International Journal of Engineering and Technical Research (IJETR)
ISSN: 2321-0869 (O) 2454-4698 (P), Volume-3, Issue-9, September 2015

A Survey on Performance Ascertainment of MANET Routing Protocols Using NS-2

K. Gowri Raghavendra Narayan, N. V. Ramana Gupta, Dr. M.V. Rama Krishna

***Abstract*— A mobile ad-hoc network (MANET) consists of wireless mobile nodes. The communication between these mobile nodes is carried out without any centralized control. MANET is a self-organized and self-configurable network where the mobile nodes move arbitrarily. The mobile nodes can receive and forward packets as a router. In this survey we compared the performance of four MANET routing protocols DSDV, DSR, AODV and TORA using the metrics like throughput, packet delivery ratio (PDR), delay, normalized routing load (NRL) and energy. We compared the performance of TCP agents against DSDV, DSR and AODV. The performance differences are analysed basing on varying simulation time and the number of nodes. These simulations are performed on NS-2 network simulator.**

***Index Terms*—MANET, AODV, DSDV, DSR, TORA, throughput, packet delivery ratio, delay, normalized routing load, TCP agents, NS-2**

I. Introduction

An autonomous system of mobile hosts connected by wireless links, often called Mobile Ad hoc Networks (MANETs) got outstanding success as well as tremendous attention due to its self-maintenance and self-configuration properties or behavior. The communication between the mobile nodes takes place within their radio ranges. The following figure 1.1 shows the radio ranges of the three mobile nodes S, I and D the dotted circles are the radio ranges of communication of the nodes. The mobile nodes act as packet data transmitters and as well as routers. If the range of destination node (D) from source node (S) is outside the communication radio range it uses intermediate node (I) for communication.

A. Classification of MANET Routing Protocols

The figure 1.2 represents the classification of MANET routing protocols, it has three types of routing namely Proactive, Reactive and Hybrid.

Many of the performance comparisons have been made on the MANET routing protocols DSDV, AODV, and DSR. But in addition to these there routing protocols with the metrics throughput, packet delivery ratio, end-to-end delay, normalized routing load, energy, simulation start time, simulation end time etc. the performance of the TORA is also analyzed in our survey. And also we have compared and analyzed the performance of AODV, DSDV and DSR by changing the TCP agents.

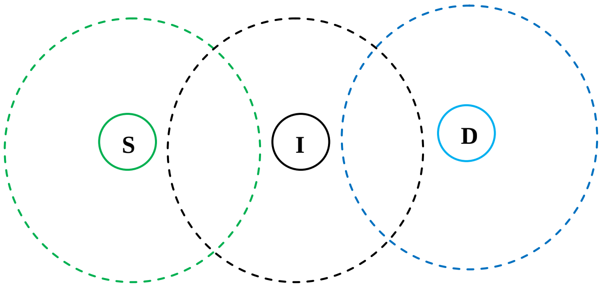

Figure 1.1: MANET Communication Ranges

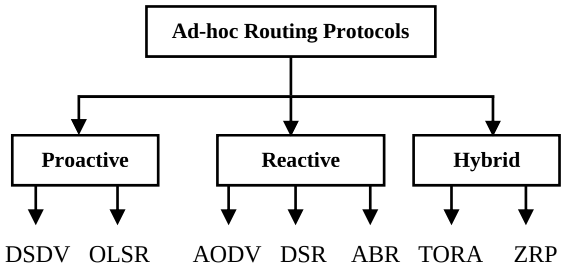

Figure 1.2: Classification of MANET Routing Protocols

The remaining paper is organized as Section II briefly illustrates the literature survey, section III describes the performance metrics section IV different types of TCP Agents, and section V simulation tool , simulation comparisons and results are depicted in section VI, and section VII concludes the paper.

II. Literature Survey

Narendra Singh Yadav et al proposed Performance Comparison and Analysis of Table-Driven and On-Demand Routing Protocols for Mobile Ad-hoc Networks [1]. In their work they examined two routing protocols for mobile ad hoc networks the Destination Sequenced Distance Vector (DSDV), the table- driven protocol and the Ad hoc on-Demand Distance Vector routing (AODV), an On demand protocol and evaluated both protocols based on packet delivery fraction, normalized routing load, average delay and throughput while varying number of nodes, speed and pause time. D. Manjunatha et al proposed Performance Study of AODV with Variation in Simulation Time and

K. Gowri Raghavendra Narayan, M.Tech Student of Dept. of Computer Science & Engineering, P. V. P. Siddhartha Institute of Technology (Autonomous), Vijayawada, Andhra Pradesh, India. Mobile No: +91 9705409393
N. V. Ramana Gupta, Asst. Professor, Dept. of Computer Science & Engineering, P. V. P. Siddhartha Institute of Technology (Autonomous), Vijayawada, Andhra Pradesh, India. Mobile No: 9849578292.
Dr. M.V. Rama Krishna, Professor & Head of Dept. of Computer Science & Engineering, P. V. P. Siddhartha Institute of Technology (Autonomous), Vijayawada, Andhra Pradesh, India., Mobile No: 9440672590

Network Size [2]. In their work the effect of network size and simulation time on the performance of AODV routing protocol under 802.11 is analyzed. Qualnet Network Simulator is used to study the performance of the protocol with the metrics such as packets delivered, throughput, end-to-end delay and jitter. The results are compared for the networks without and with mobility of nodes. Mohammed Bouhorma et al proposed Performance comparison of ad-hoc routing protocols AODV and DSR [3]. In their work They have done the performance comparison between two reactive routing protocols for mobile ad hoc networks: Dynamic Source Routing (DSR), Ad Hoc On demand distance Vector (AODV).Both protocols were simulated using the tool NS-2 and were compared in terms of packet loss ratio, end to end delay, with mobile nodes varying number of nodes and speed. V. Rajesh kumar et al proposed Comparative Study of AODV, DSDV and DSR Routing Protocols in MANET Using Network Simulator-2 [4]. In their work they have made performance comparison and study of reactive and proactive protocols AODV, DSR and DSDV based on metrics such as throughput, control overhead, packet delivery ratio and average end-to-end delay by using the NS-2 simulator. Sachin Kumar Gupta et al proposed Performance Metric Comparison of AODV and DSDV Routing Protocols in MANETS Using Ns-2 [5]. In their work the performance of AODV and DSDV routing protocol have been evaluated for Mobile Ad-hoc Networks (MANETs) in terms of throughput, the average end to end delay, jitter and drop etc. the simulation results were analyzed in graphical manner and trace file based on Quality of Service (QoS) metrics: such as throughput, drop, delay and jitter.

III. Performance Metrics

There are different types of parameters to evaluate the performance of the routing protocols. The following are the metrics that we have used to know the performance:

A. *Throughput*

It is the rate of successfully transmitted data packets in a unit time in the network during the simulation [7]. It is represented in bps or kbps and is calculated using awk script by processing the trace file which then produces the result.

Throughput=Received_Data*8/DataTransmissionPeriod

B. *Packet Delivery Ratio-PDR*

The PDR can be defined as the ratio of the number of packets received and number of packets sent from between source and destination [8]. It is also called as packet delivery fraction (PDF). Highest PDR value indicates the good performance.

∑ Number of packet receive / ∑ Number of packet send

PDR = (received packets/sent packets) * 100

C. *Normalized Routing Load-NRL*

NRL can be defined as the number of routing packets transmitted per data packet delivered to destination [9].

NRL = (Number of Routing Packet)/ (Number of Packet Received)

D. *End-to-End Delay*

It can be defined as the average time taken for data packet to arrive at destination. It may also include the route discovery delay and data packet transmission queue. The successfully delivered data packets to the destinations are counted [8]. The better performance of protocol only occurs if the delay is lower.

∑ (Arrive_time – Sent_time) / ∑ No. of connections

E. *Energy*

It will gives the energy consumed by the routing protocol for the communication process i.e., packet transmission. It is calculated in two types; the first one is the total energy and second is average energy.

Total Energy= (Initial Energy) – (Final Energy)

Average Energy = (Total Energy) / n

Where n is the number of nodes. The average energy is reduced with the increasing the number of nodes. Therefore

$$\text{Average Energy} \propto 1/n$$

IV. TCP Agents

TCP agents are of two types , One-way agents and a two-way agent; One-way agents are subdivided into a set of TCP senders and TCP receivers. The two-way agent is symmetric in the sense that it represents both a sender and receiver [10].

One-way TCP sending agents:

- TCP –a Tahoe TCP
- Reno – similar to Tahoe but includes fast recovery
- New Reno- similar to Reno but difference in action of receiving new Acknowledgements
- Sack1- it follows selective repeat based on receiver acknowledgements
- Vegas- it is uses TCP congestion avoidance reduces packet loss by delaying packets
- Fack - it implements forward Acknowledgements
- Linux- it uses congestion control algorithms form Linux Kernel

One-way TCP receiving agents:

- TCP Sink- on Acknowledgement per packet
- DelAck – Tcp sink with configurable delay per packet
- Sack1 – selective Acknowledgement Sink
- Sack/DelAck – Sack1 with DelACK

Two-way experimental sender:

- FullTcp- this is new addition to ns-2 and is under development. It supports bidirectional data transfer.

ISSN: 2321-0869 (O) 2454-4698 (P), Volume-3, Issue-9, September 2015

V. Simulation Tool

- NS: stands for Network Simulator.
  Network + Simulator.
- Network:
  A group of connected nodes.
- Simulator:

A program or dedicated device which models some aspects of real life in controlled environment. So network simulator is a simulation tool which simulates the network architecture, protocols, and their functioning.

Network Simulator (Version 2), widely known as NS2, is simply an event-driven simulation tool that has proved useful in studying the dynamic nature of communication networks. Simulation of wired as well as wireless network functions and protocols (e.g., routing algorithms, TCP, UDP) can be done using NS2. In general, NS2 provides users with a way of specifying such network protocols and simulating their corresponding behaviors. Due to its flexibility and modular nature, NS2 has gained constant popularity in the networking research community since its birth in 1989. Ever since, several revolutions and revisions have marked the growing maturity of the tool [6] [11] [12].

VI. Simulation Comparisons and Results

At first we compare the performance of the routing protocols AODV, DSDV, DSR and TORA with performance metrics at a time by varying the number of nodes and then we change the TCP Agents and compare the performance of the DSDV, DSR and AODV individually with same metrics by varying number of nodes.

A. Comparison with Performance Metrics

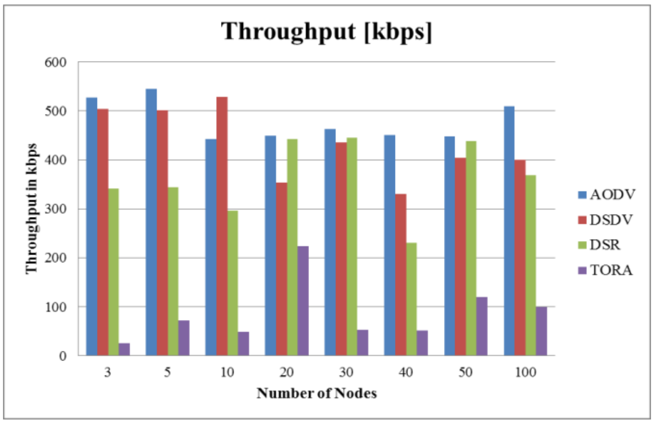

Figure 6.1: Throughput in kbps analysis

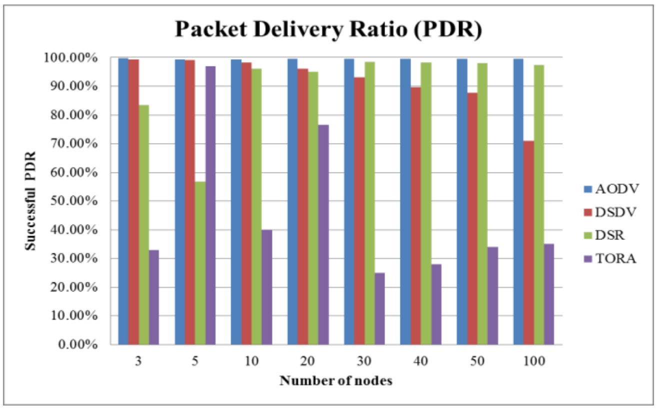

Figure 6.2: Packet delivery ratio(PDR) Analysis

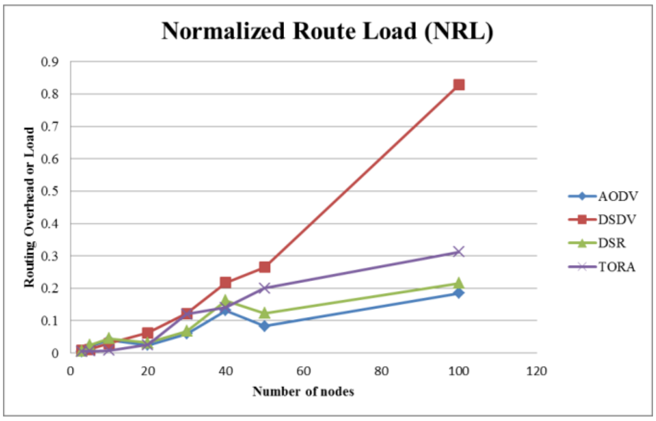

Figure 6.3: Normalized Routing Load(NRL) Analysis

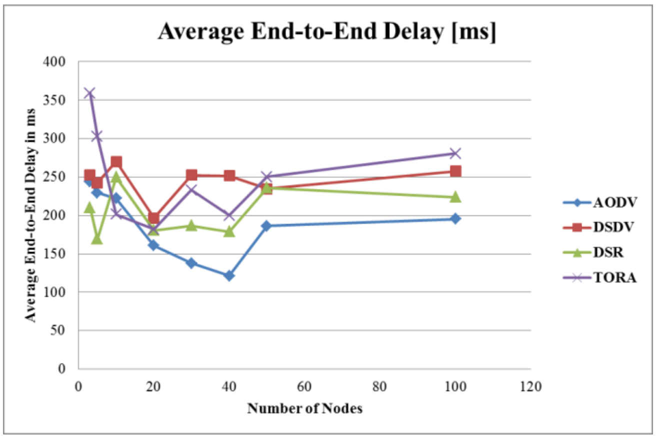

Figure 6.4: Average End-to-End delay in ms Analysis

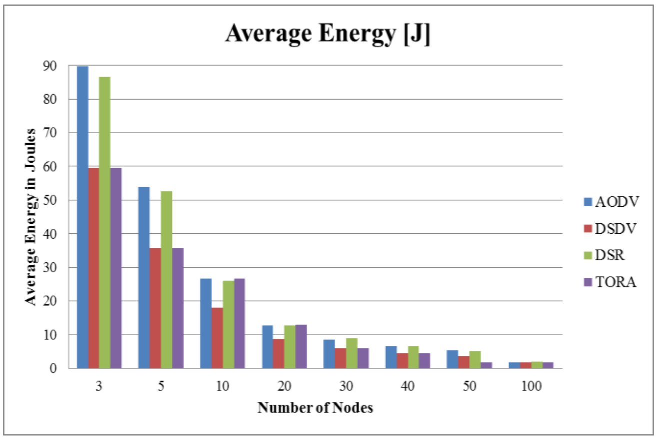

Figure 6.5: Average Energy in joules Analysis

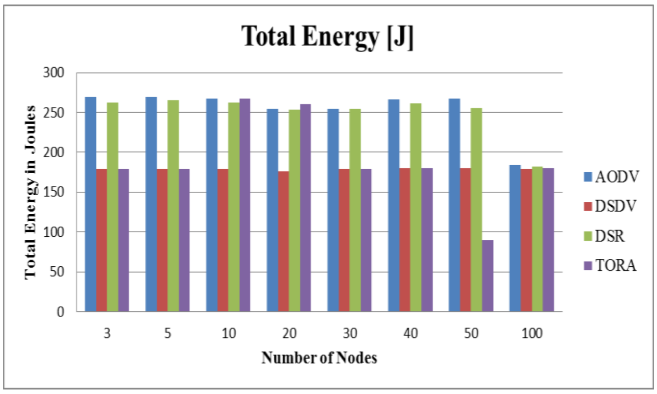

Figure 6.6: Total Energy in Joules Analysis

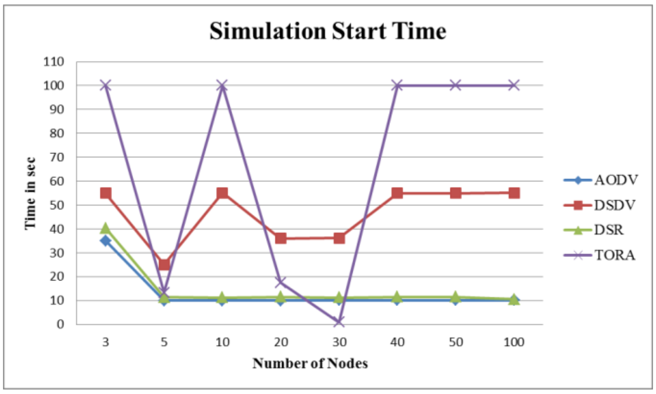

Figure 6.7: Simulation Start time analysis

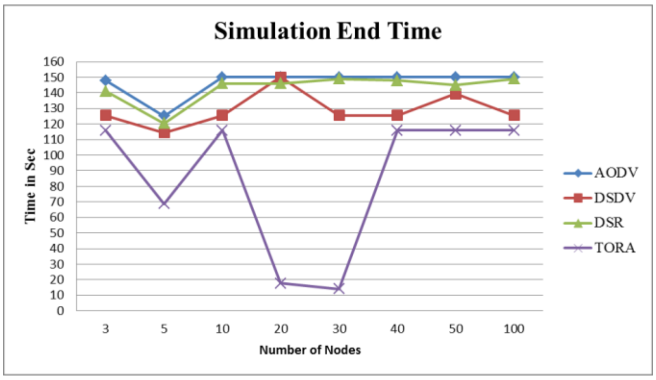

Figure 6.8: Simulation End time analysis

The figure 6.1 shows the throughput comparison of the selected four routing protocols by varying the number of nodes from 3 to 100. It clearly shows that AODV is having overall better throughput than rest of three and the TORA is having least throughput value. The figure 6.2 shows the PDR comparison by varying number of nodes. It clearly shows that as number of nodes increases the performance of all routing protocols is reducing except AODV and DSR but AODV is having more overall PDR than DSR. And as the number of nodes increases the overall PDR of TORA is reducing to least.

The figure 6.3 shows the NRL of all the selected routing protocols, the descending order of NRL of selected routing protocols is DSDV, TORA, DSR and AODV. It clearly shows that the overall performance of AODV is better than other three. The figure 6.4 shows the Average End-to-End delay for the number of nodes from 3 to 100, the TORA having overall highest delay and AODV is having overall least delay, the DSR is slightly similar to AODV.
The figures 6.5 and 6.6 represents the Average Energy and the total energy respectively, both average energy and total energy is mostly consumed by AODV and the DSR is slightly same as AODV. The rest of the two are having less energy consumption.

The figures 6.7 and 6.8 represent the simulation start time and the simulation end time. In that AODV & DSR having less simulation start time and more simulation end time. Compared to these two DSDV having slightly more start time and less end time. But TORA is having more start time and less end time.

B. Performance Comparision with TCP Agents

The figures 6.9, 6.10 and 6.11 represent the throughput, PDR and End-to-End delay comparison of TCP agents with AODV routing protocol respectively. It clearly shows that NewReno TCP is having more overall throughput, PDR value and less delay than the others with increasing the number of nodes. And Vegas TCP is having less throughput value than rest of all. Fack TCP is having less PDR; Linux TCP is having more delay out of all.

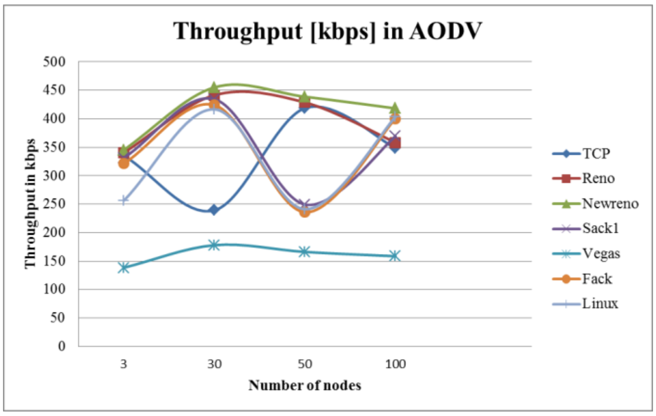

Figure 6.9: Throughput analysis in AODV with TCP Agents

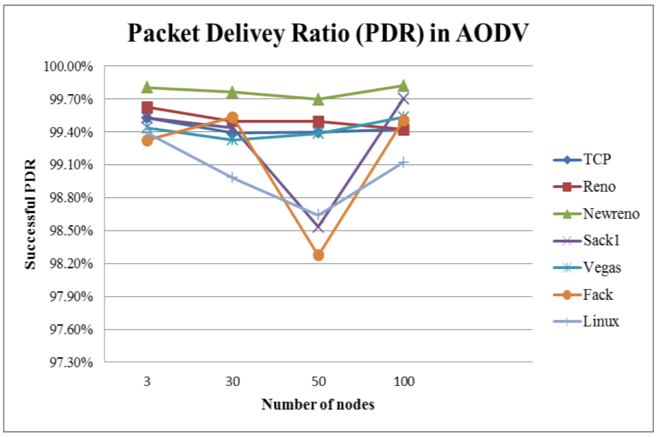

Figure 6.10: PDR analysis in AODV with TCP Agents

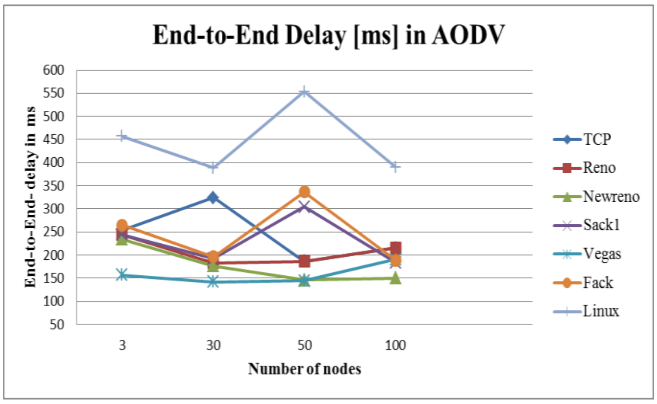

Figure 6.11: E-to-E delay analysis in AODV with TCP Agents

The figures 6.12, 6.13 and 6.14 represent the throughput, PDR and End-to-End delay comparison of TCP agents with DSDV routing protocol respectively. It clearly shows that NewReno TCP is having more overall throughput, PDR value and less delay than the others. And Fack TCP is having less throughput value than rest of all. Sack1 TCP, Vegas TCP, Fack TCP, Linux TCP's are having very less PDR values with the increasing the number of nodes. Except Linux TCP all the agents have almost slight variation with other and the Linux TCP is having more delay with increasing the number of nodes in the network.

The figures 6.15, 6.16 and 6.17 represent the throughput, PDR and End-to-End delay comparison of TCP agents with DSR routing protocol respectively. It clearly shows that NewReno TCP is having more overall throughput, PDR value and less delay than the others. Vagas TCP is having very less throughput value with increasing the number of nodes. Except Linux TCP all the agents having slight variation in PDR and Linux TCP is having less PDR compared to others with the increse of number of nodes. In the end to end delay with DSR at the initial point the Vegas TCP is having very less delay and Linux TCP is having more delay than others with the increase of number of nodes.

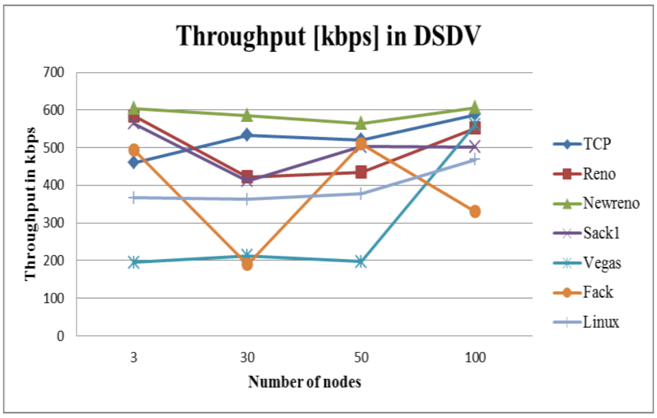

Figure 6.12: Throughput analysis in DSDV with TCP Agents

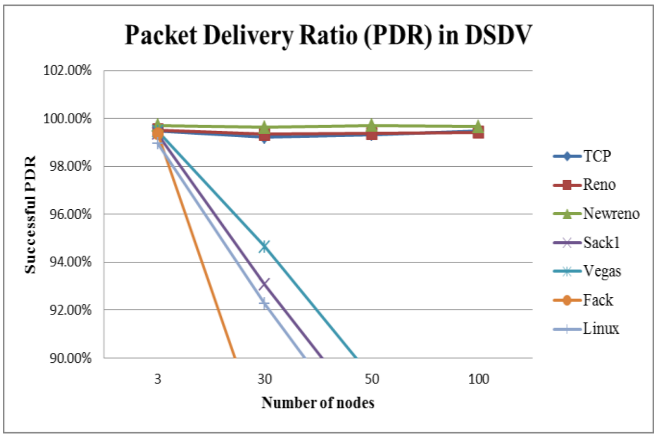

Figure 6.13: PDR analysis in DSDV with TCP Agents

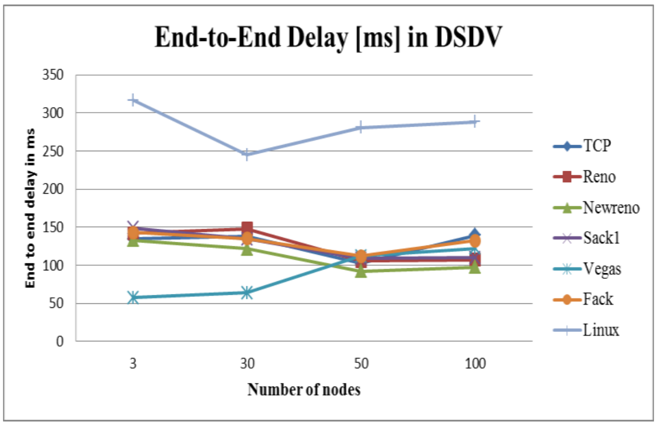

Figure 6.14: E-to-E delay analysis in DSDV with TCP Agents

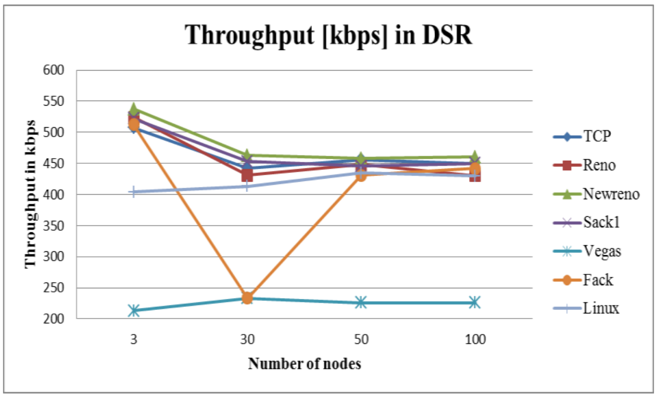

Figure 6.15: Throughput analysis in DSR with TCP Agents

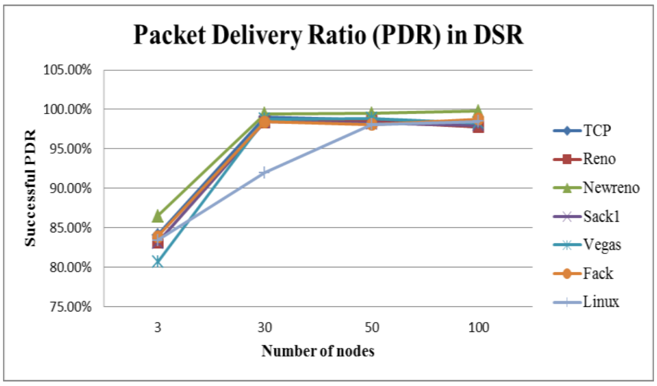

Figure 6.16: PDR analysis in DSR with TCP Agents

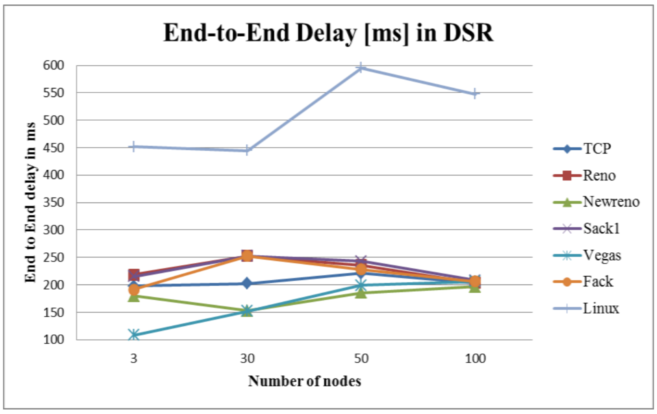

Figure 6.17: E-to-E delay analysis in DSR with TCP Agents

VII. CONCLUSION

Our survey illustrates the performance comparison of the MANET routing protocols DSDV, DSR, AODV and TORA. We have made the simulations with above explained performance metrics by changing the number of nodes in the network, TCP agents. We analyzed the results individually and we infer that the overall performance of the AODV is better when compared with the DSDV, DSR, and TORA with the taken metrics along with the variability of TCP agents. After AODV, the DSR is having better performance against others. The NewReno TCP agent is giving better results compared Tahoe, Reno, NewReno, Sack1, Vegas, Fack and Linux.

ACKNOWLEDGMENT'S

The authors would like to thank the Department of Computer Science & Engineering of Prasad V. Potluri Siddhartha Institute of technology (Autonomous), Vijayawada, Andhra Pradesh, India, for allowing us to explore this interesting area.

REFERENCES

[1] Narendra Singh Yadav & R.P.Yadav. "Performance Comparison and Analysis of Table-Driven and On-Demand Routing Protocols for Mobile Ad-hoc Networks" World Academy of Science, Engineering and Technology Vol:2 2008-12-28, 2008.

[2] D. Manjunatha M. T. Somashekara Archana K.S and S. Ravishankar, "Performance Study of AODV with Variation in Simulation Time and Network Size" , in IJARCSSE, Volume 4, Issue 9, September 2014

[3] Mohammed Bouhorma, H. Bentaouit and A. Boudhir, "Performance comparison of ad-hoc routing protocols AODV and DSR", IEEE Conference, April 2009, DOI: 10.1109/MMCS.2009.5256641.

[4] V. Rajesh kumar, P. Siva kumar "Comparative Study of AODV, DSDV and DSR Routing Protocols in MANET Using Network Simulator-2" in IJARCCE, Vol. 2, Issue 12, December 2013

[5] Sachin Kumar Gupta, R. K. Saket, "Performance Metric Comparison of AODV and DSDV Routing Protocols in MANETS Using Ns-2" in IJRRAS, June 2011

[6] "NS Simulator for Beginners", written by Eitan Altman and Tania Jiménez, 2011. e-book, ISBN: 9781608456932

[7] Miss Anjali Sharma, Prof. Alpna Singh, "Improvement in Routing Behavior of AODV Protocol in MANET", in IJARCET, Volume 2, Issue 12, December 2013.

[8] Packet Delivery Ratio, Packet Lost, End To End Delay. http://harrismare.net/2011/07/14/packet-delivery-ratio-packet-lost-end-to-end-delay/

[9] [ns] jitter NRL PDF throughput end to end delay, http://mailman.isi.edu/pipermail/ns-users/2007-July/060690.html

[10] TCP Agents, http://www.isi.edu/nsnam/ns/doc/node387.html

[11] "Introduction to Network Simulator-2" second edition, written by T. Issariyakul et al 2012.

[12] Network simulator" http://www.isi.edu/nsnam/ns/, and https://www.nsnam.org .

Mr K. Gowri Raghavendra Narayan, Received his B.Tech degree in Computer Science & Engineering from Jawaharlal Nehru Technological University Kakinada, Andhra Pradesh. And he is currently pursuing M.Tech Degree in Computer Science & Engineering in Prasad V. Potluri Siddhartha Institute of Technology (Autonomous) Vijayawada, Andhra Pradesh, India and is affiliated to Jawaharlal Nehru Technological University Kakinada, Andhra Pradesh. His area of research includes Computer Networks. He is a student Member of ACM.

Mr. N. Venkata Ramana Gupta have been working as Assistant Professor in the Department of Computer Science and Engineering Prasad V. Potluri Siddhartha Institute of Technology(Autonomous) Vijayawada, Andhra Pradesh and is affiliated to JNTU-K, Kakinada,. He obtained M.Tech (Computer Science and Technology with specialization in computer Networks) from Andhra University College of Engineering, Visakhapatnam, AP. He had more than 15 Years of teaching experience. He had published 4 research papers in various International Journals. His areas of interest are Computer Networks, Distributed Systems. He is member of ACM and ISTE.,Ph.No:9849578292

Dr. M.V. Ramakrishna has been working as Professor & Head, Department of Computer Science & Engineering, Prasad V. Potluri Siddhartha Institute of Technology (Autonomous) Vijayawada, Andhra Pradesh and is affiliated to Jawaharlal Nehru Technological University Kakinada, Andhra Pradesh. He obtained B.Tech, M.Tech and Ph.D. from NIT- Suratkal, Jawaharlal Nehru Technological University, Hyderabad and Acharya Nagarjuna University, Guntur respectively. He has 23 Years of Teaching and 4 Years of Industry Experience. He had published 8 research papers in various International Journals and conferences. His areas of research include Computer Networks and Distributed Systems. He is a Member of ACM and IEEE Computer Society.