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# Performance Analysis of Routing Protocols in Mobile Ad-hoc Networks Using NS2

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***Abstract*—**Mobile Ad-hoc Networks (MANETs) are considered as a new emerging technology of infrastructure-less mobile wireless communication systems. Routing in MANETs is considered a challenging task due to the unpredictable changes in the network topology, resulting from the random and frequent movement of the nodes and due to the absence of any centralized control. Many routing protocols for MANETs have been developed and reported in the literature but they still lack in performance. With this motivation, these five routing protocols viz. AODV (Ad-hoc On Demand Routing protocol), AOMDV (Ad-hoc On-demand Multipath Distance Vector, DSR (Dynamic source routing), DSDV (Destination Sequence Distance Vector )and PAAODV (Power Aware Ad-hoc On Demand Distance Vector) are selected for their performance evaluation by considering the Packet Delivery Ratio (PDR), average end-to-end delay, residual energy and throughput with respect to the number of mobile nodes varies from 10 to 50.The simulation are performed using NS2 simulator to study inter-layer interactions and performance of the protocols are analyzed.

***Keywords-*** *AOMDV, DSDV, DSR, MANET, PAAODV etc.*

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## I. INTRODUCTION

Mobile Ad-hoc Networks (MANETs) are considered as a new paradigm of infrastructure-less mobile wireless communication systems. In contrast to cellular and infrastructure based networks, it does not possess any fixed infrastructure or central administrator such as router. MANET is a set of independent system of mobile nodes that move freely and randomly. Its network topology is dynamic in nature and may change speedily and randomly. Due to this the intercommunications among nodes keep on changing. MANET [2, 10] depends on many other aspects including location of request initiator, topology of network and optimum selection of routers and specific underlying features that could work on finding the path rapidly and efficiently. In MANETs, routing protocols are used to decide the optimal route for packet transfer and make sure that the packets are reached to the desired destination. Several routing protocols for MANETs have been given and their performance under different network situations and traffic constraints has been considered. Routing protocols are categorized as: proactive and reactive. Proactive based routing protocols [8] are also known as table driven routing protocols. It maintains optimal routing information for each node in the network by spreading route update information at periodic intervals. Many proactive routing protocols have been proposed in the literature such as Wireless Routing Protocol (WRP), Destination-Sequenced Distance Vector (DSDV) routing protocol, Optimized Cluster-Head Gateway Routing (CGSR). In reactive based routing [7, 8] protocols, also known as on-demand routing protocol, takes a different method for routing as

compare to proactive protocols. The advantage is that when a path is desired, it is immediately available which reduces the routing overheads. Various Types of on-demand Routing Protocols are: Dynamic Source Routing (DSR) [1, 2], Ad hoc On-demand Distance Vector (AODV) [3, 6], Temporally Ordered Routing Algorithm (TORA). Among these protocols author take five routing protocols viz. Destination Sequenced Distance Vector (DSDV) protocols,Ad-hoc on demand Distance Vector (AODV), Dynamic Source Routing (DSR), Ad-hoc on demand Multicast Distance Vector (AOMDV) and Power Aware Ad-hoc on demand Distance Vector (PAAODV) are selected for their performance evaluation by considering the density of nodes. AODV routing protocol uses a reactive approach to discover routes; it uses the destination sequence number to determine fresh path to the destination, which distinguishes it from other reactive based routing protocols; it also uses a broadcast route discovery process to find a path to the target and then target node uses the unicast route reply massage to reply back to the source, whereas DSR is designed mainly to use in multi-hop mobile ad-hoc networks. In DSDV every node in the network maintains a routing table in which all the possible destinations within the network as well as the number of hops to reach each destination are recorded. Each route entry is marked with a sequence number. Nodes periodically transmit routing table updates throughout the network in order to maintain table consistency. AOMDV is more improved version of AODV protocol with extra feature of calculating more than one path in a single route discovery phase.The main diffrence between this protocol and its predecessor is the number of active routes found in each route discovery phase.In AOMDV, RREQ (Route Request) packet traveling from source to the destination to create more number of reverse active paths and RREP (Route Reply) packet go through these reverse path to create nuerous forward paths toward the destination.PAAODV is also an improved version of AODV protocol that involves more number of power level information during route discovery phase to find a route that is power effecient.In PAAODV, each node attempts to find a route to the sink at start with low power levels. If they find a route , then the power level is improved and same as all other nodes in the network perform the same procedure to maximize their lifetime.

This paper analyzes the DSDV, AODV,DSR, AOMDV, PAAODV protocols by considering the variation in network size and routing energy consumption by using performance evaluation metrics such as packet delivery ratio, average end-to-end delay, throughput and residual energy.

The following sections are organized as follows: Section II discusses the review of previously related work. Section III shows the performance evaluation of DSDV, AODV,DSR, AOMDV, PAAODV protocols and simulation activity process

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for simulation scenarios. Section IV discusses the simulation results. Section V presents the concluding remarks and future extensions.

## II. RELATED WORKS

There are numerous papers [6, 8, 9, 12, 13, 14, 20, 21] related to the performance evaluation of routing protocols in MANETs. Khattak, M. A. H. et al [6] analyzed various routing protocol by changing the mobility and density of nodes with TCP and UDP traffic. They show that all routing protocols did well under TCP traffic type whereas PDR was less in case of UDP due to unreliable transmission.

Chenna R. et al. [8], Gaiwak, L. G. et al [9] presented a detailed simulation of DSDV, AODV and DSR with 40 wireless nodes forming ad hoc networks and the author concluded that DSDV and TORA indicate decent performance in a network with low mobility whereas AODV and DSR gives comparatively better results in all mobility situations.

Dadhania, P, et al. [12] observe that, for application oriented metrics such as delay and throughput, DSR outperforms AODV when the numbers of nodes are smaller. AODV outperforms DSR when the number of nodes is very large. The authors show that DSR consistently produce less routing load than AODV.

S.S.Kaushisk et al., [14] evaluated the performance of DSDV, DSR and AODV routing protocols using NS-2 simulator by taking three metrics throughput, normalized network delay load and no. of sent packets with speed of the node as constant and varying network size. The scenarios of the network contains 550*550 terrain region, node mobility is constant as 15 m/s, simulation time is 300 second and no. of mobile nodes varies from 10 to 30. The outcome of the experiments shows that DSR outperforms AODV and DSDV in less dense situation but when the number of nodes increases the DSR performance regularly decreases.

Kanungo, P. et al. [20], Performances of AODV, DSR, OLSR and DSDV are analyzed on randomly generated traffic pattern and mobility with different number of nodes and size of network. As a simulation result, OLSR gives better solution for high mobility with larger number of mobile nodes on the network than other objective routing protocols (AODV, DSR, and DSDV). But in small size of network (600m X600m) with small mobility of node, DSR gives highest performance on PDR parameters.

Grover, J. T. et al. [21], several routing protocols (AODV, DSDV, and DSR) is analyzed on different transmission range with different number of node and mobility of nodes. In this simulation, AODV has maximum packet delivery ratio and maximum throughput compare to DSDV and DSR. And this paper shows performance of routing protocol could be enhanced in higher transmission range and higher mobile environment.

## III. PERFORMANCE EVALUATION OF DSDV, AODV, DSR, AOMDV AND PAAODV PROTOCOL

As discussed in the earlier section, the performance among DSDV,AODV and DSR protocols are compared with lesser matrices. Now in this paper author includes two more protocols i.e. AOMDV and PAAODV and evaluate above all five protocols with broader matrices by considering network size from 10 to 50 mobile nodes. For evaluation following metrics are used - Packet Delivery Ratio(PDR), Average End-to-End Delay, Residual Energy and Throughput. Fig. 1 shows the methodology of studying the performance of these protocols. A TCL script with wireless scenario & traffic pattern of mobile nodes is created, which is run on the network simulator. The outcomes of the simulation are trace file & the awk script, which are used for analysis

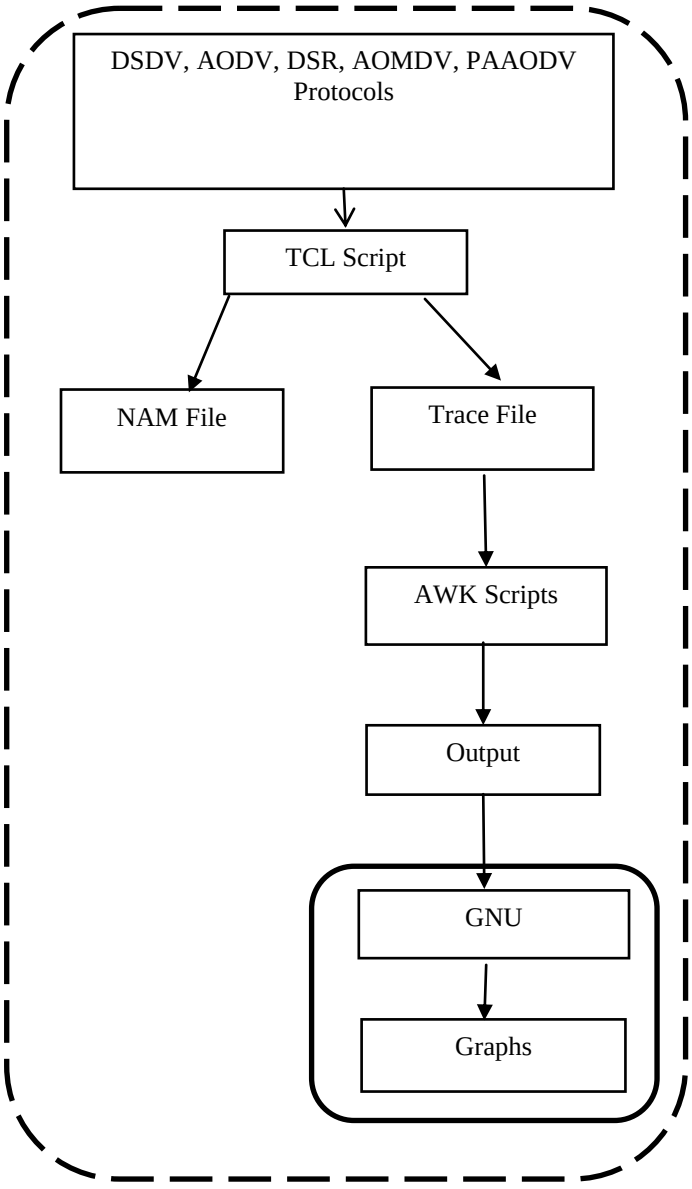


Fig. 1: Methodology Process

The following four metrics are used to evaluate the performance of the protocols:

Packet Delivery Ratio (PDR): This is the ratio of the number of data packets successfully delivered to the receiver to those generated by the sender.

$$PDF = \frac{No.\ of\ packets\ recieved}{No.\ of\ packets\ sent}\ X\ 100$$

End-to-End Delay: It is average time required to transfer the data packets from source to destination.

$$End - to - End\ Delay = \frac{\sum(Arrival\ Time - Sent\ Time)}{\sum No.\ of\ Connections}$$

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| Table 2: PDR of DSDV, AODV, DSR, AOMDV and PAAODV | | | | | |
|---|---|---|---|---|---|
| **No.of Nodes** | **DSDV** | **AODV** | **DSR** | **AOMDV** | **PAAODV** |
| **10** | 94.33 | 99.99 | 99.0 | 98.43 | 86.86 |
| **20** | 98.27 | 100.00 | 100 | 97.91 | 99.33 |
| **30** | 97.88 | 99.97 | 99.9 | 96.58 | 99.75 |
| **40** | 97.5 | 100 | 100 | 97.26 | 100 |
| **50** | 96.95 | 99.98 | 99.9 | 97.68 | 100 |

Throughput: Throughput is defined as the number of packets successfully transferred from sender to the receiver per unit time.

$$Throughput = \frac{No.\,of\ bits\ recieved\ X\ 8}{Simulation\ Time\ X\ 1000}\ Kbps$$

Residual Energy: Residual energy is the energy left after the packets are transferred by every node or the remaining energy at every node after transmission of packets.

Residual Energy=RE(i) - RE(t)

Where RE(i) is the primary energy of a node and
RE(t) is the energy used by the node by time t.
Total Residual Energy of the node is:

$$TRE = N\sum_{i=1}^{i=N}(InitialEnergy - RE(i))$$

Here N is the number of mobile nodes and initial battery power of the mobile nodes is set to 52 joules.

## IV. SIMULATION RESULTS AND PERFORMANCE ANALYSIS

The experiment was performed using Network Simulator NS2.35 by using the parameters shown in Table 1. The traffic sources were UDP Constant Bit Rate (CBR)and File Transfer Protocol (FTP). The source sink pairs were spread randomly over the network. The model used for mobility was 'random waypoint model' in a rectangular field of 670m x 670m with (10-50) nodes as shown in table1.

| TABLE 1: Simulation Scenario | |
|---|---|
| Parameters | Values |
| Simulator | NS 2.35 |
| Media Access Control | 802.11 |
| Simulation Period | 500 sec. |
| Channel | Wireless Channel |
| Protocols | DSDV, AODV, DSR, AOMDV, PAAODV |
| Antenna Model | Omnidirectional |
| Simulation Range | 670m × 670m |
| Traffic Type | CBR (UDP), FTP(TCP) |
| Radio Propagation | TwoRay Ground |
| Interface Queue Type | DropTailPriQueue (AODV , AOMDV, PAAODV, DSDV), CMUPriQueue (DSR) |
| Number of Nodes | 10,20,30,40,50 |
| Mobility Model | Random Way Point |
| Packet Size | 512 Bytes |
| Initial Energy | 52 joules |

| Table 3: No. of Packets Sent Vs No. of Packet Recieved | | | | | |
|---|---|---|---|---|---|
| **No. of Nodes (Sent Packets)** | **Recieved Packets** | | | | |
| | **DSDV** | **AODV** | **DSR** | **AOMDV** | **PAAODV** |
| **10(56923)** | 53695 | 56916 | 56354 | 56031 | 49443 |
| **20(20125)** | 19777 | 20126 | 20125 | 19706 | 19990 |
| **30(10954)** | 10722 | 10951 | 10953 | 10580 | 10926 |
| **40(7117)** | 6939 | 7117 | 7117 | 6922 | 7117 |
| **50(5094)** | 4939 | 5093 | 5090 | 4976 | 5094 |

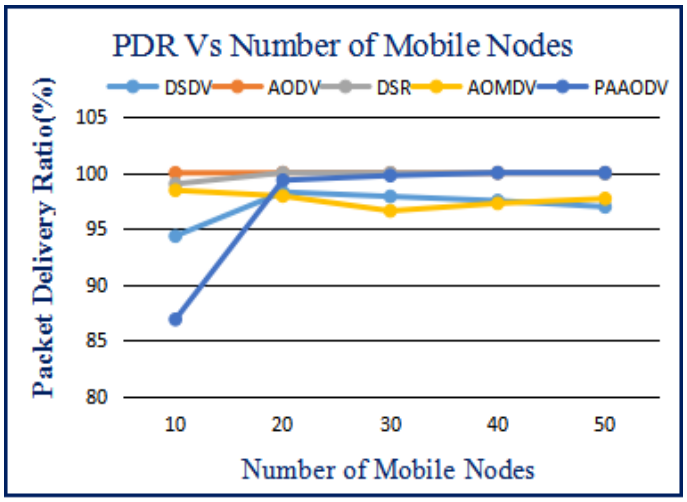


Fig.-2: Packet Delivery Ratio Vs Number of Mobile Nodes

Fig. 2 shows the PDR of DSDV,AODV, DSR, AOMDV and PAAODV protocols with varying number of mobile nodes 10 to 50. X-axis represents number of mobile nodes & Y-axis represents PDR. Experiment results shows DSR is much better than other protocols when number of mobile nodes are increased. Initially PDR of PAAODV is less as compare to other protocol but with increasing the number of nodes PAAODV gives better PDR value as compare to DSDV, AODV and AOMDV. But PDR of DSR and PAAODV is still same when the number of mobile node is increased.

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**Table 4: End-to-End Delay of DSDV, AODV, DSR, AOMDV and PAAODV**

| No.of Nodes | DSDV | AODV | DSR | AOMDV | PAAODV |
|---|---|---|---|---|---|
| **10** | 21.26 | 8.55 | 7.26 | 8.09 | 8.11 |
| **20** | 17.37 | 9.46 | 5.59 | 7.19 | 6.69 |
| **30** | 6.3 | 6.17 | 4.63 | 5.17 | 6.07 |
| **40** | 5.41 | 5.13 | 4.65 | 5.33 | 6.19 |
| **50** | 6.77 | 6.63 | 4.77 | 5.29 | 6.09 |

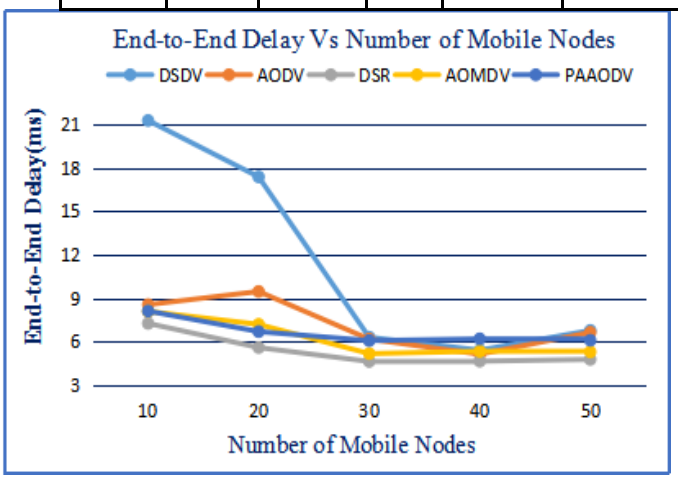


Fig.-3: End-to-End Delay Vs Number of Mobile Nodes

Fig. 3 shows the Average End-to-End Delay of DSDV,AODV, DSR, AOMDV and PAAODV protocols with varying number of mobile nodes 10 to 50. X-axis represents number of mobile nodes & Y-axis represents average End-to-End Delay. Experiment results show that the best average End-to-End Delay is exhibited by DSR and AODV protocols. It is also observed that DSDV is the worst protocol in terms of delay due to increase in the number of control overheads. The results also shows that the best average end-to-end delay for DSR protocol is lesser than all other protocols.

**Table 5: Throughput of DSDV, AODV, DSR, AOMDV & PAAODV**

| No.of Nodes | DSDV | AODV | DSR | AOMDV | PAAODV |
|---|---|---|---|---|---|
| **10** | 495.2178 | 629.9604 | 618.5844 | 612.7524 | 595.5498 |
| **20** | 217.881 | 314.4222 | 300.6432 | 289.1025 | 219.3228 |
| **30** | 118.1322 | 212.4738 | 201.1149 | 197.5824 | 120.5739 |
| **40** | 58.447 | 88.308 | 80.003 | 78.147 | 74.5389 |
| **50** | 54.423 | 70.513 | 64.884 | 63.8208 | 61.5132 |

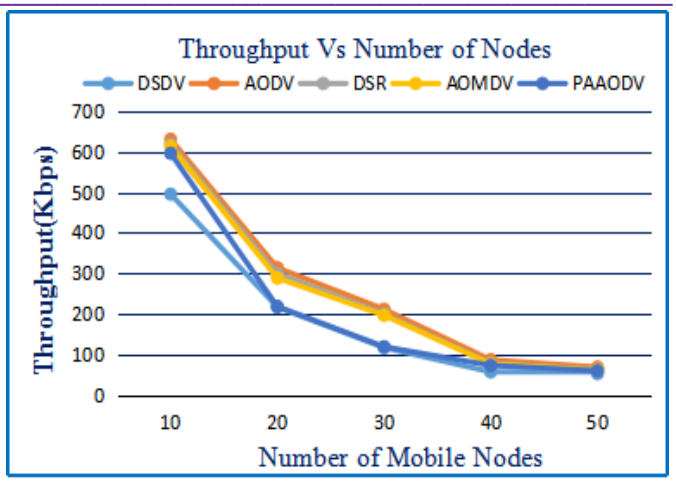


**Fig.-4:** Throughput Vs Number of Mobile Nodes

Fig. 4 shows the Throughput of DSDV,AODV, DSR, AOMDV and PAAODV protocols with varying number of mobile nodes 10 to 50. X-axis represents number of mobile nodes & Y-axis represents Throughput. Experimental results show that AODV has highest throughput as compared to all other protocols. DSR and AOMDV has same throughput value while DSDV has the lowest throughput among the five protocols.

**Table 6: Residual Energy of DSDV, AODV, DSR, AOMDV and PAAODV**

| No.of Nodes | DSDV | AODV | DSR | AOMDV | PAAODV |
|---|---|---|---|---|---|
| **10** | 49 | 49 | 48 | 49 | 74 |
| **20** | 39 | 43 | 42 | 43 | 74 |
| **30** | 29 | 41 | 41 | 30 | 87 |
| **40** | 19 | 41 | 40 | 30 | 311 |
| **50** | 9 | 41 | 41 | 39 | 312 |

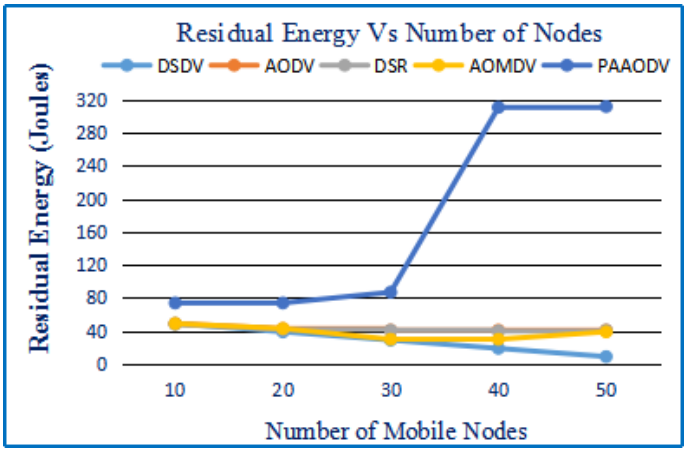


**Fig.-5:** Residual Energy Vs Number of Mobile Nodes

Fig. 5 shows the Residual Energy of DSDV,AODV, DSR, AOMDV and PAAODV protocols with varying number of mobile nodes 10 to 50. X-axis represents number of mobile nodes & Y-axis represents Residual Energy. Experimental

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results shows that PAAODV performed more efficient than all other protocols in high mobility conditions and also shows that the residual energy is increasing with the increase in the number of mobile nodes. The results also indicates that PAAODV consumes the highest energy with increasing the number of mobile nodes and DSDV give the wrost result in case of residual energy.

## V. CONCLUSIONS AND FUTURE WORKS

In this paper, performance of the five protocols – DSDV,AODV,DSR, AOMDV and PAAODV have been evaluated on the basis of network size. The experimental results have shown that DSR protocols have outperformed to all other protocols in terms of PDR and average end-to-end delay when the number of mobile nodes in the network are increased.. It has also been found that the AODV have given better results as compared to DSDV, DSR, AODV and PAAODV in terms of throughput. On the other side PAAODV is better in terms of residual energy when number of mobile nodes are increased.

Overall it has been observed that DSR and PAAODV has performed better than AODV , MAODV and DSDV protocols. As an extension to future work, these five protocols are also compared with QoS parameters like node mobile, speed of the network and pause time.

## REFERENCES

[1] Hakak, S., et al"Impact of packet size and node mobility pause time on average end to end delay and jitter in MANETs", IEEE International Conference on Computer and Communication Engineering (ICCCE), pp. 56-59, Sept. 2014.

[2] Khediri, E. S. et al., "Routing protocols in MANET: Performance Comparison of AODV, DSR and DSDV Protocols Using NS2", IEEE International Symposium on Networks, Computers and Communications, pp. 1-4, 17-19 June 2014.

[3] Kumar, P. et al., "Effect of Pause Time on Performance of AODV and DSR Routing Protocols in Wireless Ad-hoc Networks", International Journals of Modern Trends in Engineering and Research, Vol. 1(5), pp. 61-70, November 2014.

[4] Ahmed, A., "A Comparative Study of AODV & DSR with Varying Speed, Pause Time and Node Density over TCP Connections in VANET", Vol. 2(12), pp. 3915-3955, December 2014.

[5] Jamalia, A. et al., "Scenario Based Pause Time Analysis of AODV, DSDV and DSR over CBR Connections in MANET", vol. 1, no. 1, pp. 57-60, February 2013.

[6] Khattak, M. A. H. et al., "Challenging Ad-Hoc Networks under Reliable & Unreliable Transport with Variable Node Density", Journal of Theoretical and Applied Information Technology, 2008.

[7] Katiyar, S. et al., "Comparative Performance Analysis of MANET Routing Protocols in Military Operations using NS2", International Conference on Green Computing and Internet of Things (ICGCIoT), pp. 603-609, 2015.

[8] Chenna, R. et al., "Performance Analysis of Ad-hoc Network Routing Protocols", ISAUHC, pp. 186-187, 2006.

[9] Gaiwak, L. G. et al., "Simulation based comparative performance analysis of Ad-hoc routing protocols", TENCON- 2008, pp. 1-5, 2008.

[10] Royer, E. M., "A Review of Current Routing Protocols for Ad Hoc Mobile Wireless Networks", University of California, Santa Barbara Chai-Keong Toh, Georgia Institute of Technology, vol. 2, pp. 1-12, 2004.

[11] The Network simulator ns-allinone 2.35, http://www.isi.edu/nsnam/ns.

[12] Dadhania, P., et al., "Comparative performance analysis of AODV and DSR routing protocols in MANET" International Journal of Emerging Trends and Technology in Computer Science (IJETTCS) ISSN: 2278-6856 vol. 1(3), September – October 2012.

[13] Gupta, S. et al., "Performance comparison of routing protocols using different mobility models", IJMECS, vol. 4(8), pp.54-61, August 2012.

[14] Kaushik, S.S. et al., "Comparison of effectiveness of AODV, DSDV and DSR routing protocols in mobile ad hoc networks", International Journal of Information Technology and Knowledge Management, vol. 2,(2), pp.499-502, 2009.

[15] Bharti, M. et al., "Performance Evaluation of Energy Consumption for AODV and DSR Routing Protocols in MANET", IEEE International Conference on Computer & Information Science (ICCIS), pp. 636-642, 2012.

[16] Upadhyaya, S. et al., "comparison and performance analysis of reactive type DSR, AODV and Proactive type DSDV routing protocol for wireless mobile ad-hoc network, using NS-2 simulator", Journal of Engineering and computer innovations, vol. 2(10), pp. 36-47, march 2012.

[17] Taksande, V. K. et al., "Performance Comparison of DSDV, DSR and AODV protocol with IEEE 802.11 MAC for chain topology for MANET using NS-2", 2nd National Conference on computing, communication and sensor network, pp. 26-31, CCSN 2011.

[18] Gupta, A. K. et al., "Review of various Routing Protocols for MANETs", International Journal of Information and Electrical Engineering, vol. 1, no. 4, pp. 251-259, 2000.

[19] Kanungo, P. et al., "Performance analysis of AODV, DSR, OLSR and DSDV Routing Protocols using NS2 Simulator", Procedia Engineering, vol. 23, pp. 229–234, 2011.

[20] Grover, J. T. et al., "Impact of Transmission Range and Mobility on Routing Protocols over ad hoc Networks", International Conference on Computing Sciences, pp. 201-206, 2012.

[21] Saini, Anil et al., "Performance Evaluation of AODV, DSR and DSDV Protocols Based On Network Size & Density of Nodes", International Research Journal of Engineering and Technology (IRJET), Vol. 3(7), pp. 1367-1372, July 2016.

[22] Saini A., Nath R. (2018) Performance Evaluation of AODV and DSR Routing Protocol on Varying Speed and Pause Time in Mobile Ad Hoc Networks. In: Lobiyal D., Mansotra V., Singh U. (eds) Next-Generation Networks. Advances in Intelligent Systems and Computing, vol 638. Springer, Singapore.