



Impact of Network Load and node Mobility on the performance of Proactive, Reactive and Hybrid routing protocols of MANET

Vikas Singla

Ph.D Research Scholar

Shri Jagdishprasad Jhabarmal Tibrewala University,
Jhunjhunu (India)

Dr. Yogesh Kumar Sharma

Department of Computer Science & I.T.

Shri Jagdishprasad Jhabarmal Tibrewala University,
Jhunjhunu (India)

Abstract: Wireless communications between mobile users is becoming very popular in today's environment. This is due to technological advances in laptop computers and wireless communication devices, such as mobile phones, Laptops etc. In wireless networks, MANET is very popular in today. In this paper, we will evaluate the impact of Network Load and Node Mobility on the performance of Proactive, Reactive and Hybrid routing protocols of MANET on the basis of Packet delivery ratio. We will take CBR and TCP both types of traffics into consideration for performing the evaluation. We have used the NS-2 simulator for performing all the simulation work.

Keywords: MANET, Packet Delivery Ratio (PDR), Network Load, Mobility, Traffic Pattern.

I. INTRODUCTION

Mobile ad hoc network is a collection of mobile nodes forming a temporary network without the requirement of any centralized administration or standard support services. Ad-hoc networks are expected to play important role in future commercial and military settings where mobile access to a wired network is either ineffective or impossible [1, 2]. Mobile ad-hoc networks have the potential to serve as a ubiquitous wireless infrastructure capable of interconnecting number of devices with a wide range of capabilities and uses [3]. Mobile Ad hoc networks have no fixed routers and all nodes in itself are capable of movement and can be connected dynamically in an arbitrary manner. In MANET, nodes act as both end systems and routers at the same time [4].

The properties of MANET are given in Section-II. The remainder of paper is organized as follows: Section III briefly gives the introduction of the various routing protocols of MANET. Section IV gives evaluation of MANET routing protocols with simulation results. Section V concludes the paper and provides directions for future work.

II. PROPERTIES OF MOBILE AD-HOC NETWORKS

In Mobile Adhoc Network, topology of the network changes with time. There are different routing protocols in MANET that are required to provide the following basic properties of the network [5] :

1. **Autonomous Terminal:** In MANET, each mobile node act as an autonomous node which perform the functionality of both host and router.
2. **Loop Free:** MANET routing protocol are required to guarantee that the routes supplied are loop-free to avoid wastage of bandwidth.
3. **Network Scalability:** In MANET, nodes are coming into and out of the network. Many MANET applications involve large networks with tens of thousands of mobile nodes e.g. in sensor and tactical networks. Scalability is critical to the successful deployment of these networks.
4. **Security:** Security is main issue in MANET. The network operations can be easily jeopardized if countermeasures are not embedded into basic routing protocol of MANET. Wireless mobile ad hoc network

routing protocols have to be thoroughly tested and analyzed in term of their operations. The radio environment is especially vulnerable to impersonation attacks, so to ensure the wanted behavior from the routing protocol, we need some sort of preventive security measures.

5. **Performance of Routing Protocols:** MANET provides the dynamic infrastructure in which topology of the network changes with time. With this nature of MANET, it is difficult to support real-time applications with appropriate QoS.

III. ROUTING PROTOCOLS IN MANET

Routing in MANET is somewhat different from traditional routing found on infrastructure networks due to dynamic nature of mobile ad-hoc networks. Routing in MANET depends on many factors such as topology, selection of routers, initiation of request and other characteristics that serve as a heuristic in finding the path quickly and effectively. MANET routing protocols are classified as under [5, 6]:

- (a) **Proactive Routing Protocols:** Proactive routing protocols are also known as table-driven routing protocol. In these protocols every node maintains the network topology information in the form of routing tables by periodically exchanging routing information. In these protocols routes to various nodes in the network are determined in advance. Route Discovery overheads are large in such schemes as one has to discover all the routes. They consume bandwidth to keep routes up-to-date. Packet forwarding is faster in these schemes as the route is already present. Example of the protocol of this category is: Destination Sequenced Distance Vector Routing (DSDV).
- (b) **Reactive Routing Protocols:** Reactive routing protocols are also known as On-demand routing protocols. Reactive Protocols determine the route when needed. In this method, the route to a destination may not exist in advance and it is computed only when the route is needed. When a source node needs to send packets to a destination, it firstly finds a route or several routes to the destination. After the routes are discovered, the source transmits packets along the route. As the routes are

discovered whenever required therefore reactive protocols have smaller route discovery overheads [7]. Examples of such type of protocols are: Ad-hoc On-Demand Distance Vector (AODV) and Dynamic Source Routing (DSR).

- (c) **Hybrid Routing Protocols:** Hybrid routing protocols are combination of both reactive and proactive routing protocols. It was proposed to reduce the control overhead of proactive routing protocols and also decrease the latency caused by route discovery in reactive routing protocols [8]. Examples of hybrid Routing Protocols are Location Aided Routing (LAR) and Zone Routing Protocol (ZRP).

IV. EVALUATION OF MANET ROUTING PROTOCOLS

In this paper, we have evaluated the Performance of Reactive, Proactive and Hybrid routing protocols of MANET under both CBR and TCP traffic pattern [9, 10] by varying network load i.e. number of nodes, and varying the mobility i.e. speed of nodes movement. The performance is evaluated on the basis of packet delivery ratio. Packet delivery ratio is calculated by dividing the number of packets received by the destination through the number of packets originated by the application layer of the source. It specifies the packet loss rate, which limits the maximum throughput of the network. The better the delivery ratio, the more complete and correct is the routing protocol [11, 12].

(a) Impact of Network Load on MANET routing protocols

We have evaluated the Packet Delivery Ratio of Proactive, Reactive and Hybrid routing protocols by changing the number of nodes to 30, 60, 90, 120. Environmental parameters that are taken into consideration for evaluation of MANET routing protocols are as per table -1.

Figure 1 shows the Packet Delivery Ratio for CBR traffic with respect to change in number of nodes and Figure 2 shows the Packet Delivery Ratio for TCP traffic with respect to change in number of nodes.

Table-1

Parameter	Value
# of nodes	30, 60, 90, 120
Maximum speed	30 m/s
Pause time	10 sec
Environment size	1000x1000 m
Packet size	512 Bytes
Traffic type	CBR/TCP
Packet Rate	4 packets/sec

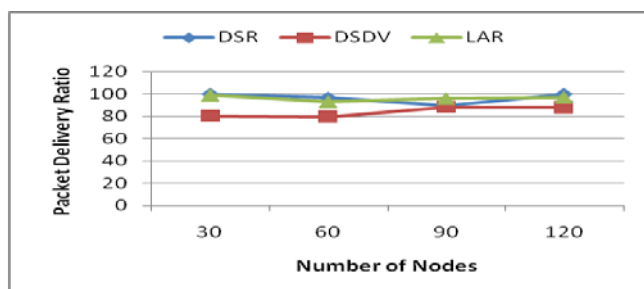


Figure 1: Packet Delivery Ratio for CBR traffic w.r.t. change in network load

It has been seen from the graphs that in case of CBR traffic Reactive protocols (DSR) and Hybrid routing protocols (LAR) deliver almost all the originated data packets converging to 90-95% delivery whereas Proactive protocols (DSDV) Packet Delivery Ratio is approx 80%. It is concluded that Reactive protocols and Hybrid routing protocols perform better than the proactive protocols in case of CBR traffic pattern.

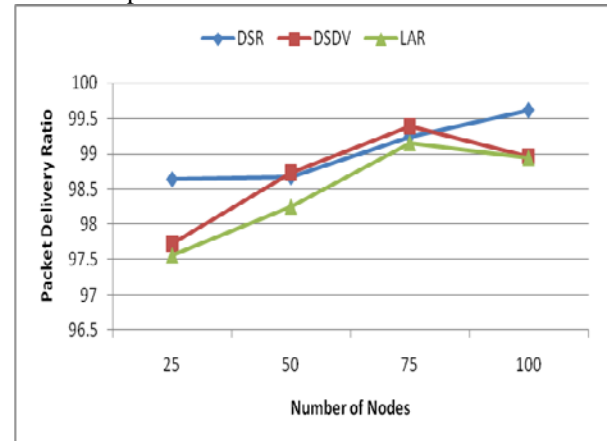


Figure 2: Packet Delivery Ratio for TCP traffic for change in network load

In the case of TCP traffic pattern, Packet delivery ratio of all three protocols changes with change in network load. Here, proactive protocol also produces more than 95% PDR that is much better as compared to CBR traffic pattern. It is also concluded that PDR is improved with increase in network load.

(a) Impact of Mobility on MANET routing protocols

We also evaluated the Packet Delivery Ratio of Proactive, Reactive and Hybrid routing protocols by changing the speed of node movement to 15, 30, 45, 60. Environmental parameters that are taken into consideration for evaluation of MANET routing protocols are as per Table -2. Impact of change in speed (i.e. 15, 30, 45, 60 m/s) on Packet Delivery Ratio for CBR Traffic pattern is shown in Figure 3 and for TCP Traffic pattern is shown in Figure 4.

Table-2

Parameter	Value
# of nodes	60
Maximum speed	15, 30, 45, 60 m/s
Pause time	10 sec
Environment size	1000x1000 m
Packet size	512 Bytes
Traffic type	CBR/TCP
Packet Rate	4 packets/sec

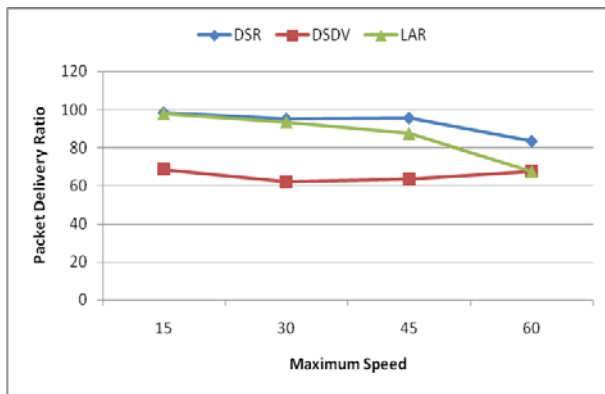


Figure 3: Packet Delivery Ratio for CBR Traffic w.r.t. change in Speed

It is observed that in case of CBR sources, Packet Delivery Ratio of Reactive protocols i.e. DSR and Hybrid routing protocol i.e. LAR is decreasing with respect to increase in mobility of nodes. Whereas Packet Delivery Ratio of Proactive protocols (DSDV) is very less as compared to others and there has been little impact of change in mobility on the PDR of Proactive routing protocols.

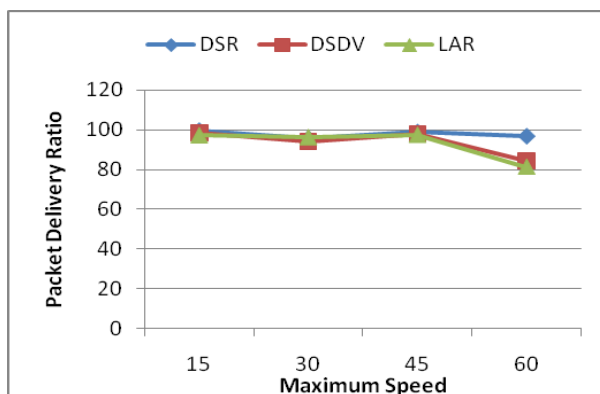


Figure 4: Packet Delivery Ratio for TCP traffic w.r.t. change in speed

In case of TCP traffic, Packet Delivery Ratio of Hybrid and Proactive protocols is almost similar and its somewhat decreases with change in mobility. Whereas Reactive routing protocols produces almost 100% PDR in case of TCP traffic.

V. CONCLUSION AND FUTURE SCOPE

In this paper, we evaluated the packet delivery ratio of Reactive, Proactive and Hybrid routing protocols. The performance of said routing protocols has been evaluated for both CBR and TCP traffic types. Number of simulations has been done using NS-2 simulator for performing the evaluation. Evaluation of protocols has been done for packet delivery ratio from said results. It has been concluded from the above results that reactive and hybrid routing protocols behaves better as compared to proactive routing protocols as they produces almost 100% PDR whereas for proactive routing protocols it is near about 80%. Change in Network load has little impact as compared to mobility on PDR of all kinds of routing protocols under consideration. In future researchers can perform the evaluation of said routing

protocols on basis of energy as it is important factor to be taken into consideration due to wireless nodes.

VI. REFERENCES

- [1] H. Hassanein and A. Zhou, "Routing with load balancing in wireless Ad hoc networks", 4th ACM international workshop on Modeling, analysis and simulation of wireless and mobile systems, ACM, New York, NY, USA, 2001, pp. 89-96.
- [2] G. Sharma and R. R. Mazumdar, "Scaling laws for capacity and delay in wireless ad hoc networks with random mobility", IEEE International Conference on Communications, Vol. 7, 2004, pp. 3869-3873.
- [3] M. Minematsu, M. Saito, H. Aida and H. Tokuda, "Efficient route discovery scheme in ad hoc networks using routing history", IEICE Transactions on Communications, March 2005, pp. 1017-1025.
- [4] P. Ghosekar, G. Katkar and P. Ghorpade, "Mobile Ad Hoc Networking: Imperatives and Challenges", IJCA Special Issue on Mobile Ad-hoc Networks, 2010, pp. 153-158.
- [5] K. Sivakumar, "Mobile Ad-Hoc Network Routing Principle and Protocol Evaluation Metrics", International Journal of Computer Science & Technology, Vol. 2, Issue 4, Oct-Dec, 2011, pp. 261-266.
- [6] M. Lakshmi and P. E. Sankaranarayanan, "Performance analysis of three routing protocols in wireless ad hoc networks", Information technology Journal Asian Network for Scientific Information, Vol. 5, No. 1, pp. 114-120.
- [7] S. T. Yuan and J. Tsao, "An incentive mechanism for ad-hoc wireless content service: contextualized micro pricing", International Journal of Information Technology and Decision Making, Vol. 9 No. 1, 2010, pp. 81-113.
- [8] Patil and G.B. Hangargi, "An application, challenges and routing protocol in Mobile Ad-Hoc Network", International Journal of Ethics in Engineering & Management Education, Volume 2, Issue 5, May 2015, pp. 43-48.
- [9] T. Clausen, P. Jacquet and L. Viennot, "Comparative study of CBR and TCP performance of MANET routing protocols", 2001, France: Project HiPERCOM – INRIA.
- [10] P. Mani and D. W. Petr, "Development and performance characterization of enhanced AODV routing for CBR and TCP traffic", IEEE 2004, pp. 44-51.
- [11] V. Singla and P. Kakkar, "Traffic pattern based performance comparison of Reactive and Proactive protocols of Mobile Ad-hoc Networks", International Journal of Computer Applications, Vol. 5, No. 10, 2010, pp. 16-20.
- [12] V. K. Samyal and Y. K. Sharma, "Performance evaluation of Delay Tolerant Network routing protocol under varying time to Live", International Journal of Advanced Research in Computer Science, 2017, pp. 299-302.
- [13] A. Aneiba and M. Melad, "Performance Evaluation of AODV, DSR, OLSR, and GRP MANET Routing Protocols Using OPNET", International Journal of Future Computer and Communication Vol. 5 No. 1, 2016, pp. 57-60.
- [14] A. Kumar and A.K. Singla, "Performance evaluation of MANET routing protocols on the basis of TCP traffic pattern", international Journal of Information Technology Convergence and Services (IJITCS) Vol. 1, No.5, October 2011, pp. 41-48.

AUTHOR'S PROFILE



***Vikas Singla** received a Bachelor of Technology degree in Information Technology from Kurukshetra University, Kurukshetra in 2004 and Master in Technology degree in Computer Science & Engineering from DAVIET, Jalandhar, P.T.U Regional Campus, Punjab in 2011. Presently working as Assistant Professor in the Department of Computer Sc. & Engg. at Malout Institute of Management & Information Technology (MIMIT), Malout, Punjab. He is CISCO Certified Network Instructor. Since April 2016 he has joined as a research scholar in Shri Jagdishprasad Jhabarmal Tibrewala University, Jhunjhunu (India). His research interests are in Mobile Ad-hoc Network.



****Dr Yogesh Kumar Sharma** is Associate professor in the Department of Computer Science and Information Technology at Shri Jagdishprasad Jhabarmal Tibrewala University, Jhunjhunu (India). He is served as Head of the Department. He has published many research papers in International Journal and Conferences and presently guiding five Research Scholars of Ph.D./M.Tech.