Performance of AODV, DSR and ZRP for Different Mobility Model in MANET

Suresh Kumar[a] and Rakesh Sidharth[a]

[a] *ECE Department, University Institute of Engineering and Technology (UIET) MDU, Rohtak, Haryana, India*

Abstract

In Mobile ad-hoc Network (MANET), all nodes are self-organized and self-motivated. These mobile nodes are connected to each other mostly by a wireless link. The schedule of mobility of these nodes are not fixed and hence not pre-planned. It keeps changing randomly based on the application. Each Routing protocol (RP) have definite advantages and disadvantages for a particular chosen performance parameters. In this present paper we have modelled and evaluated the performance of Routing protocols i.e., Ad-hoc on Demand Distance Vector (AODV), Dynamic Source Routing (DSR) and Zone Routing Protocol (ZRP) with various Mobility models (MMs) namely Random Walk Mobility (RWM), Random Way Point Mobility (RWPM), Group Mobility (GM) and File Base Mobility (FBM). The evaluation parameters selected are Throughput (mbps), Delay (microsecond) for a configuration of 10and 20 number of nodes by using NETSIM Simulator.

Keywords 1

AODV, DSR, ZRP, Mobility Model, Netsim.

1. Introduction

MANET is basically an independent system of mobile nodes where no fixed infrastructure exists and network Connectivity keeps changing regularly in random way. In MANET, all mobile units in the field share information to each other without a central control unit. The Source node and destination node works as transmitter and receiver respectively. In this layout each nodes is completely free to move anywhere in the area of responsibility connected wirelessly in field space [1]. No Separate router is available because the function of all the nodes are to act as self-sustained router. All nodes are capable of finding the routes and maintain the path directory for data transmission from source to destination nodes. The network structure continuously changing with respect location and application by executing a particular model of node mobility. In well and highly developed areas, communication between nodes may get affected due to fading effect. To reduce this effect network manager uses some common techniques such as (i) Diversity reception (ii) Rake receiver (iii) Space time coding (iv) Forward error correction etc [2]. A basic systematic layout of MANET Scenario is shown in figure 1 below.

WCNC-2021: Workshop on Computer Networks & Communications, May 01, 2021, Chennai, India.
EMAIL: skvashist_16@yahoo.com (Suresh Kumar)
ORCID: 0000-0002-3679-1049 (Suresh Kumar)

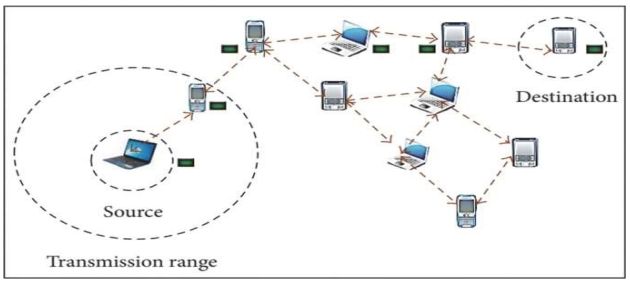


Figure 1: Basic layout of MANET Scenario

In MANET, Routing protocols (RPs) are divided into two parts: one is unique path RPs and another is multiple path RPs. AODV, DSR and ZRP are under unique path RPs. AODV and DSR are Reactive RPs and ZRP is hybrid RP. Reactive RPs can also be denoted as on demand routing protocol. These Reactive RPs protocols basically work on two things: (i) Route discovery and (ii) Route maintenance. Whereas the process of route discovery gets executed when routes are required in the event of disruption of the link between source and destination and has resulted in link failure. This will lead to commencement of the route search process [3]. These are mainly (i)AODV (ii) Light Weight Mobile Routing (LMR), (iii) Associativity-Based Routing (ABR) (iv)Temporally Ordered Routing Algorithm (TORA) (v) DSR, etc. Hybrid RPs are combination of both proactive and reactive protocols. Few example of these are: (i) ZRP (ii) Zone-Based Hierarchical Link State (ZHLS) (iii)Distributed Spanning Trees based routing protocol (DST) (iv) Distributed Dynamic Routing (DDR) (v) Scalable Location Update routing protocol (SLU) etc.[4]. Each RPs have definite advantages and disadvantages. In the present research the focus has been on AODV, DSR and ZRP protocols for this present modelled MANET scenario. The goal of this present paper is to find out the performance of AODV, DSR and ZRP with multiple MMs such as RWM, RWPM, GM and FBM in term of Throughput and Delay for 10 and 20 nodes. Many places where the MANET have wide applications are comprises of Defence, Military, War zone, Farming, Medical Robotics automation etc. [5].

This paper is organized in the order such that the latest research works are given in Section II and the proposed work is explained in Section III. Section IV presents the results and discussion of the simulated work. The overall output of this scenario is summarized in Section V.

2. Updated Research Work

In [6] authors analysed the performance of AODV and ZRP RPs at different speed. The simulation results were calculated for End to End delay, Throughput, Queue length and Drop packets. Author used Qualnet Simulator for analysis. On the bases of simulation output, AODV performed better than ZRP.

In [7] the authors have compared the performance of AODV and AOMDV RPs for 40, 80, 120 nodes at maximum speed of 10m/s. The performance metrics evaluated parameters chosen are throughput (b/s) and average end to end delay (second). Authors found performance of AOMDV is good in all output parameter as compared to AODV RPs.

In [8] the authors compared AODV, AOMDV and DSDV. Based on the simulation result, authors analysed that AODV perform better in terms of the (i) throughput, (ii) RO. It has also been seem that while checking the packet delivery ratio and (iv) packet loss, AOMDV is more reliable. For Delay, DSDV is more credible than AODV and AOMDV.

In this paper [9] Authors Described three energy model such as Generic, Micaz and Micamotes for transmitting mode and receiving mode using AODV and Dynamic MANET on Demand (DYMO)

RPs. On the basis of simulation outcome authors found that AODV RPs perform better in Micamotes energy model than other energy model. For throughput and AEED, AODV also performs well.

In [10] the authors evaluated AODV RPs for Throughput, jitter, AEED, Total packet received and Energy expenditure models. On the basis of Qualnet Simulation Outputs, It has been observed that jitter is high in Micaz model. In transmitting and receiving mode, Energy consumption of Micamotes is very less as compared to other energy models.

In [11] the authors used Qualnet simulator version 5.0.2 for simulation. And they compared the performance for: AODV, DSR and ZRP based on CONSTANT BIT RATE (CBR). The performance evaluated in terms of first & last Packet transmit (second), Total bytes & packet transmit, Throughput client & Server (bits/second), First & last Packet received (second), Total received bytes. They found that these RPs performed good at constant bit rate.

3. Proposed Model

In this proposed network model, simulation is done using NETSIM with Version 9.0. All the essential work parameters chosen are described in the table 1.

Table 1 : MANET Scenario parameters

Parameters	values
Environment area	700*700 meter^2
Simulator tool	NETSIM 9.0
Routing Protocols	AODV , DSR , ZRP
No. of nodes	10 , 20
Mobility types	RWM , RWPM , GM , FBM
Maximum mobility speed	15 m/s
Simulation time	120 seconds
Application type	CBR

The performance evaluated of these protocols: AODV, DSR and ZRP with multiple MMs namely RWM, RWPM, GMP and FBM in term of throughput and delay. The performance is calculated for two different set of 10 and 20 nodes in area of 700*700 meter2. The application applied between source and destination is CBR type. The maximum speed of nodes is 15 m/s in this network scenario. In 10 and 20 nodes network scenario. First among the nodes will be acting as source and final node in the chain as destination node. All nodes are connected to each other by a wireless link. MANET scenario with 10 nodes is presented in figure. 2 and with 20 nodes is presented in figure. 3 respectively.

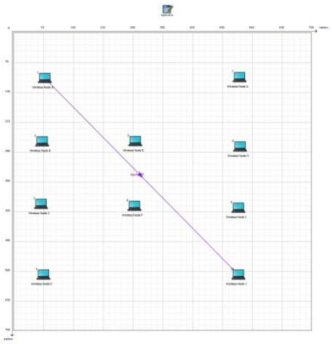


Figure 2: MANET scenario with 10 nodes

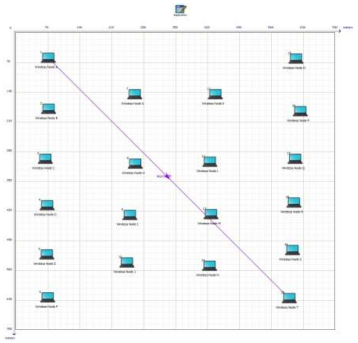


Figure 3: MANET Scenario with 20 nodes.

4. Results & Discussions

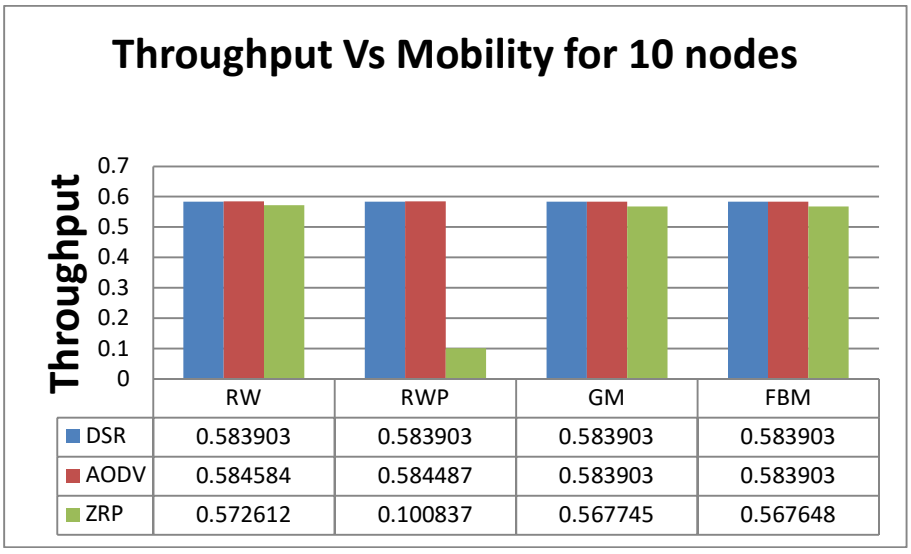
4.1 Throughput: Total number of data bit is transferred in specific time duration from Source to destination is called Throughput and It is measured in mbps. It represents the state of transmitted information rate in the network [12].Its represented in equation.1
Mathematically

$$Throughput = \frac{\text{data bits}}{\text{time duration}} \quad (1)$$

4.2 Delay: It is the time collected by the data to travel from transmitter to receiver in the network. It is calculated in microsecond. Various types of delay are included in Delay such as route finding, propagation and retransmission etc. [12].

Case 1: No. of nodes 10

In this MANET scenario shown in Figure 4, while calculating the throughput verses mobility, it is observed that for DSR, Throughput are 0.583903, 0.583903, 0.583903 and 0.583903. For AODV, Throughput are 0.584584, 0.584487, 0.583903 and 0.583903. For ZRP, Throughput are 0.572612, 0.100837, 0.567745 and 0.0567648 for RWM, RWPM, GM and FBM respectively.



	RW	RWP	GM	FBM
DSR	0.583903	0.583903	0.583903	0.583903
AODV	0.584584	0.584487	0.583903	0.583903
ZRP	0.572612	0.100837	0.567745	0.567648

Figure 4: Throughput versus mobility model for 10 nodes.

Throughput of the AODV and DSR with all mobility model is almost same. But for ZRP, throughput is less for all mobility model except for group mobility. From overall performance seen through result is that the AODV and DSR is more reliable than ZRP.

On the basis of simulation outcomes to measure the Delay verses mobility as shown in Figure 5, it has been found that for DSR, Delay are 12862.28476, 12862.3644, 12860.25648 and 12861.45009. For AODV, Delay are 16613.86295, 16232.52069, 16254.82639 and 16107.94337. For ZRP, Delay are 21593.59712, 93018.86365, 18061.32 and 17285.52525 for RWM, RWPM, GM and FBM respectively.

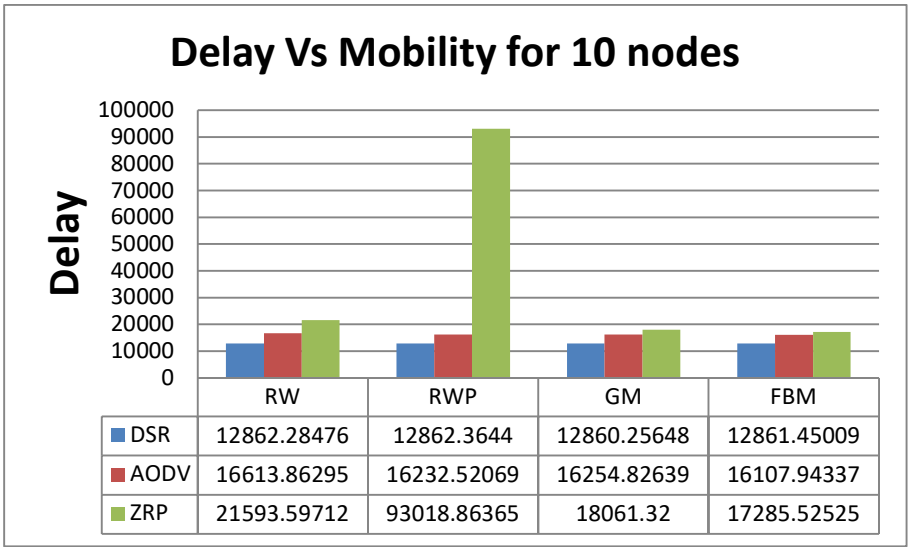
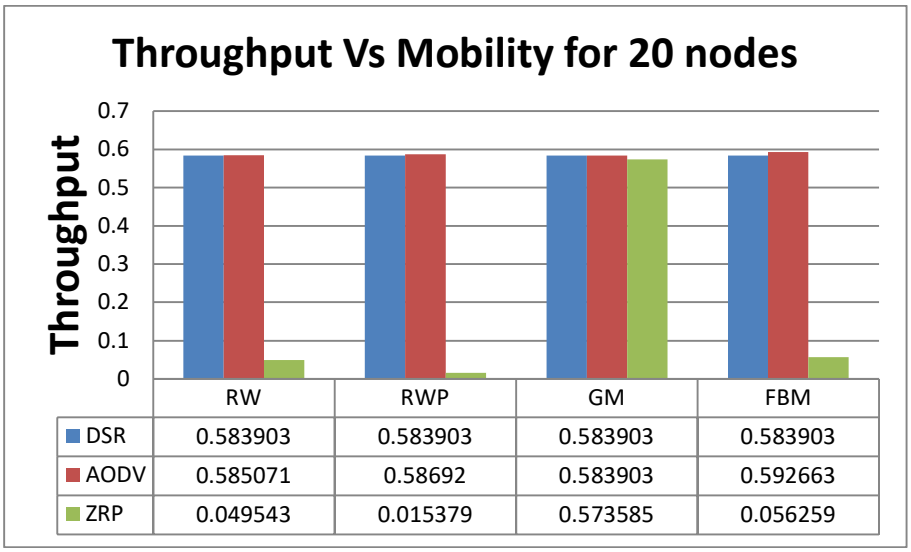


Figure 5: Delay versus mobility model for 10 nodes

From overall result conclusion, DSR is perform better than other two Routing protocols.

Case 2: No. of nodes 20

In this new scenario shown in Figure 6, while calculating the throughput verses mobility, it is observed that for DSR, throughput are 0.583903 , 0.583903 , 0.583903 and 0.583903, for AODV, Throughput are 0.585071 , 0.58692 , 0.583903 and 0.592663. For ZRP, Throughput are 0.049543, 0.015379, 0.573585 and 0.056259 for RWM, RWPM, GM and FBM respectively.

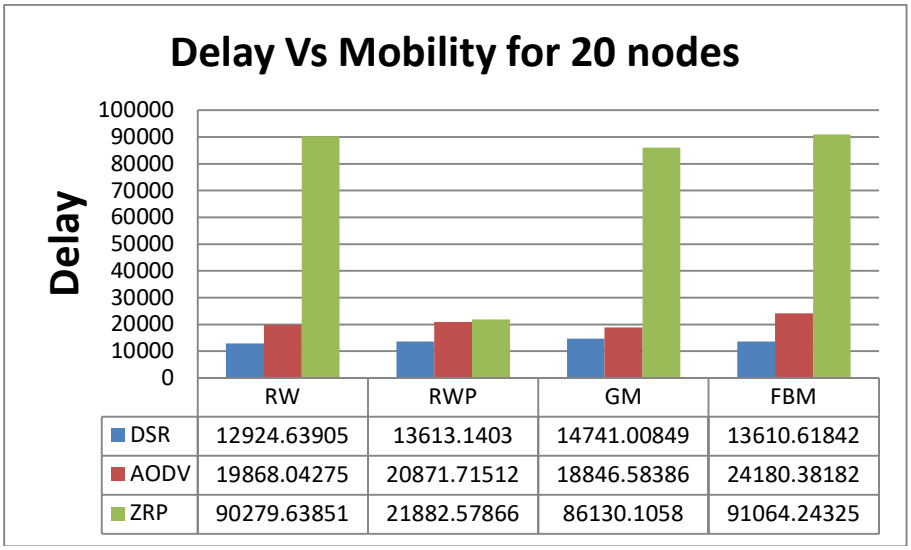


	RW	RWP	GM	FBM
DSR	0.583903	0.583903	0.583903	0.583903
AODV	0.585071	0.58692	0.583903	0.592663
ZRP	0.049543	0.015379	0.573585	0.056259

Figure 6: Throughput versus mobility model for 20 nodes.

Throughput values of AODV and DSR are near about. From overall result conclusion, AODV and is more reliable than DSR, ZRP. Throughput of the AODV and DSR is approximately same.

From Simulation Result, outcomes to measure the Delay verses mobility as shown in Figure 7, it has been found that for DSR, Delay are 12924.63905, 13613.1403, 14741.00849 and 13610.61842. For AODV, Delay are 19868.04275, 20871.71512, 18846.58386 and 24180.38182. For ZRP, Delay are 90279.63851, 21882.57866, 86130.1058 and 91064.24325 for RWM, RWPM, GM and FBM respectively.



	RW	RWP	GM	FBM
DSR	12924.63905	13613.1403	14741.00849	13610.61842
AODV	19868.04275	20871.71512	18846.58386	24180.38182
ZRP	90279.63851	21882.57866	86130.1058	91064.24325

Figure 7: Delay versus mobility model for 20 nodes.

In 10 nodes, DSR, AODV and ZRP RPs are used to calculate the performance for these MMs. In the results, throughput is high and delay is low in DSR as compared to both AODV and ZRP RPs. Throughput of AODV is much closed to DSR but it is less. Therefore DSR is best in both throughput and Delay metrics with these MMs. In case of 20 nodes, we repeat same process and observed that throughput is high in AODV, DSR than ZRP RPs. For delay, DSR have low delay compared to other RPs. So DSR is also best for 20 nodes with these MMs. Therefore we can say that DSR performed well for these MMs with increase in number of nodes.

5. Conclusion

In this present research paper, the Comparison of the performance of AODV, DSR and ZRP routing protocols with multiple MMs namely RWM, RWPM, GM and FBM in terms of the throughput (mbps) and delay (microsecond) for a configuration of 10 and 20 nodes has been presented. These outcome of the performance metrics vary with all MMs. For ZRP, both throughput and delay are highly unstable with some MMs. But in the case of DSR and AODV, the results are stable. After deeply analysis of simulation results, we found that the performance of DSR is more reliable and efficient than both AODV and ZRP RPs with all types of mobility models.

6. References

1. Kumar, S., Kumar, C. D. S. (2015). Study of MANET: Characteristics, Challenges, Application, Routing Protocol and Security Attacks. *INTERNATIONAL, JOURNAL*, *2*(5).
2. Ekwe, O. A., A. E. Abioye, M. O. Oluwe, and K. C. Okoro. (2014). Effective fading reduction techniques in wireless communication system. *IOSR Journal of Electronics and Communication Engineering* 9, no. 4 (2014): 35-43.
3. Khurana, S.,Kumar, S., & Sharma,D.(2017). Performance evaluation of congestion control in MANETs using AODV, DSR and ZRP protocols. *International Journals of Advanced Research in Computer Science and Software Engineering*, (ISSN: 2277-128X) Vol (2017): 398-403.
4. Abolhasan, M., Tadeusz,W., & Eryk, D.(2004).A review of routing protocols for mobile ad hoc networks. Ad hoc networks 2, no. 1 (2004): 1-22. https://doi.org/10.1016/S1570-8705(03)00043-X
5. Nayak, P., Pallavishree,S.(2015). Analysis of random way point and random walk mobility model for reactive routing protocols for MANET using NetSim simulator. *In 2015 3rd International Conference on Artificial Intelligence, Modelling and Simulation (AIMS)*, pp. 427-432. IEEE, 2015. https://doi: 10.1109/AIMS.2015.87.
6. Mehra, M., Mehajabeen F. (2020). AODV and ZRP Analysis for Congestion in MANET. *International Journal of Research in Engineering, Science and Management* Volume-3, Issue-5, May-2020 ISSN (Online): 2581-5792
7. Sharma, D., Kumar,S.(2020). Performance Evaluation of MANETs with Variation in Transmission Power using Ad-hoc on-demand Multipath Distance Vector Routing Protocol. *In 2020 5th International Conference on Communication and Electronics Systems (ICCES)*, pp. 363-368. IEEE, 2020. https://doi: 10.1109/ICCES48766.2020.9137954.
8. Setijadi, E., Purnama, K.E. & Pumomo, M. H. (2018). Performance comparative of AODV, AOMDV and DSDV routing protocols in MANET using NS2. *In 2018 International Seminar on Application for Technology of Information and Communication*, pp. 286-289. IEEE, 2018. https://doi: 10.1109/ISEMANTIC.2018.8549794.
9. Kumar, S., Dhull, K., Sharma, D., Arora, P. & Dahiya, S. (2019). Evaluation of AODV and DYMO Routing Protocol using Generic, Micaz and Micamotes Energy Conservation Models in AWSN with Static and Mobile Scenario. *Scalable Computing: Practice and Experience* 20, no. 4 (2019): 653-662. https://doi.org/10.12694/scpe.v20i4.1584
10. Kumar, S., Dhull, K., Arora, P. & Luhach , A. K. (2019). Performance of Energy Conservation Models, Generic, Micaz and Micamotes, using AODV Routing Protocol on a Wireless Sensor Network. *Scalable Computing: Practice and Experience* 20, no. 4 (2019): 631-639. https://doi.org/10.12694/scpe.v20i4.1563
11. Kumar, S., Kumar, J. (2012). Comparative performance study of zone routing protocol over AODV and DSR routing protocols on constant bit rate (CBR). *IJCA (097S-8887)* Volume 4S-NoA, *(2012)*.
12. Singh, G., Khurana, R. (2017). Performance Evaluation of DSR, OLSR and ZRP using NetSim Simulator.*International Journal of Advanced Research in Computer Science* 8, no. 3 (2017): 346-349.