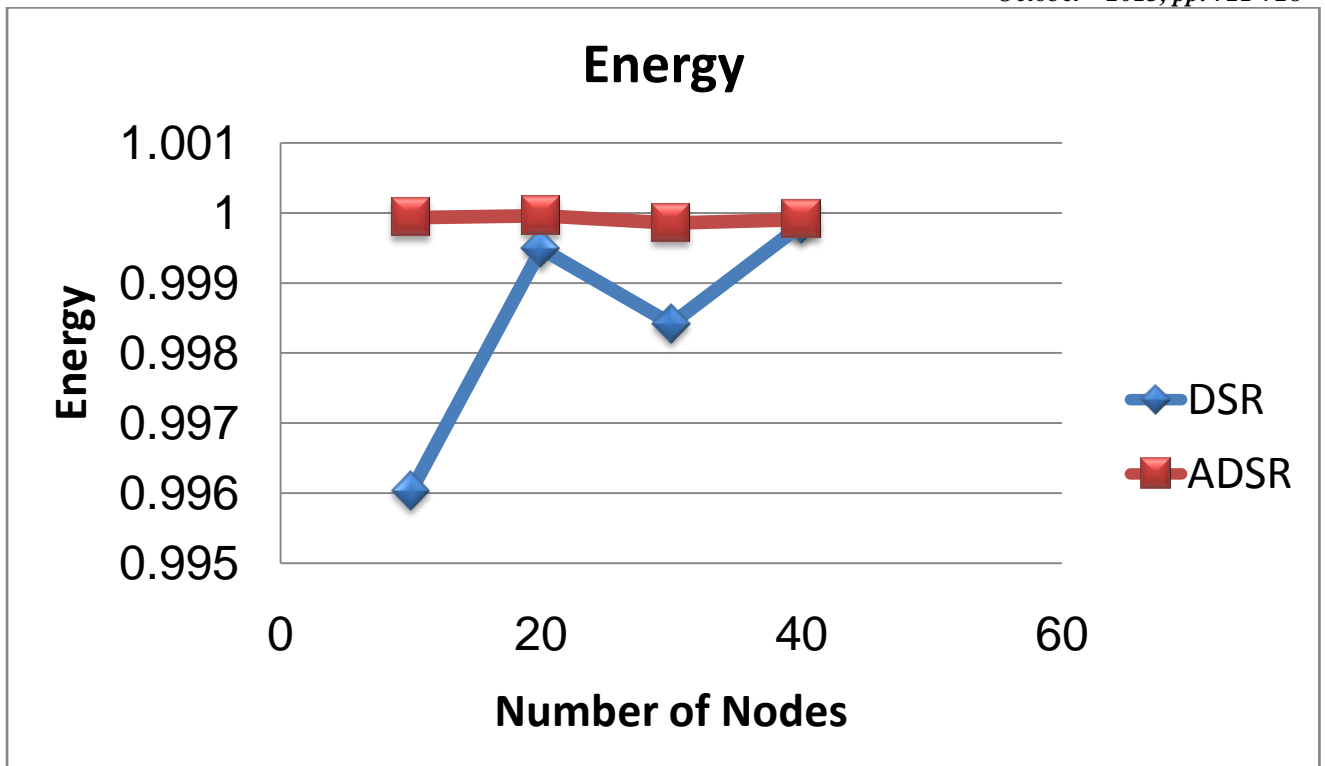


Figure: 8 Comparison of DSR and ADSR using Energy

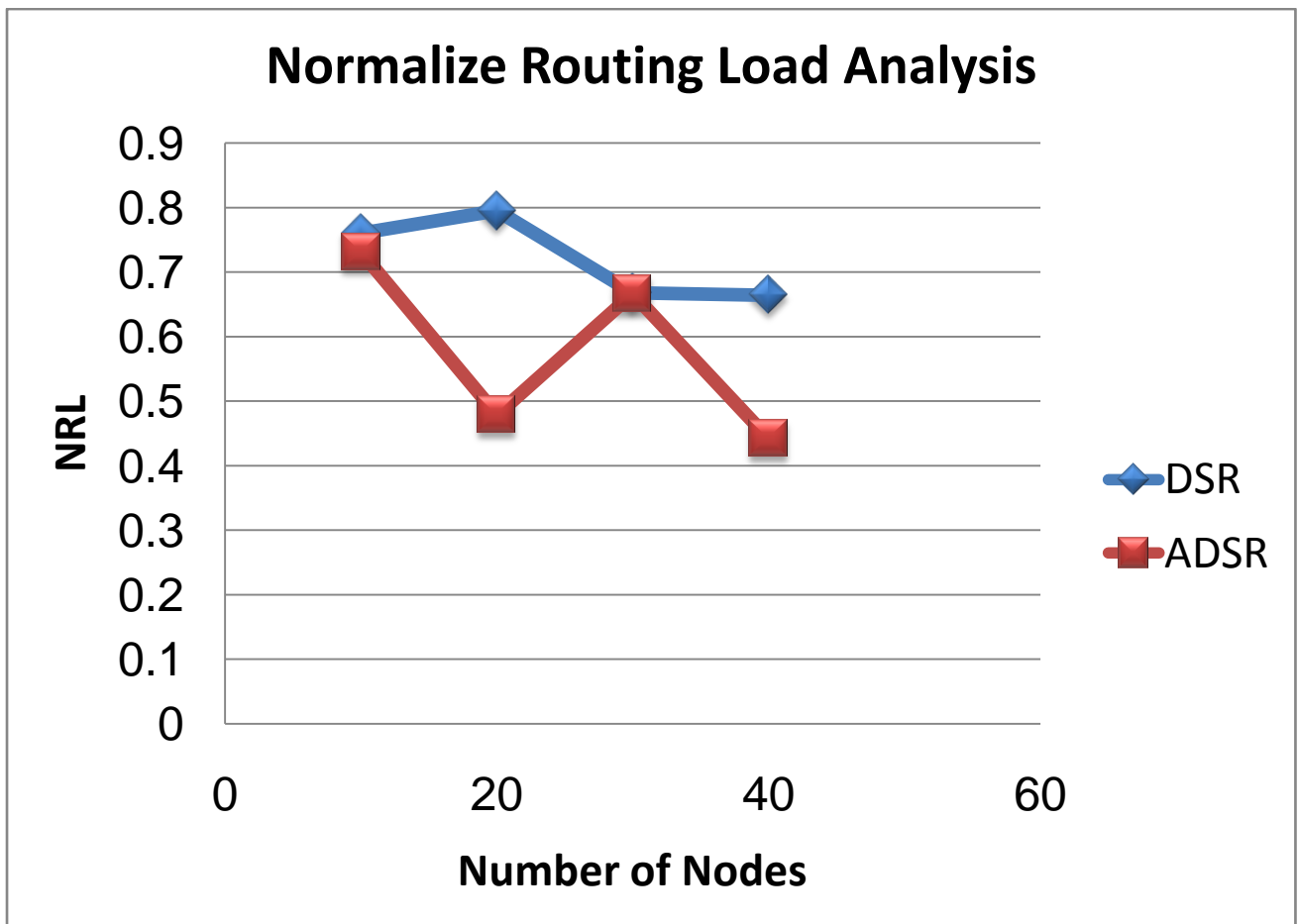


Figure: 9 Comparison of DSR and ADSR using Normalize Routing Load

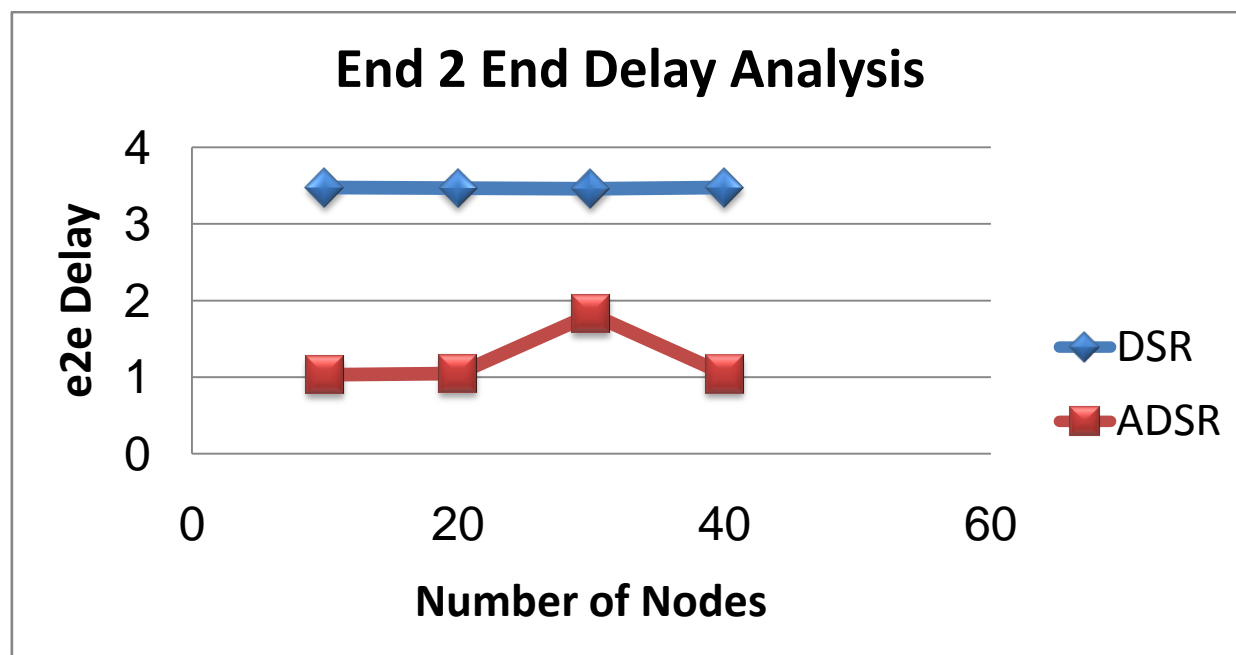


Figure: 10 Comparison of DSR and ADSR using End to End delay

## VI. Conclusion

The highly dynamic topology of Ad Hoc networks and their limited bandwidth makes the routing task more difficult. A state of the art ACO inspired ad hoc routing protocol is considered in this work and put to partial comparison. This paper aims to provide a platform for researchers worldwide to get an overview of the existing ACO based routing protocol. To know about their performance against traditional ad hoc routing protocol. We have evaluated and compared ACO based algorithm to the original ones and obtained better results in terms of throughput and delay jitter etc. for environments of dynamic topology. In future Other ACO based algorithms such ARA, ABC and AntHocNet can also be implemented on DSR Protocol. Antnet Algorithm can also be implemented on other Table Driven Routing Protocols.

## Acknowledgement

The authors would like to thank all the anonymous reviewers and experts for their valuable and critical comments in bringing out more useful information and enhancements to the present study.

## References

- [1] Anuj K. Gupta, Harsh Sadawarti, and Anil K. Verma, "MANET Routing Protocols Based on Ant Colony Optimization", *International Journal of Modeling and Optimization*, Vol. 2, No. 1, February 2012, P.P 42-49.
- [2] Parma Nandl, Dr. S.C. Sharma, "Performance study of Broadcast based Mobile Adhoc Routing Protocols AODV, DSR and DYMO", *International Journal of Security and Its Applications*, Vol. 5 No. 1, January, 2011,P.P 53-64.
- [3] SHARIQ HASEEB, KHAIRUL AZAMI SIDEK, AHMAD FARIS ISMAIL, LAI W.K. &AW YIT MEI, "*IJUM Engineering Journal*", Vol. 5, No. 1, 2004, P.P 1-12.
- [4] Network Simulator, <http://www.isi.edu/nsnam/ns>
- [5] B.SOUJANYA, T.SITAMAHALAKSHMI, CH.DIVAKAR," *International Journal of Engineering Science and Technology (IJEST)*, Vol. 3 No. 4 April 201, ISSN: 0975-5462, P.P 2622-2631.
- [6] Anuj K. Gupta, Member, IACSIT, "Performance analysis of AODV, DSR & TORA Routing Protocols", *IACSIT International Journal of Engineering and Technology*, Vol.2, No.2, ISSN: 1793-8236, April 2010.
- [7] Shivanajay Marwaha Jadwiga Indulska Marius Portmann, "Biologically Inspired Ant-Based Routing In Mobile Ad hoc Networks (MANET): A Survey,""STUDY OF ROUTING PROTOCOLS IN MOBILE AD-HOC NETWORKS",*The Sixth International Conference on Ubiquitous Intelligence and Computing*.
- [8] Md.Masud Parvez, Shohana Chowdhury, S.M.Bulbul Ahammed, A.K.M Fazlul Haque, Mohammed Nadir Bin Ali, " Improved Comparative Analysis of Mobile Ad-hoc Network "*International Journal of Emerging Technology and Advanced Engineering*, ISSN 2250-2459, Volume 2, Issue 8, August 2012,P.P 205-211.
- [9] Sunil Taneja and Ashwani Kush, "A Survey of Routing Protocols in Mobile Ad Hoc Networks", *International Journal of Innovation, Management and Technology*, Vol. 1, No. 3, August 2010, ISSN: 2010-0248, P.P 279-285.
- [10] Anuj K. Gupta, Harsh Sadawarti, and Anil K. Verma, "MANET Routing Protocols Based on Ant Colony Optimization", *International Journal of Modeling and Optimization*, Vol. 2, No. 1, February 2012. P.P 42-49.
- [11] Sharmin Sultana,"Enhanced-DSR: A New Approach to Improve Performance of DSR Algorithm", *International Journal of Computer Science and Information Technology*, Volume 2, Number 2, April 2010. P.P 113-123.

- [12] G. di Caro and M. Dorigo, AntNet: distributed stigmergetic control for communications network, Journal of Artificial Intelligence Research (JAIR), Vol. 9, 1998, Pag. 317-365.
- [13] Md. Golam Kaosar, Ashraf S. Hasan Mahmoud, Tarek R. Sheltami, ” Performance Improvement of Dynamic Source Routing Protocol Considering the Mobility Effect of Nodes in Cache Management”, *IEEE*, May 2006.
- [14] Anil Rawat, Prakash Dattatraya Vyavahare, and Ashwani Kumar Ramani , “Enhanced DSR for MANET with Improved Secured Route Discovery and QoS”, *International Journal of Network Security*, Vol.5, No.2, PP.158–166, Sept. 20007.
- [15] Sangeeta Biswal, Suneeta Mohanty and Dambarudhar Seth, ” Study of DSR Routing Protocol in Mobile Adhoc Network”, *International Conference on Information and Network Technology*, Volume 4, 2011. P.P 131-135.
- [16] Tarek H. Ahmed,” Simulation of Mobility and Routing in Ad Hoc Networks using Ant Colony Algorithms”, *International Conference on Information Technology: Coding and Computing*, March 2005.