Stress-Based Performance Analysis of AODV& DSDV Routing Protocols in MANET

ISSN (e) 2520-7393
ISSN (p) 2521-5027
Received on 26 Feb, 2018
Revised on 25,June, 2018
www.estirj.com

K.H Mohammadani[1], R.A.Khan[2], K.A.Memon[3], N.N. Hussaini[4], J.H Awan[5], R. Kumar[6]

[1]*Department of Computer Science ISRA University Hyderabad Sindh Pakistan*
[2,5]*Institute of Information and Communication Technology, University of Sindh, Jamshoro, Pakistan*
[4]*Institute of Mathematics and Computer Science, University of Sindh, Jamshoro, Pakistan*
[3]*School of Electronic Engineering, Beijing University of Posts and Telecommunications Beijing, China*
[6]*Department of Software Engineering, Mehran University, Jamshoro, Pakistan*

Abstract: A self-configuring network of mobile nodes with colocation capability and connection over wireless without the use of existing infrastructure is known as a wireless mobile ad-hoc network. Main focus of this paper is the analyzing and comparing behavior of ad-hoc on-demand distance vector (AODV) and destination-sequenced distance vector (DSDV) routing protocols. An environment of the mobile ad-hoc network has been simulated where UDP user datagram protocol and CBR traffic is used for purpose of real traffic communication. A duplex mode of communication for stress-based pattern has been simulated using CBR traffic flow to facilitate the actual environment at a certain distance from two locations. Further, the effects of different call durations (call stresses) and node connections on the performance of MANET routing protocols are presented. Simulation results show the AODV is scalable in terms of packet delivery ratio (PDR) and network performance such as network throughput.

Keywords: *MANET, Call stress, Full duplex,UDP, AODV, DSDV.*

1. Introduction

An ad hoc mobile network (MANET) is a collection of mobile telephones that form a temporary network without infrastructure. In such an environment, each node acts as a router and sends packets to the next hop, so packets can reach the destination over multiple hops [1][2]. The role of a routing protocol is very important in MANET implementation because of its dynamic topology. An important issue is a need for MANET routing protocols to react quickly to changes in network topology.

The performance of MANET routing protocols is not much simulated with varying call stressing loads using different applications in different network applications. MANET network with call loads is simulated due to a growing demand for different types of applications in the different situations. These applications demand more requirements service quality with low end-to-end delay[3].

We evaluate the performance of the delivery of the data through multi-hop wireless paths of MANET and study the capacity of the different MANET scenarios and examine the impact of different call loads in the mobile ad-hoc network. To conduct this research, we have taken a realistic two separate department buildings of the University of Sindh. Building A and building B where building A is (IICT building) and Building B is (IMCS building), where nodes situated two different buildings with a distance and bearing different load (stress) and we have observed their performances proving that which protocol will be better for such situation. The captured google image of our scenario is in figure.1

Figure.1. Two Departments of University of Sindh (IICT &IMCS) captured via Google Earth

This research article is structured as follows. Section 2 provides literature of the research on MANET, In Section 3, the network model and the configuration parameters for the simulation is presented. The results and discussions are highlighted in section 4, followed by the conclusion and references in section 5.

2. Related Work

Network nodes use routing protocols to find the path source to destination. Routing protocols are categorized into two main categories. E.g. Topology based and Position based. This paper presents topology based routing protocols which are further distributed into a proactive family such as

Corresponding author Email address: *khalid.mohammadani@gmail.com*

DSDV and reactive family such as AODV routing protocols[4].

DSDV uses the Bellman-Ford algorithm[5]. The order of the individual entries in the routing table has a number even or odd. Compared to the routing information protocol (RIP), an additional attribute is inserted into the routing table. The feature ensures a new series of loop-free. The routing table for each node contains a list of all nodes. To observe the routing table for the nodes maintains a periodic update of the routing table. In this way, the mobile node announces its routing information by sending a packet routing update the table[6].

AODV is a routing protocol for MANET related with the proactive family of routing protocols[7]. The route determination method is available upon request from the source to the destination node for the data packet. Remembers the routing path until the transfer is finished. AODV uses four types of control messages (e.g. route request, route response error and hello) to discover, update and maintain the routing path. The closest nodes update their routing table with help of RREQ and RREP messages. The routing table of source nodes to create a reverse route entry. When the nodes move to break the links of next hop, it leads to disconnections. Routing tables are updated to link errors and messages RERR informs all active neighbors.

Several performance evaluations of MANET routing protocols using simplex way of UDP/CBR application are covered[8] in previous literature taking into account various parameters such as data rate, packet size random and static call duration as network load for the limited scenarios.

In[9], simulation of CBR application was done over the UDP under various MANET routing protocols e.g. AODV, DSR, and DSDV. They simulated simplex mode of application for varying network size and compare network overhead load where DSR did not perform very well but AODV and DSDV presented their valuable status. Their results showed that DSDV was very effected in term of delay due to the mobility of components of MANETs. Finally, they suggested that AODV routing protocol was stable in all situation.

Authors analyzed the behavior of MANET routing protocols under two transport layer protocol like user datagram protocol (UDP) and Transmission Control Protocol (TCP) using variable bit rates in[10]. They selected AODV, DSDV and AOMDV routing protocols. Simulations are done in discrete event simulator NS2. The main attention of work is to analyze the behavior with a variation of a number of nodes. For results, the performance is analyzed with the quality of service parameters such as end-to-end delay, pdr and network throughput. From their results, it was showed that reactive nature of protocols response positively with the association of UDP agents as compared to TCP while proactive nature encouraging results with TCP.

In[11] authors analyzed the CBR application in single channel and multichannel (P-MAC) over AODV routing protocol in simplex mode. They measured jitter, delay, throughput, and packet drop ratio as the quality of service metrics in different case studies using CBR traffic. They suggested that the parallel media access control (P-MAC) might enhance performance for multichannel in MANET.

In our previous work[12], we analyzed the behavior of MANET routing protocols AODV, AOMDV, DSR and DSDV under vehicular ad-hoc network using different UDP/CBR traffic loads in a simplex way. Where various mobility speeds of vehicular nodes were observed. Based on results; we suggested that the AODV performed the best in the network delivering maximum packets and maintains the quality throughput, whereas DSDV produces results supporting a minimum delay. And we also observed the very poor performance of DSR.

In this work, the analysis of MANET routing protocols is based on duplex communications between network nodes at constant bit rate (CBR), like audiocalls. Stress to the routing protocol is posed by establishing duplex communication among nodes at random instants of time and for random duration during the total simulation time span. To the best of our knowledge, the usage of multiple call stress with full duplex mode has not been used in literature and is a part of our contribution in MANET scenarios.

3. Methodology

3.1 Simulation setup and performance metrics

We have simulated our scenarios in network simulator (NS2)[13]. NS2 is one of the open source simulators and wider used by many researchers. It is available for Windows, Linux, and Mac OS X. It supports popular network protocols AODV, DSDV, DSR, RIP and DV to support the results of the simulation of wired, wireless and hybrid wireless networks[14]. To conduct this research, a realistic scenario of two departments of university of Sindh were adopted as mentioned. The realistic scenario was captured via google earth map.

The following table shows the simulation parameters that are used to conduct this research.

Table 1: Simulation Parameters and Settings

Simulation Parameters	Settings
# Nodes	98
Environment Area Size	1000 m X 1000 m
Antenna type	Omni
Ch. Radio Propagation	Two Ray Ground
Agent	UDP
Routing protocols	AODV, DSDV
Simulation time	300 sec
Traffic source	CBR
Call stress load	Call-60, Call-90, Call-120
Call talk time/Call gap time	60/240,90/210,120/180
Packet size	160 Bytes
Data rate	16 Kbps

To simulate mobile wireless network environment, we have used full duplex communication stress pattern which is

created by communication generator software[15]. It is written in Pascal language. It includes on a number of source-nodes, the number of destination-nodes, average call-time, average silent (gap) time, source agents, sink agents, applications with packet size, data rate simulation time. All features of traffic generator are shown in figure.2. After filling needed fields, it generates TCL code of communication that is usable in network simulator (NS2).

The network contains 98 nodes, for variation we select 20, 40, 60 and 80 active nodes in the scenario, half of them are senders and half of them are receivers. Figure. 3 presents the simulation setup of the system in network simulator (NS2).

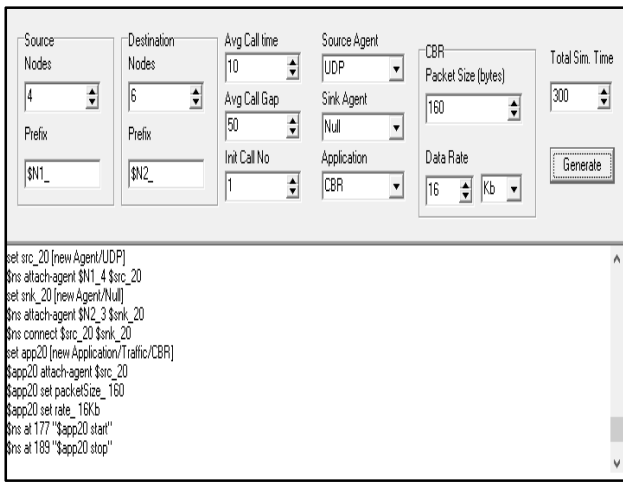

Figure.2. Traffic generator tool

Where two specifics group of nodes are presenting and there are some other forwarding nodes presenting between both groups to make possible connectivity of both groups using their routing ability of MANET.

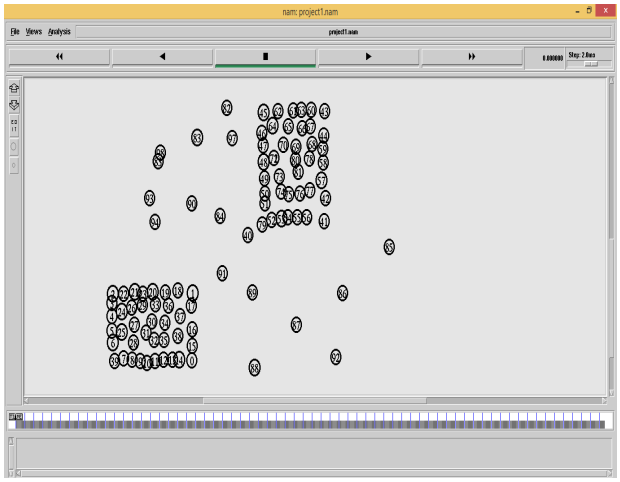

Figure.3. Simulation Setup for System Design in Network Simulator (NS2).

4. Results and Discussion

We measure two quality of services parameters e.g. network throughput and packet delivery ratio for analyzing the routing protocols Results and discussion of every metric are presented as following.

4.1 Throughput Analysis

Receiver receives the total amount of data packets in unit time, called network throughput. Figure. 4, and Figure. 5 are related to network throughput. From the graph, it is observed that performance of AODV routing protocol is higher than the DSDV routing protocol. DSDV tried to deliver more and more data as number of connections increased but it failed to deliver more amount of data than the AODV in all scenarios. In fact, DSDV creates and uses the predefined routes that is main reason it could not deliver more data due to its natural effect.

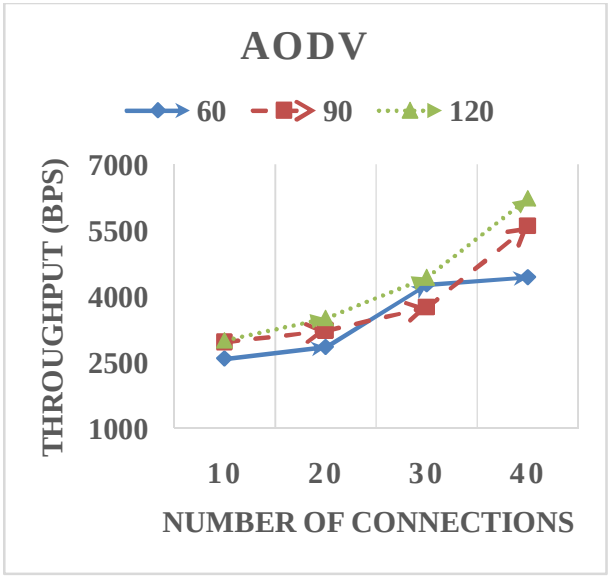

Figure.4. AODV – Throughput versus Number of Connections

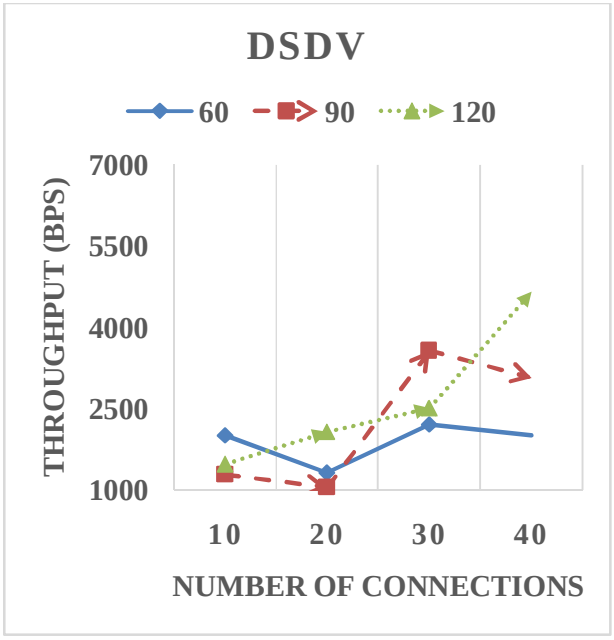

Figure.5. DSDV – Throughput versus Number of Nodes

4.2Packet Delivery Ratio Analysis

Source nodes generate CBR data packets for communication traffic, PDR is a ratio of generated data packet to receiver packets. From Figure. 6, and Figure. 7,

the PDR shows for AODV and DSDV under different connections. The DSDV does not deliver the more packets in overall scenarios. DSDV increases at initial stage when call-stress 120 but connections are lesser. As connections increase the DSDV decreases its position due high stress condition because as compare to last connection were lesser at point 20. But at the point 40 more connections are communication and send more data.

As compare to DSDV, the AODV maintains its position and delivers more packets. Initially AODV decreases at point 20 and 30 due to lesser communicating paths and drops more packet. As AODV gets more connection and communicating path it again stables its position and deliver more CBR packets.

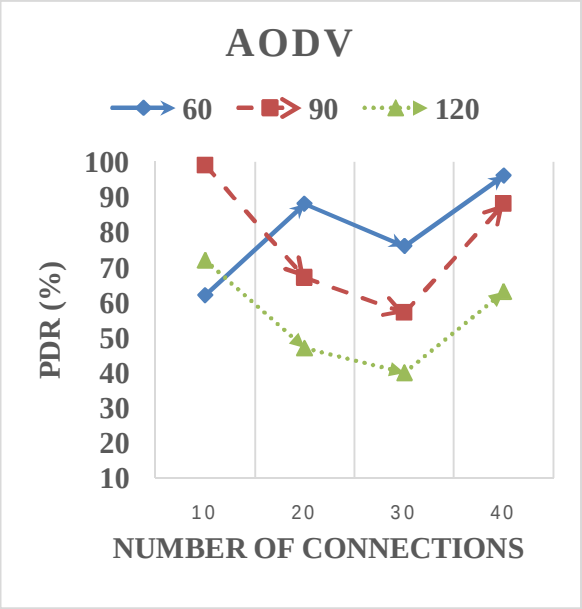

Figure.6. AODV – PDR versus Number of Connections

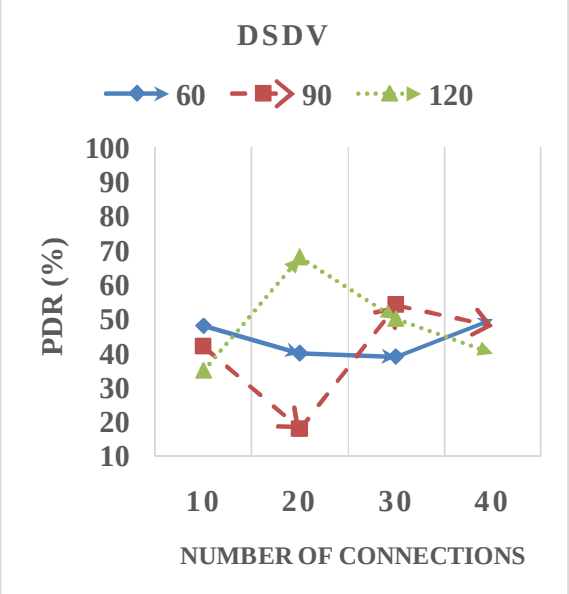

Figure.7. DSDV – PDR versus Number of Nodes

5. Conclusion

We have simulated a real-time scenario and used different stress levels to the analysis of AODV & DSDV routing protocols in MANET. To conduct this study, we designed a practical scenario based on two departments of University of Sindh IICT and BCS. The call load of duplex mode generated by our native call/stress generator. With respect to, Packet Delivery Ratio (PDR) and network throughput, the performance of AODV is much better than DSDV but a rare disturbance in performance is observed in middle call load/stress. DSDV shows rare improvement in high call loads/stress but remains below than AODV. DSDV needs more time to develop routing paths, it is main reason that DSDV poorly performed. On another hand, AODV does not construct its routing table hence, forwards data to neighboring nodes and so on. In the current research, we analyzed the voice traffic with duplex communication. We will simulate video traffic using exponential or VBR applications instead of CBR application with UDP for real-time communication in duplex mode in the future.

References

[1] K. H. Mohammadani, H. Kazi, I. Channa, and D. Vasan, "A Survey on Integrated Wireless Network Architectures," *Int. J. Comput. Appl.*, vol. 79, no. October, pp. 4–9, 2013.

[2] K. H. Mohammadani, S. Abbasi, N. A. Memon, Z. A. Bhutto, and I. R. Memon, "Simulation Analysis of Routing Protocols in Hybrid wireless network," *Sindh Univ. Res. Journal-SURJ (Science Ser.*, vol. 50, no. 1, pp. 165–170, 2018.

[3] T. Liang, Y., Zheng, Y., Ren, J., & Li, "End-to-End Delay in Multi-Hop Wireless Networks With Random Relay Deployment," in *International Conference on Computing, Networking and Communications (ICNC)*, 2018, pp. 513–517.

[4] A. Shaikh, D. Vasan, and H. Mohammadani, Khalid, "Performance Analysis of MANET Routing Protocols – A Comparative Study," vol. 83, no. 7, pp. 1–29, 2013.

[5] S. K. Barma, M. K. D., Chowdhuri, R., Roy, S., & Sen, "Comparison of Performance Metrics of ModAODV with DSDV and AODV.," in *In Proceeding of International Conference on Intelligent Communication, Control and Devices*, 2017, pp. 105–112.

[6] K. Zafar, S., Tariq, H., & Manzoor, "Throughput and Delay Analysis of AODV, DSDV and DSR Routing Protocols in Mobile Ad Hoc Networks.," *Int. J. Comput. Networks Appl.*, vol. 3, no. 2, pp. 1–7, 2016.

[7] M. Gupta, S., Dhaliwal, B. S., Malhotra, R., & Kumar, "Enactment Evaluation of Hybrid Routing Protocol and Comparison with Aodv and Olsr Protocols.," *Int. J. Appl. Eng. Res.*, vol. 12, no. 5, pp. 793–796, 2017.

[8] M. N. Karthikeyan, B., Ganesh, S. H., & Kanimozhi, "Security Improved Ad-Hoc on Demand Distance Vector Routing Protocol (SIm AODV).," *Int. J. Inf. Sci. Comput.*, vol. 10, no. 2, 2016.

[9] I. S. K. Payal, "Tcp traffic based performance

investigations of DSDV, DSR and AODV routing protocols for manet using ns2," *Int. J. Innov. Technol. Explor. Eng*, vol. 3, no. 2, pp. 2278–3075, 2013.

[10] S. Abbasi, K. H. Mohammadani, S. Shah, and R. H. Shah, "Performance Analysis of MANET Routing Protocols with UDP and TCP under VBR traffic," *SindhUniv. Res. Jour. (Sci. Ser.)*, vol. Vol. 47, no. 4, pp. 787–792, 2015.

[11] M. Morshed, M., Rahman, M. U., & Islam, "An Empirical Study of UDP (CBR) Packet Performance over AODV Single & Multi-Channel Parallel Transmission in MANET," *arXiv Prepr. arXiv*, p. 1109.6502, 2011.

[12] S. Abbasi, K. H. Mohammadani, Z. Hussain, J. H. Awan, and R. H. Shah, "Evolution of V2V Routing Protocols In Realistic Scenario of National Highway NH-5 Pakistan," *Sci. Int.*, vol. 28, no. 5, pp. 4711–4714, 2016.

[13] K. H. Mohammadani, S. Faizullah, A. Shaikh, N. N. Hussaini, R. A. Khan, and C. Technology, "Empirical Examination of TCP in MANET," *Eng. Sci. Technol. Int. Res. J.*, vol. 1, no. 2, pp. 22–27, 2017.

[14] K. H. Mohammadani, H. Kazi, A. Shaikh, I. Channa, and S. Faizullah, "A Comparison of Homogeneous vs Heterogeneous Choice of Routing Protocols in Integrated Wireless Networks," *Eng. Sci. Technol. Int. Res. J.*, vol. 1, no. 3, pp. 44–50, 2017.

[15] "NS2 Traffic Genrator." [Online]. Available: https://github.com/khalid-mohammadani/NS2.

About Authors

Khalid Hussian Mohammadani is a Computer Science Professional with over five-year experience in teaching networking, programming in C, Web development and other CS and Telecommunication courses. His area of interest includes wireless sensor network, mobile ad-hoc network and hybrid wireless network, security of mobile adhoc wireless network, image processing and Radio over Fiber technology. He worked as a trainer in two workshops of Network Simulator NS2 that held by Department of Telecommunication, Mehran University, Jamshoro, and Sindh. He has served as reviewer in 37th and 38th IEEE Sarnoff Symposium Newark and wireless personal communication (WPC) journal. He obtained his BS in Telecommunication from University of Sindh, Jamshoro, and Sindh, Pakistan in 2008. He also received M. Phil. Degree in Computer Science from Isra University, Hyderabad, and Sindh Pakistan in 2015. At present, he is pursuing Ph.D. in Computer science at Isra University Hyderabad, Sindh, Pakistan.

Rahat Ali Khan received his BS Electronics, MBA Finance and M. Phil Telecommunications from University of Sindh Jamshoro in 2005, 2012 and 2016 respectively. He is enrolled in Ph.D. in Information Technology at the Institute of Information and communication Technology University of Sindh Jamshoro, Pakistan. He is working as an Assistant Professor at the Institute of Information and Communication Technology University of Sindh Jamshoro, Pakistan since 2018. His research interests include Wireless Sensor Networks, Wireless Body Area Sensor Networks and Underwater Acoustic Sensor Networks.

Kamran Ali Memon received his Bachelor in Electronics degree (2009) from Mehran University of Engineering Technology, Jamshoro Pakistan, and Masters in Communication (2015) from Quaid-e-Awam UEST Nawabshah Pakistan. He worked as a Lecturer/Assistant Professor in QUEST Pakistan for 07 years. Currently, he is working toward his Ph.D. at State Key Laboratory of Information Photonics and Optical Communications (IPOC), Beijing University of Posts and Telecommunications, China. His research interests include optical and Wireless communications, PONs, Radio over fiber and WSNs.

Nazish Nawaz Hussaini works as Assistant Professor at Institute of mathematics and computer science, university of Sindh, Jamshoro, Pakistan. She has completed her PhD from ISRA University Hyderabad, Sindh, Pakistan. Her research interests in wireless ad Hoch network, multicast wireless ad Hoch networks and WSNs.

Jawad Hussain Awan is a member of IFIP WG 9.10 -ICT Uses in Peace and War. He is PhD Research Fellow, in Institute of Information and Communication Technology at University of Sindh, Pakistan. His research interests are Cyber security, Information Security, e-Governance, e-Democracy, Security challenges in Information Systems and Wireless Body Area Networks. He published his research in several national and international research journals. Mr. Awan attended and presented his research in national and international conferences. He is not only the member of Editorial Review Board of International Journal of Cyber Warfare and Terrorism (IJCWT) Journal but also reviewer of various reputable HEC recognized national and international journals such as Elsevier Journal of Informatics, IJCSNS, and IJCWT. He is also Microsoft Certified Professional in Web

Programming.

Engr. Rajesh Kumar is a software Engineer and M.E scholar with two years' experience in teaching at Undergraduate level. Currently, he is serving as a teaching assistant in the department of software engineering at Mehran University Jamshoro. He is also working SQA engineer at Basecamp data solution Hyderabad, Sindh, Pakistan.