

## Performance of Various Ad Hoc Routing Protocols Using NS-3 Simulator

K. C. Kullayappa Naik<sup>1</sup>, Ch. Balaswamy<sup>2</sup>, D. Prabhakar<sup>3</sup>, Sowjanya Kandula<sup>4</sup>, Shabhana Begum<sup>5</sup>

<sup>1</sup>Research Scholar, JNTUCEA, Anantapur, A.P. India, [kcknaik@gmail.com](mailto:kcknaik@gmail.com)

<sup>2</sup>Professor, Gudlavalleru Engineering College, Gudlavalleru, India, [ch.balaswamy7@gmail.com](mailto:ch.balaswamy7@gmail.com)

<sup>3</sup>Associate Professor, Gudlavalleru Engineering College, Gudlavalleru, India, [prabhakar.dudla@gmail.com](mailto:prabhakar.dudla@gmail.com)

<sup>4</sup>M.Tech Student, Gudlavalleru Engineering College, Gudlavalleru, India, [sowjkandula@gmail.com](mailto:sowjkandula@gmail.com)

<sup>5</sup>Assistant Professor, Gudlavalleru Engineering College, Gudlavalleru, India, [shabanabegum2@gmail.com](mailto:shabanabegum2@gmail.com)

### Abstract.

Computer communication and networking acts a major role in latest trends such as in 5G communications, IoTs, Autonomous cars and Blockchain technology. Among the various communication networks MANET is an important network because of self-configuring systems with versatile hubs associated to make self-assertive topology without any centralized unit. Routing protocols plays an important role in transmitting data from source to destination through efficient paths. They involve in finding the best route using route discovery process and finding the alternative route using route maintenance process. NS-3 is most widely used simulator for performance evaluation of MANET. In this research, performance of various ad hoc routing protocols is analyzed using protocol dependent and independent metrics using NS-3 simulator.

**Keywords:** MANETs, DSR, DSDV, AODV, NS-3.

### INTRODUCTION

MANETs are formed in a dynamic fashion using self-determining system. The nodes are joined using wireless links. Self-configurability and easy of deployment are the main attractive features of MANETs made them more popular in recent technologies. The major problem with MANET is topology changes dynamically due to its dynamic nature of mobile node which leads to frequent link failures between the nodes<sup>1</sup>. In order to overcome the above problem it need to require the best and efficient route in the process of communication without any loss of packets and collision during transmission of data. Communication network becomes more complex in traditional analytical methods to provide accuracy and efficient routes in the process of transmitting data. Network simulator comes with support of many technologies and applicable in many fields such as IOT, WSN, MANETS etc<sup>6</sup>.

MANETs have the flexibility to change the topology. It may vary according to its convenience. For example, topology varies when current route has heavy traffic, if any nodes in the current route or path are failed due to battery exhaustion. This is the best feature of MANETs to get succeed in today's world. MANETs plays a vital role in communication, they provide temporary networks composed with mobile nodes without any centralized infrastructure or any pre-existing system. MANETs are helpful in the situations like disaster areas where there is no possibility of getting information through fixed networks at that situation.

Wireless networks are categorized into networks with centralized and without centralized infrastructures. The traditional network based on access point comes under centralized infrastructure.

Cellular networks are example of network with infrastructure. If the network does not require fixed infrastructure is called network without infrastructure. Ad hoc networks are example of network without infrastructure because no-cables, no-configuration and no-maintenance are required.

### CHALLENGES FACED BY THE MANET

MANET is very special setup without any infrastructure; thus, MANET has to face some threats to achieve best quality of service. Some of the threats are

1. Unicast and Multi cast routing
2. Limited power supply and bandwidth
3. Security
4. Energy efficiency
5. Rapid and dynamic changes of topology

### ROUTING PROTOCOLS FOR MANETS

Routing is the fundamental research issue in MANETs which is used to exchange the data between the nodes in appropriate manner using efficient paths<sup>7</sup>. The node in MANET is within a limited range of transmission, if any node willing to transfer the data to intended destination through the neighboring intermediate nodes only. All the

intermediate nodes in the network can serve as router and a host. The data alone can be transmitted when both the nodes are within the direct broadcast range of each other, otherwise it is not possible to transfer the data between the nodes in the network. Consequently, MANET is not a single hop transmission, but it is a multi-hop transmission between source and intended destination nodes.

The highly dynamic nature of MANET is always changing its topology due to mobility of node which leads to increases the link failures and decreases the performance of the network<sup>9</sup>. Therefore, routing technique is always required to discover the reliable and efficient route to destination so as to forward and establishing communications among the group of nodes. So, designing of ad hoc routing protocol is a major interesting task due to limited bandwidth, node mobility and multi hop communication.

Design of any new routing protocol is required to meet the particular needs of MANET environments and characteristics of mobility limitations are as follows:

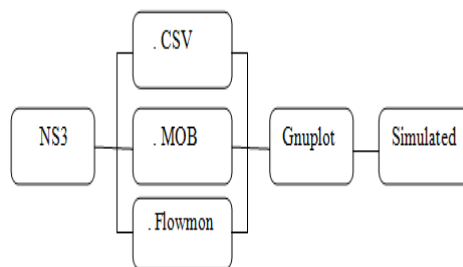
- Keep the network simplicity and ease of maintenance.
- Choose the route that should be optimal, loop-free and robustness.
- Requires distributed network but lightweight in nature.
- Maintains scalable, secure and reliable network.
- Choose with minimum overhead, computing efficient bandwidth and power.
- Requires quick adaption to topology and traffic pattern due to node mobility.
- Supporting quality of service requirements.

Routing protocols are classified based on updated routing information they are called reactive and proactive. All the protocols are not well suited for all the network scenarios because, each routing protocol performs differently and it has particular definite qualities as well as faults and sometimes the protocol is well-matched for certain situations<sup>3</sup>.

## MATERIALS AND METHODS

### Product feature:

The given flowchart in below figure 4.1 describes about the product feature of a simulation model. In this section simulation of different routing protocols are executed and their performance is also analyzed. The simulation is done using network simulator 3. NS-3 supports both simulator and emulator.

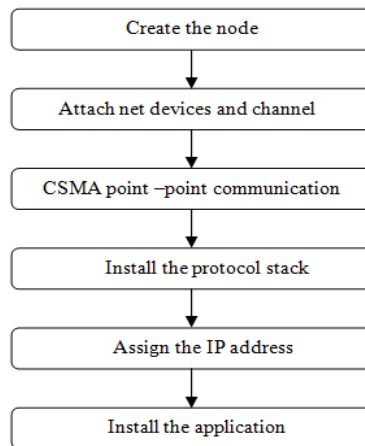


**Fig. 4.1. Product feature**

The script can be written in c++ and python programming languages which can be selected by the user to run with ns-3.25, first user can write the programs in c++ or python programming languages to get the results. After execution .CSV, .Mob, .Flowmon files are generated. Gnuplot is a command line driven function which is used to plot the data with functions. Thus, the graphs are plotted according to generated data.

### B. Procedure of simulation:

The below figure 4.2 gives the explanation of the procedure of network simulator-3. First of all, select the application which is to be implemented and create the essential nodes. Next attach the net devices which are used to setup or manage the local area network and all intermediate node are act as channel between source and intended destination.



**Fig. 4.2. Procedure of simulation**

In Carrier Sense Multiple Access (CSMA), if the node is busy then node waits for a random period until the channel is idle and then it sends data immediately.

Protocol stack is also known as network stack used for implementation of protocol family, practically these stacks are often divided into media, transport and application sections. Thus, installation of protocol stack is also mandatory.

## LITERATURE REVIEW

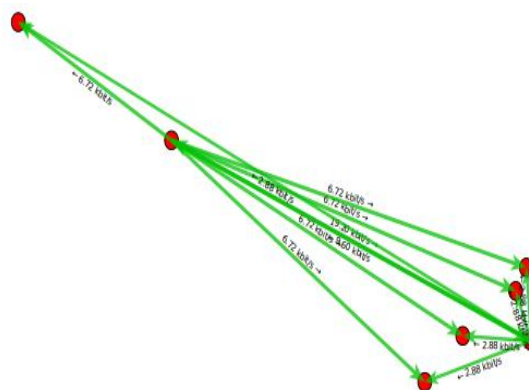
The algorithm of Dynamic Source Routing (DSR) required to discovery the route, switching and efficient route maintenance by predicting the mobility of a node with other nodes<sup>8</sup>.

DSR has the capability to provide best route to send or transmit the information from source to destination. The comparison of different protocols was analyzed using Glomosim and Omnet etc. DSR header consists of DsrFheader and Dsroptionheader which are used to carry information to all dsr nodes and to specific dsr options<sup>2</sup>. DSR gives great performance of routing in multi hop networks. It has no periodic activity at any level of network.

MANETs are broadly utilized in large-scale applications and nodes ought to be reasonably active and dense<sup>10</sup>. Wireless ad hoc network does not require any fixed infrastructure to operate in significant research. At various scenarios, performance of DSDV was compared with OLSR, and the attributes are also tabulated. DSDV slightly similar when compared to conventional wired distance-vector routing<sup>4</sup>.

## RESULTS

Performance of various ad hoc routing protocols are evaluated using protocol dependent metrics and its simulation results are carried out using NS-3<sup>5</sup>. Establishment of communication among the nodes is shown in below figure 6.a.

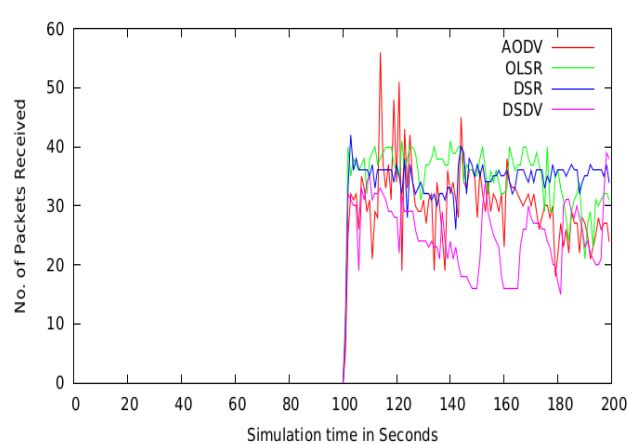


**Fig. 6.a : Example of node setup using NS-3**

The above figure 6.a explains about the node setup which has seven wifi nodes and two sink nodes are used. After completion of routing mechanisms in routing protocols, data is transmitted.

**Throughput:**

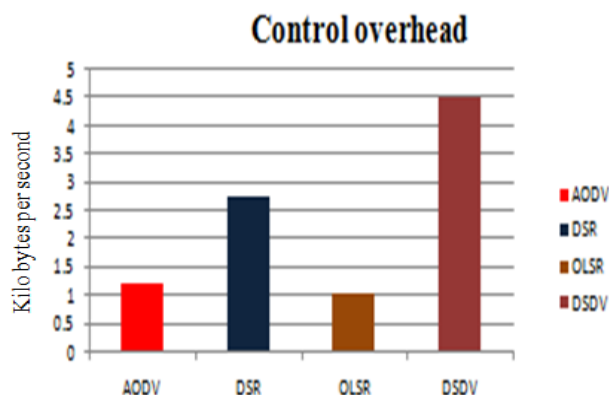
Throughput is defined as number of packets that can be transferred over the communication channel in unit of time is called the throughput and is shown in below figure 6.b.



**Fig. 6. b. Throughput**

### Control overhead:

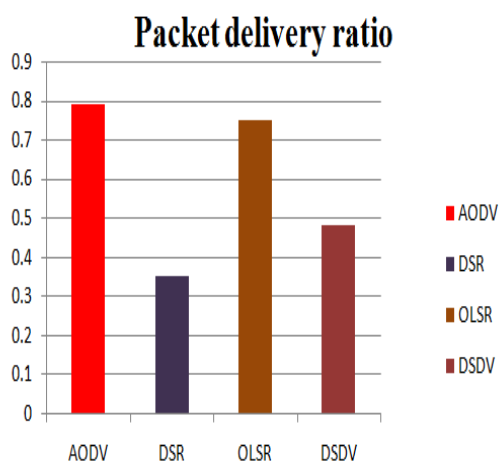
Control overhead is nothing but number of packets transmitted to number of packets received successfully towards destination. The control overhead of different protocols is plotted in below figure 6.c.



**Fig. 6. c. Control overhead.**

### PDR:

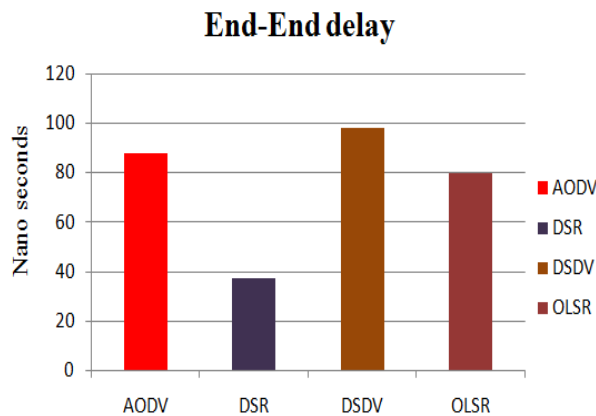
It measures the effectiveness of a routing protocol. It is generally less when node moves with high speed otherwise it is more. PDR for different protocols is plotted in below figure 6.d.



**Fig. 6.d. Packet Delivery Ratio.**

### End-to-End delay:

It generally depends on the physical medium and the corresponding associated propagation time and is measured in milli seconds or seconds. This parameter is always as low as possible for enhancing the throughput of the network. It is shown in below figure 6.e.



**Fig. 6.e. End-to-End delay**

### CONCLUSION

In this paper, the performance metrics corresponding to packet delivery ratio, receive rate, through put, and control overhead of Dynamic Source Routing protocol are compared with the other routing protocols using NS-3 simulator. NS-3 simulator has the capability of internet connectivity, by assigning IP address to the nodes to transmit data. By these parameters, efficient routing path is selected to transfer data from source to destination.

The DSDV has high control overhead when compared to other routing protocols, because loss of packets during transmission is very less. DSR is better in terms of delay. AODV outperforms over the other protocols in terms of throughput and PDR.

### FUTURE WORK

Since the NS-3 Simulator has the capability of both simulator and emulator, the routing protocols analyzed in this paper may be applied practically in the latest trends such as 5G communications, IoTs and Blockchain technology wherever the computer communication and networking required in adhoc mode. As the nodes rely on the battery, the presented work can be extended by considering the energy required in the process of route discovery and maintenance mechanisms. The presented work can be also extended to enhance the lifetime of the network.

### REFERENCES

1. A.Prasanth, S.Pavalajaran, 'Zone-Based Sink Mobility in Wireless Sensor Networks', Sensor Review, Vol.39, pp.874–880, 2019.
2. Yufei Cheng, EgemenK.Çetinkaya, and James P. G. Sterbenz "Dynamic Source Routing (DSR) Protocol Implementation in ns-3" 2012.
3. A.Prasanth, 'Certain Investigations on Energy-Efficient Fault Detection and Recovery Management in Underwater Wireless Sensor Networks', Journal of Circuits, Systems, and Computers, Vol. 30, 2020
4. Hemanth Narra, Yufie cheng "Destination Sequenced Distance Vector Routing (DSDV) Protocol Implementation in ns-3".
5. Yefa Mai, Yuxia Bai and Nan Wang "Performance Comparison and Evaluation of the Routing Protocols for MANETs Using NS3" Journal of Electrical Engineering 5 2017.
6. A.Prasanth, S.Jayachitra, 'A Novel Multi-Objective Optimization Strategy for Enhancing Quality of Service in IoT enabled WSN Applications', Peer-to-Peer Networking and Applications, Vol.13, 2020, pp.1905–1920
7. A.Prasanth, S.Pavalajaran, 'Implementation of Efficient Intra- and Inter-Zone Routing for Extending Network Consistency in Wireless Sensor Networks', Journal of Circuits, Systems, and Computers, Vol.29, 2020

8. Ravi Ranjan Kumar, Mahender "Implementation of DSR on Manet using NS2" International Research Journal of Engineering and Technology (IRJET) Volume: 03 Issue: 07 July-2016
9. A.Prasanth, S.Pavalarajan 'Particle Swarm Optimization Algorithm Based Zone Head Selection in Wireless Sensor Networks', International Journal of Scientific & Technology Research, Vol.8, pp.1594-1597, 2019
10. David B. Johnson David A. Maltz Josh Broch "The Dynamic Source Routing Protocol for Multi-Hop Wireless Ad Hoc Networks", 2017
11. Murugan, S., Jeyalakshmi, S., Mahalakshmi, B., Suseendran, G., Jabeen, T. N., & Manikandan, R. (2020). Comparison of ACO and PSO algorithm using energy consumption and load balancing in emerging MANET and VANET infrastructure. Journal of Critical Reviews, 7(9), 2020.