Investigation of DSR protocol performance in Wireless MANET using Correlation Method

Umang Rastogi1*, Balachandra Pattanaik2, B Barani Sundaram3, Manish Kumar Mishra4, and Dhanabal Thirumoorthy5
1Department of Computer Science and Engineering, Meerut Institute of Engineering and Technology, Meerut, India
2Department of Electronics and Communication Engineering, Bule Hora University, Bule Hora, Ethiopia
3Department of Computer Science, Bule Hora University, Bule Hora, Ethiopia
4Department of Computer Science, University of Gondar, Ethiopia
5College of Informatics, Bule Hora University, Bule Hora, Ethiopia.
Email: umang.rastogi@miet.ac.in

Abstract. As we know already MANET means Mobile ad-hoc network that works made by two words Mobile and Ad-hoc Network collection of moving nodes shows mobile and kind of temporarily network which do not have any fixed point or centralised administration. Here assortment of nodes forms a network it can be adjust mobility to bandwidth in high or low level. In this paper, we evaluate performance of DSR protocol. In this unique design shows the results in terms of how protocol changes quickly according to nodes movement along with compare by correlation method. The result of this paper is coming after analysing of different behaviour of DSR can be applied in other new protocols that are using DSR framework. In this paper I showed results in term of break time, PDF, delay, throughput etc by simulation. These simulation results are applied on correlation method and finding out in which point DSR protocol parameters are performing good performance. In this result shows when pause time is increases along with no of nodes then correlation will be high.

Keywords: Correlation Method, DSR, Mobility, Packet delivery fraction, PDF, MANET, RREQ, RREP, RERR.

1. Introduction
In this network every node act as a router that will connect with each other and forward information packets to other nodes via multi-hop wireless links. In this protocol if two nodes communicate or interact smoothly that will depend on design of appropriate ad hoc network. For network interaction with high-speed research is going on by laptop or palmtop, they are designed nodes for mobility called packet radio network [1-2].

Last year we can see MANAT got much more popularity in research world doing many research different aspects of routing protocols. Here as we know MANAT doesn’t have any fixed architecture or base station or centralized administration. Hence it will be good to use for dynamic topologies and for low consumptions [3].

As we know already in ad-hoc network work on demand source. Here in the proactive protocols is not so important than the DSR reactive characteristics where all routes are jointly paired of source-destination. In the DSR on demand protocols are used for routing loads along with will impact on low bandwidth because of high routing packs. When in required route data packets are present then only on
demand performance will initiate and steering source used by DSR [4]. Here in paper, we try to motivate of merits of all protocols are used in ad hoc network and how it will expansion successfully in wireless network. In this paper we follow some steps [5] like first we studied working of DSR protocol then showing already done work by review of many good literature, after this I do simulation to take some parameters which are effect the performance of DSR protocols and make some results which decide in which point DSR perform well and that point we find out how strongly related those parameters by correlation coefficient (r).

In the security terms wireless not good as much as wired network so that it can be affected many types of attacks like DoS, middle of attack etc. So that it should be deal very carefully. That network performance depends on which routing protocols we will use, and for various parameters will use for Quality of service like Pause time, no of nodes, throughput PDF, E2E delay etc.

2. Related Works
The recurrent topology changes owing to the type of the system rather unbalanced. A respectable next hop collection approach is, thus, necessary that is capable for improve the lifespan as well as enhance the data transaction [6]. In [7] introduced a location-based approach that supporting an energy efficient selection as well as data routing to extend the lifespan of network. The clustering approach sure equated size cluster arrangement with least amount of broadcast accepts functions. This approach developed to attain equates the energy utilization between the nodes within the cluster as a result extending the lifespan.

The LEACH (Low-Energy Adaptive Clustering Hierarchy) approach [8] is an extensively recognized as well as efficient one to diminish and equate the energy utilization. The LEACH approach arbitrarily rotates Cluster Heads (CHs) between nodes, so as to avoid rapid energy utilization of the set of CHs.

Modified routing through comprising signal-to noise ratio (SNR) [9] based active clustering. This approach that is a proficient routing approach via SNR-based active clustering that divider the nodes into clusters as well as choose the CH established on the power as well as non-CH nodes link through a precise CH established on the SNR values [10]. Error revival had been enforced through the inter-cluster routing so as to evade error revival. In this approach, network region is separated into two parts: border area as well as inner area. This approach limits CH collection to only inner area of the nodes. An adaptable routing with the receptiveness of energy is applied to receive through an active situation. Although the transmitter communicates the data to a multicast group, the transmitter communicates the data through highest power among neighbourhood, therefore improve the life duration [11]. Throughput is improved with a data-aided estimation procedure through means of transmitting choice, channel next communicate responsibility.

Zonal approach [12] is a prevalent WSN routing approach. Here, typically focussed on optimization of steady selection approach. Energy Efficient Fuzzy Based Cross Layer approach [13] forecast the energy depletion of node. It attains longer sensor lifetime. Energy management system is concentrating on observe the existence of worker in the consistent office cubicle [14]. Optimization of energy aware routing approach that include the routing method with hop-based direction-finding nature throughout procedure. Grey wolf optimization technique is combined to predicament the precise location of unidentified nodes, to switch the node localization difficult [15].

3. Proposed Methodology
In this paper we evaluate DSR routing protocol performance over MANET with the help of correlation method. Here in this paper try to evaluate in which point DSR routing protocol will perform best.

3.1. Description of Protocol:
As by the name DSR [11] is using for source routing. Here in this protocol’s senders know how msg will take route in network hop by hop called direction cache. In the DSR some procedures are going on which is following here:

1. packet descriptors having basic route.
2. Route discovery will decide the route in ad hoc network for sending the information packets to the destination.
3. Route detection works with RREQ and RREP. Each noted broadcasting RREQ with a direction reply RREP which will back to the original source.
4. For the future use RREP stored the information of the route. So that RERR notified to the node which node is source for route fault if source route is broken.
5. If route is motion less new rout will find by source node.

3.2. Route Discovery
Route Discovery is used for when source will sent packets to the destination then source will decide packets choose which way to go destination by rout table. Source used Route Discovery protocol for finding new route when there is no route for destination. RREP will come to source when RREQ reaches to destination. The figure 1 explains about the route discovery procedure.

3.3. Route Maintenance
In the network every node has to be responsibility to send ack to the source when they will reach to destination but if there is no ack to source then DSR have specific software to do same for all. Figure 2 explains the Route Maintenance procedure in MANET.

3.4. Correlation Method:
This method shows how pairs of variables are strongly related. For example, in this paper we show in particular pause time when no of nodes are increases then how DSR parameters like throughput, packet drop ratio, PDF etc. is strongly related. [12]. Figure 3 demonstrates the examples of Approximation r values.
**Correlation coefficient:** denoted by "r" is the result of correlation is varying from -1.0 to +1.0. When Two variable are strongly related that means r value is near to +1 or -1.

\[
r_{ab} = \frac{\sum (a_i - \bar{a})(b_i - \bar{b})}{\sqrt{\sum (a_i - \bar{a})^2 \sum (b_i - \bar{b})^2}}
\]

(1)

Where:
- \( r_{ab} \) – coefficient between a & b variable
- \( a_i \) – sample of a variable
- \( \bar{a} \) – mean of variable a
- \( b_i \) – sample of b variable
- \( \bar{b} \) – mean of variable b

![Figure 3: examples of Approximation r values](image-url)
Many Researchers have been working on DSR ad-hoc routing protocols. In these protocols shows in small network if nodes are use as host and this host will move in network will change then delay will be small. Performance measure will be done by many parameters like no of nodes, through-put, eng to end delay, pause time and etc.

Some researchers did very deep comparisons between many protocols like DSR, AODV, ZRP, and OLSR. And shows in which condition which protocol will useful. So that now a days in real world when ad-hoc network implements we care about how much nodes is using in the network and how much through put will come how much data packets re dropped and how much delay will come. So that we can measure the performance of network protocol.

For this purpose, evaluation matrices are there like pause time versus through put, pause time versus Packet Delivery fraction, pause time versus Delay, and pause time versus packet dropped. After these performance matrices it will be compare by correlation method. By this method in this paper will show that how much correlation are there, and which point those matrices are highly correlated with each other. If correlation value $r$ will close to 1 or -1 means those parameters are highly correlated and that point protocol will perform best.

![Figure 4: Simulation by NS-2](image)

Figure 4 shows how simulation will work in this research paper. Every simulator runs first input, and, in the simulation, input will take as scenario file which shows how nodes will move over network and how many packets will originated by those nodes along with exactly which time nodes changes their movement and packets will originated. When we will run this file then trace file will generated and store in device and analysed using variety of scripts called totals.pl which shows all parameters results like no of packets successfully delivered, throughput, end to end delay [16]. Finally, figure 5 explains the Flow Chart of Methodology.
4. Performance Evaluation

Many simulators are used by many researchers but after observation every simulator like GloMosin, OPNET and many more, then researchers find that network simulator are working good more than others. In NS2 many researchers found high accuracy in experiment when researchers need to produce data so that we use NS-2 simulation as par performance of this in previous records. Here in this below table shows comparison of different simulators [14]. The parameters matrices evaluated in this research paper shows an indication of performance of this protocol in terms of following:

**Pause Time:** How much time node will take to go next node.

**Throughput:** show how many packets actually move from source to destination.

\[
\text{Throughput} = \frac{\text{Packet Size}}{\text{Stop Time} - \text{Start Time}}
\]

**Packet Delivery Fraction:** Ratio between no. of packets receives in destination an no. of packets sent by source.

\[
\text{PDF} = \frac{\text{No.of received packets}}{\text{No.Of Sent Packets}}
\]

**Packet Dropped:** Total no of packets dropped over all simulation time

\[
\text{Packet Dropped} = \frac{\text{Dropped Packet}}{\text{Total No.of Packets}} \times 100
\]

**Delay:** how much time will yield by packet to distribute over the network.

\[
\text{AED} = \sum_{i=0}^{n} \frac{(\text{TimePacketReceived}_i \text{-- TimePacketSent}_i)}{\text{TotalNo.of PacketsReceived}}
\]
Here in this table trying to show what parameters are working in this research paper and mentioned what type of values can be put over simulators while simulation time [15]. Table 1 indicates the Simulator parameters.

| Serial No. | Parameters            | Value             |
|------------|-----------------------|-------------------|
| 1.         | Number of nodes       | 50                |
| 2.         | Simulation Time       | 500               |
| 3.         | Area                  | 1500*300          |
| 4.         | Max Speed             | 10                |
| 5.         | Traffic Source        | CBR               |
| 6.         | Pause Time (sec)      | 100, 200, 300, 400, 500 |
| 7.         | Packet Size           | 512               |
| 8.         | Packets Rate          | 4 Packets/s       |
| 9.         | Max. Number of connections | 10,20,30,40,50   |
| 10.        | Mobility model used   | Random way point  |

4.1. Throughput-T
In the readings above we had seen from the result that as we increase the maximum number of connections for each pause time ranging from 100 to 500 then the effect can be seen on the graph of throughput, which increases linearly and simultaneously we can see for co-relation coefficient (r) value also, which also increases linearly approaching to +1. So, we can find out that our results of ns2 simulation of DSR performance are correlated [16]. Table 2 represents the Pause Time and Throughput using (r) value. Figure 6 shows the Pause Time and Throughput (bits/sec) For r = +.875.

| Pause Time | 100  | 200  | 300  | 400  | 500  |
|------------|------|------|------|------|------|
| max Connection(x) | T    | T    | T    | T    | T    |
| 10         | 148.28 | 148.84 | 148.73 | 148.73 | 148.4 |
| 20         | 283.39 | 284.14 | 283.9  | 283.86 | 283.41 |
| 30         | 420.68 | 419.34 | 419.92 | 419.59 | 420.02 |
| 40         | 420.43 | 392.25 | 404.98 | 418.52 | 401.85 |
| 50         | 414.07 | 384.2  | 401.76 | 411.74 | 402.49 |
| Correlation Coefficient(r) | 0.875 | 0.822 | 0.855 | 0.873 | 0.855 |
4.2. Packets Dropped
In the readings above we had seen from the result that as we increase the maximum number of connections for each pause time ranging from 100 to 500 then the effect can be seen on the graph of Packet Dropped, which increases linearly and simultaneously we can see for co-relation coefficient (r) value also, which also increases linearly approaching to +1.

| Pause Time | 100 | 200 | 300 | 400 | 500 |
|------------|-----|-----|-----|-----|-----|
| max Connection | Packet Dropped | Packet Dropped | Packet Dropped | Packet Dropped | Packet Dropped |
| 10 | 18 | 5 | 0 | 1 | 0 |
| 20 | 21 | 6 | 8 | 8 | 2 |
| 30 | 33 | 12 | 23 | 5 | 2 |
| 40 | 15851 | 19547 | 17752 | 16163 | 18145 |
| 50 | 20071 | 23692 | 21383 | 20257 | 21360 |
| Correlation Coefficient | 0.89 | 0.887 | 0.886 | 0.889 | 0.884 |

We can find out that our results of ns2 simulation of DSR performance are correlated. Table 3 indicates the Pause Time and Packets Dropped using – (r) value. Figure 7 represents the Pause Time and Packet Dropped for r = +.89

4.3. PDF-Packet Delivery Fraction
In the readings above we had seen from the result that as we increase the maximum number of connections for each pause time ranging from 100 to 500 then the effect can be seen on the graph of PDR fraction, which increases linearly and simultaneously we can see for correlation coefficient (r) value also, which is decreases linearly approaching to -1. So, we can say that for the same parameters, PDR fraction decreases with the
max. Number of connections for each pause time. Table 4 illustrates the Pause Time and PDF using $-r$ value and Figure 8 proves the Pause Time and PDF for $r = -.886$.

![Figure 7: Pause Time and Packet Dropped For r = +.89](image)

![Figure 8: Pause Time and PDF For r = -.886](image)

| Table 4: Pause Time and PDF using $-r$ value |
|---------------------------------------------|
| Pause Time | 100 | 200 | 300 | 400 | 500 |
| max Connection | PDF | PDF | PDF | PDF | PDF |
| 10 | 99.98 | 100 | 100 | 99.99 | 100 |
| 20 | 99.97 | 100 | 99.99 | 100 | 99.99 |
| 30 | 99.99 | 100 | 99.97 | 99.99 | 100 |
| 40 | 76.88 | 71.72 | 73.96 | 76.46 | 73.48 |
| 50 | 72.11 | 67.01 | 70.07 | 71.82 | 70.12 |
| Correlation Coefficient(r) | -0.886 | -0.883 | -0.882 | -0.886 | -0.88 |
4.4. Delay
In the readings above we had seen from the result that as we increase the maximum number of connections for each pause time ranging from 100 to 500 then the effect can be seen on the graph of End-End Delay, which increases linearly and simultaneously we can see for co-relation coefficient (r) value also, which also increases linearly approaching to +1. So, we can find out that our results of ns2 simulation of DSR performance are correlated. Table 5 explains the Pause Time and End to End Delay using – (r) value and Figure 9 illustrates the Pause Time Vs End to End Delay For r = .88.

Table 5: Pause Time and Delay using – (r) value

| Pause Time | 100  | 200  | 300  | 400  | 500  |
|------------|------|------|------|------|------|
| max Connection | Delay | Delay | Delay | Delay | Delay |
| 10         | 8.05 | 9.2  | 7.65 | 6.75 | 8.36 |
| 20         | 9.47 | 10.32| 10.29| 8.28 | 11.19|
| 30         | 17.98| 14.84| 16.77| 12.49| 16.16|
| 40         | 4141.28| 4831.25| 4859.91| 4502.95| 4825.69|
| 50         | 4703.13| 5347.16| 5431.45| 5071.82| 5203.2|
| Correlation Coefficient | 0.882| 0.879| 0.88 | 0.88 | 0.876 |

Figure 9: Pause Time Vs End to End Delay For r = .88

5. Conclusion
In this paper showing some interesting results of routing protocols like how protocols react while presence of high mobility, and same results came when we are using correlation method. In this paper we showed performance of DSR protocol with no of parameters like pause time, throughput, PDF etc. in this simulation results when pause time increases DSR performance also increases. After getting this result we applied correlation method of all parameters vs pause time then we got the exact point where DSR protocol will gives max performance over wireless ad hoc network. We got this point where all the parameters vs pause time correlation coefficient value is close to +1 or -1.

6. Future Scope
In this paper shows best performance of DSR Routing protocol with correlation method but this protocol shows good performance for only small network means less no of nodes this phenomenon will not work for big network or no of nodes are more. In this case this protocol performance will not good, for this limitation routing protocol needs some updating on their algorithm. In future needs some more complex simulations for various factors also additional elaborated in-depth investigation of MANET.
References

1. Bhushan, S., Singh, A. K., & Vij, S. (2019, April). Comparative study and analysis of wireless mesh networks on AODV and DSR. In 2019 4th International Conference on Internet of Things: Smart Innovation and Usages (IoT-SIU) (pp. 1-6). IEEE.

2. Nancy, V. (2018). A Security for MANET Interruption Recognition & Preclusion approaches for Network Layer Attacks. International Journal of Applied Engineering Research, 13(12), 10702-10706.

3. Sureshbhai, T. H., Mahajan, M., & Rai, M. K. (2018, April). An investigational analysis of DSDV, AODV and DSR routing protocols in Mobile Ad hoc Networks. In 2018 International Conference on Intelligent Circuits and Systems (ICICS) (pp. 281-285). IEEE.

4. Zhang, H., & Guo, J. (2017, July). Application of manet routing protocol in vehicular ad hoc network based on NS3. In 2017 7th IEEE International Conference on Electronics Information and Emergency Communication (ICEIEC) (pp. 391-394). IEEE.

5. Zonouz, A. E., Xing, L., Vokkarane, V. M., & Sun, Y. L. (2014). Reliability-oriented single-path routing protocols in wireless sensor networks. IEEE Sensors Journal, 14(11), 4059-4068.

6. Kumar, M. J & Baskaran, R (2015), ‘Performance Analysis and Comparison of Congestion Control in Wired and Wireless Environment’, International Journal of Control Theory and Applications, vol. 8, no. 5, pp. 1743-1757.

7. Ahmed, T., Nuruzzaman, S., Haque, M. N., & Masum, M. (2007, December). Modification of DSR and its implementation in Ad Hoc City. In 2007 10th international conference on computer and information technology (pp. 1-6). IEEE.

8. Ahmad, S., Awan, I., Waqqas, A., & Ahmad, B. (2008, May). Performance analysis of DSR & extended DSR protocols. In 2008 Second Asia International Conference on Modelling & Simulation (AMS) (pp. 191-196). IEEE.

9. Aissani, M., Senouci, M. R., Demigna, W., & Mellouk, A. (2007, June). Optimizations and performance study of the dynamic source routing protocol. In International Conference on Networking and Services (ICNS'07) (pp. 107-107). IEEE.

10. Al-Mehlafi, Z. G., & Hassan, R. (2011, July). Evaluation study on routing information protocol and dynamic source routing in Ad-Hoc network. In 2011 7th International Conference on Information Technology in Asia (pp. 1-4). IEEE.

11. Kumar, M. J & Baskaran, R (2017), Analyzing a Personalized Network System through NetFlow’, Institute of Integrative Omics and Applied Biotechnology (IIOAB), 7(7), pp. 1-7.

12. Braden, R. (1989). Requirements for Internet Hosts-Communication Layers RFC 1122 (Standard). Updated by RFC 1349.

13. Seet, B. C., Lee, B. S., & Lau, C. T. (2003). Optimisation of route discovery for dynamic source routing in mobile ad hoc networks. Electronics Letters, 39(22), 1606-1607.

14. Cheng, Y., Huang, C., & Shi, W. (2007, September). Trusted dynamic source routing protocol. In 2007 International Conference on Wireless Communications, Networking and Mobile Computing (pp. 1632-1636). IEEE.

15. Perkins, C., Belding-Royer, E., & Das, S. (2003). Ad hoc On-Demand Distance Vector (AODV) Routing: RFC Editor.

16. Niu, D., Zhang, Y., Zhao, Y., & Yang, M. (2009, December). Research on Routing Protocols in Ad Hoc Networks. In 2009 International Conference on Wireless Networks and Information Systems (pp. 27-30). IEEE.