Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 02, February-2016

Simulation based Performance Comparison of Reactive and Proactive Routing Protocols of MANET Under CBR and TCP Traffic Model

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Abstract **- MANETS are connected and established between mobile nodes temporarily for a short period of time for the purpose of sharing information and exchanging messages among the source and destinations nodes. Since the length is normally very small therefore maximum throughput is necessary in order to exploit the entire communication period. Nodes which are part of this network behave both as the host and the router for the other communicating nodes. The main purpose of this research work is to simulate and analyzed the performance of proactive and reactive routing protocols of MANET under TCP and CBR traffic. In this work we have simulated and compared the performance of the three common and well known MANET routing protocols. We have use DSR and AODV as reactive routing protocols, DSDV as proactive routing protocols. Belligerent research in this area has been done since then with famous studies on Dynamic Source Routing, Ad hoc on demand Distance Vector and Destination Sequenced Distance Vector routing protocol. The simulations are performed and completed using Network Simulator version 2.35(NS-2.35) and the post analyses are performed by using awk script. To simulate and analyze the performance of the above routing protocols we have used Packet Delivery Ratio, Number of Packets Dropped and Throughput performance evaluation metrics. After simulating, measuring and analyzing the performance of thus routing protocols we are explore the effect of change in number of nodes on MANET reactive and proactive routing protocols.**

It has been observed from the simulation part Reactive protocols (AODV and DSR) are better than proactive routing protocols (DSDV) in terms of packet delivery ratio and throughput in case of both traffics i.e. TCP and CBR. But in the case of number of dropped packets of both 50 and 100 nodes with pause time shows that proactive routing (DSDV) have less number of dropped packets with TCP traffic.

Keywords: MANET, Routing Protocol, CBR, TCP, AODV, DSR, DSDV, Simulation, NS-2.35

I. INTRODUCTION

MANETs are self-governing and decentralized wireless systems established without the need of any infrastructure. The utilization of thus wireless technology has become a ubiquitous method to access the Internet or making connection to the local network due to its simplicity and inexpensiveness consumption with a possibility of adding new devices or nodes to the network with a minimum price. Nodes can also connect or departed the network freely and randomly without any limitation or constraints in these types of network.

The Internet Engineering Task Force (IETF) formed a MANET working group with the aim to standardize IP routing functionality appropriate for wireless routing purposes within both static and dynamic topologies in 1996. MANETs are mostly applicable in personal area networks, disaster recovery, informal conference, military operation and communication, forestry area to control the wild life of animals and etc. Generally there are three types of routing protocols in MANET, Proactive, Reactive and Hybrid routing protocol [1]. Proactive routing protocols are also known as Table-driven routing protocols. In these types of routing protocol every node maintains one or more tables representing the whole topology of the network. These tables are updated frequently in order to maintain up-to-date routing information from each node to every other node. To maintain the up-to-date routing information, topology information wants to be exchanged between the nodes on a regular basis, leading to relatively high overhead on the network. On the other hand, routes will constantly be accessible on request. Reactive routing protocols [2] are also called on-demand protocols. These protocols do not attempt to preserve accurate routing information on all nodes at every time. Routing information is collected only when it is desired, and route determination depends on sending route queries throughout the network. The main advantage of this routing protocol is that the wireless channel is not subject to the routing overhead data for routes that may not be used. Hybrid routing is based on the idea of organizing nodes in groups and then assigning nodes different functionalities inside and outside a group [2]. Both routing table size and update packet size are reduced by including in them only part of the network (instead of the whole); thus, control overhead is reduced.

The main problem of this routing protocol is how to deliver packets efficiently to mobile nodes, which is the main objective of thus routing protocols. Consequently routing in mobile ad hoc network is a challenging task due to node mobility. Moreover bandwidth, energy and physical security are limited. In this research work, we have used DSR and AODV routing protocols as reactive routing protocols and DSDV as proactive routing protocols. Belligerent research in this area has been done since then with famous studies on Dynamic Source Routing, Ad hoc on demand Distance

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ISSN: 2278-0181
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Vector and Destination Sequenced Distance Vector routing protocol. The simulation is performed for comparing the performance of reactive and proactive routing protocols under CBR and TCP traffic models The simulations are performed and completed using Network Simulator version 2.35(NS-2.35) and the post analyses are performed by using awk script.. To simulate and analyze the performance of the above routing protocols we have used Packet Delivery Ratio, Number of Packets Dropped and Throughput performance evaluation metrics. After simulating, measuring and analyzing the performance of thus routing protocols we are explore the effect of change in number of nodes on MANET reactive and proactive routing protocols.

II. STATEMENTS OF THE PROBLEM

Since their inauguration within the past decade, MANET has received significant consideration in the world of computer research. A MANET is a growing technology, which offers a cost-effective and scalable method to hook up wireless devices. Recently, this technology has become increasingly fashionable due to its potential application in many areas. For illustration, such a network can be helpful in rescue operations where there is not adequate time or resource to organize a wired network [3]. MANETs are also very useful in military operations where the units are moving around the battlefield in a random way and a central unit cannot be used for organization [4]. Although MANET has been considered as a persuasive candidate for better wireless services, research to attractive its functionality is still in its formative years [5]. In the present years, research has been undertaken with regard to the task of recognizing more appropriate, suitable or proper routing protocols with different traffics models and variants.

In this research we have select two reactive routing protocols AODV and DSR, one proactive routing protocol DSDV which are the most famous and attractive types of routing protocols for simulation and performance comparisons. We choose these as our contestant protocols since they envelop a range of design choices, including source routing, hop-by-hop routing, periodic advertisement, and on-demand route discovery. The choice of these three protocols is also aggravated by the fact that they have been anticipated in the Internet Engineering Task Force (IETF) MANET Working Group. In addition, these protocols supplies loop-free functions as well as responsive routing information in the network.

This research studies the routing performance with respect to traffic patterns under a variety of network situation. In order to evaluate such performance, packet Delivery ratio, number of Packet loss and throughput are considered as performance metrics.

Consequently, the routing in MANET is becoming more complex compared to in a typical wired LAN or ad-hoc network. Likewise, there are other factors like network size, network load, bandwidth and signal strength that affects the performance of the MANET routing protocols. Therefore, a detailed analysis is required in order to gain an insight of these factors that conclude the performance of the routing protocol. More particularly, it would be important to study how the different network parameters and protocols work together, and to what extent each of the individual factors affects the routing performance experimental from the transport layer, i.e., the TCP and CBR.

III. LITERATURE SURVEY

As formerly mentioned, there is a congregation of routing protocols developed for Mobile Ad-hoc Networks; the most popular or common ones are DSDV, AODV and DSR. These protocols do not have comparable properties and their behaviors differ from one network environment to another. For this reason, it becomes indispensable to simulate these protocols in an ideal environment to study and examine how they execute in a particular network. A good number of researches have been carried out almost on each individual protocol; however, there is not much research has been carried out on aspects relating to any comparative analysis of these routing protocols with respect to CBR and TCP traffic models.

Hassan Al-Mahdi et.al.[6] measures and compares the performance of AODV,DSR,AOMDV and DSR Routing protocols on the basis of packet delivery ratio , end to end delay and average throughput with respect to TCP traffic models. This paper is more focus on the impacts of TCP variants on the performance of MANET routing protocols. Hence, they use TCP-Reno, TCP-New-Reno, TCP-Vegas, and TCP-Sack. They examine the behavior of these variants over AODV, DSDV, DSR, and AOMDV routing protocols. The simulation results of this result shows that TCP-Vegas performs better compared with others variants (Reno, New-Reno and Sack1) in the case of end to end delay, and has higher Packet Delivery Ratio. The TCP-Reno has higher average throughput in the case of low data connections compared with TCP-New-Reno, TCP-Vegas and TCP-Sack1. In case of high data connections the TCP-Vegas have the higher average throughput compared with the other variants.

Megha Rastogi et.al.[7] compares the performance of reactive and proactive routing protocols. They used AODV, DSDV and DSR routing protocols under FTP, CBR, Variable Bit Rate (Exponential),

Pareto (Poisson) and PackMime (HTTP 1.1). As performance metrics they used Packet Delivery Ratio and Throughput. When we see the simulation result all the routing protocols shows that almost the same performance with packet delivery ratio greater than 92% under CBR traffic. But the performance of DSDV is better as compared to the other two routing protocols with packet delivery ratio observed as 96% for FTP traffic model. AODV routing protocol out performs with packet delivery ratio as 96% for VBR traffic patterns. HTTP traffic model comprises approximately 95% of the total traffic in a Mobile Ad-Hoc Network. Therefore it deserves the best performance but regrettably none of the routing protocols performs better for HTTP traffic pattern. DSDV routing protocols shows 95% of performance for the multimedia traffic using Pareto analysis models. Under Pareto traffic pattern which is similar to the multimedia traffic with variable intervals and fixed packet sizes DSDV routing protocol is better than the other two algorithms.

Sengar Abhishek et. al. [8] compares the performance AODV (Ad-hoc on demand distance vector) and DSDV (Destination sequence distance vector) routing protocols performance on

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the foundation of different criteria for performance. At this point, an effort has been made to evaluate the performance of two well known routing protocols AODV, DSDV by using three performance metrics which are packet delivery ratio, throughput and Routing overheads. The Performance evaluation has been done by using simulation tool NS-2 (Network Simulator).

Sravya et. al [9] compares the performance of different routing protocols for MANET . They used AODV, DSR and DSDV over MAC Layer protocol of IEEE 802.11. As per their findings the differences in the protocol technicalities directs to considerable performance differentials for these routing protocols. In this paper they are used Packet Delivery Fraction (PDF), Average end-to-end delay, Normalized Routing Load (NRL), and Dropped packets performance metrics with varying network size. To simulation they are using the NS-2.

Mukesh Kumar Garg et. al. [10] in this paper an attempt has been made to assess, evaluate, analyze and compare the performance of two most commonly used on-demand-driven routing protocols named as Adhoc on Demand Distance Vector (AODV) & Dynamic Source Routing (DSR) protocol. They are used QualNet 5.0 Simulator for measuring the performance of the above said routing protocols. From their findings they have concluded that neither of the protocol is better in all circumstances. For some parameters one outperforms the other and vice-versa as reported in the research paper.

IV. MANETs Routing Protocol

The process of transferring the information from a source to a destination in an internetwork is known as Routing [11]. In MANET data/information is transferred from the source to the destination at least one intermediate node within the internetwork is encountered. At this stage mainly two activities are concerned. Thus are transferring the packets through an internetwork and determining optimal routing paths. The transferring of packets during an internetwork is known as packet switching which is straight forward, and the path determination could be very difficult. Mobile adhoc networks are the progressively more developing technology in the last 20 years [12]. Their charisma is also increased due to their dynamic nature, ease of deployment, and the no need of any infrastructure. MANETs summarize a new set of demands to be applied and to provide well organized and better end to end communication.

MANET routing protocols are complicated and gorgeous tasks, that is why researchers are giving major amount of attention to this key area. In MANET, there are different types of routing protocols each of them is applied according to the network circumstances [11].Thus routing protocols are classified into three different groups, which are Reactive, Proactive and Hybrid routing protocol based on their functionality.

A. REACTIVE ROUTING PROTOCOLS

Thus routing protocols are also called on-demand protocols [13]. These protocols do not challenge to safeguard accurate routing information on all nodes at every time. Routing information is collected only when it is desired, and route determination depends on sending route queries throughout the network. The main advantage of this routing protocol is that the wireless channel is not subject to the routing overhead data for routes that may not be used. While reactive protocols do not have the fixed overhead required by preserving continuous routing tables, they may have significant route discovery delay. Reactive search procedures can also add a major amount of control traffic to the network due to query flooding. Because of these weaknesses, reactive routing is in appropriate for real-time traffic or in scenarios with a high volume of traffic between a large numbers of nodes. There are various popular reactive routing protocols such as AODV and DSR.

Adhoc On-Demand Distance Vector (AODV)

Basically Adhoc on demand distance vector is an improvement of Destination Sequence Distance vector (DSDV) [14]. But, it is a reactive routing protocol instead of proactive. It minimizes the number of broadcasts by creating routes based on demand, which is not the case for DSDV. When any source node wants to send a data packet to a destination, first it broadcasts a route request (RREQ) packet to every neighboring node. Then the neighboring nodes in turn broadcast the packet to their neighbors and the process continues until the packet reaches the destination. During the process of forwarding the route request, intermediate nodes record the address of the neighbor from which the first copy of the broadcast packet is received and stored in routing table, which helps for establishing a reverse path. If additional copies of the same Route Requests are later received, these packets are discarded. The reply is sent by Route reply control messages using the reverse path. For route maintenance, when a source node moves, it can reinitiate a route discovery process. If any intermediate node moves within a particular route, the neighbor of the drifted node can detect the link failure and sends a link failure announcement to its neighbor. This process continues until the failure announcement reaches the source node. Based on the received information, the source might make a decision to re-initiate the route discovery phase [15].

Dynamic Source Routing (DSR)

It is a widely used reactive (on-demand) routing protocol which is planned particularly for the mobile ad-hoc networks. Dynamic Source Routing authorized the network to run without any existing used network infrastructure and thus the network becomes as a self-organized and self-configured network. This protocol maintains an on-demand approach and hence quenches the periodic table-update messages needed in the table-driven approach.

Accordingly, it is able to deny the control packets from overwhelming a lot of bandwidth. Like other on-demand routing protocols, Dynamic Source Routing does not provide the broadcast of any periodic beacon or hello packet, which is essential for informing its occurrence of the other nodes. As a replacement for, during the route creation phase, it establishes the route by flooding a Route Request packet in the network. Each Route Request Packet (RREQ) holds a sequence number which is generated by all the nodes through which the packet is flooded. By using this sequence number, loop

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formation and multiple transmission of the same Route Request is possible to be escaped. When a Route Request packet is reached to its destination node, immediately the final destination node sends a Route Reply Packet (RREP) to the source node through the opposite way the Route Request is travelled. While, it cannot be an sufficient mechanism for the nodes to provide continuous flooding; DSR occupies the route caches to store the routing information.

B. *PROACTIVE ROUTING PROTOCOLS*

In a network operates a proactive routing protocol, every node maintains one or more tables representing the whole topology of the network. These tables are updated frequently in order to maintain up-to-date routing information from each node to every other node. To maintain the up-to-date routing information, topology information wants to be exchanged between the nodes on a regular basis, leading to relatively high overhead on the network. On the other hand, routes will constantly be accessible on request. Many proactive protocols stop from conventional link state outing, including DSDV [13].

Destination Sequenced Distance-Vector Routing (DSDV)

This routing protocol was developed 1994 by C. Perkins and it is a proactive distance-vector protocol [15].

It is a proactive, distance vector protocol which uses the Bellman -Ford algorithm. DSDV is a hop-by-hop distance vector routing protocol, where in each node maintains a routing table inventory the next hop and number of hop for each accessible destination. This protocol wants each mobile station to advertise each of its current neighbors to its own routing table. The entries in this list may change practically energetically over time, so the advertisement must be made frequently enough to guarantee that every mobile computer can roughly always locate every other mobile nodes of the compilation. In addition, each mobile node consents to communicate data packets to the other nodes upon appeal. This agreement places a quality on the ability to determine the shortest number of hops for a route to a destination we would like to avoid gratuitously disturbing mobile hosts if they are in sleep mode. In this way a mobile node may substitute data with any other mobile nodes in the group even if the target of the data is not within range for direct communication.

V. PERFORMANCE METRICS AND SIMULATION ENVIRONMENT

A. *Performance Metrics*

In this paper we are evaluates the performance comparison of AODV, DSDV and TORA and DSR routing protocols on the following performance metrics: Average end-to-end delay, Packet delivery ratio and throughput and packet loss.

Packet Delivery Ratio

Packet delivery ratio is calculated by dividing the number of packets received by the destination by the number of packets initiated by the application layer of the source. It identifies the packet loss rate, which limits the maximum throughput of the network. The better the delivery ratio, the more comprehensive and proper is the routing protocol.

Throughput

The throughput of the protocols can be defined as percentage of the packets received by the destination among the packets sent by the source. It is the amount of data per time unit that is delivered from one node to another via a communication link. The throughput is measured in bits per second (bit/s or bps).

Packet loss

The total number of packets dropped during the simulation.

B. *Simulation Environment and Scenarios*

In this paper, we have taken two different scenarios. In the first scenario, traffic pattern is taken as CBR and Pause time have been varied and performance comparisons have been made between AODV, DSDV and DSR and protocols. In the second scenario, traffic pattern is taken as TCP and Pause time have been varied and a performance comparison has been made between AODV, DSDV and DSR protocols. Identical mobility pattern are used across protocols to gather fair results.

The following table summarizes all the parameters used during simulation

Parameter	Value
Number of nodes	50,100
Maximum speed	10m/s
Simulation Time	100 sec
Pause time	0,10,20,40,60 sec
Environmental Size	1000 * 1000
Packet Size	512
Traffic Type	CBR, TCP
Rate	2 packets/sec
Routing protocols	AODV,DSR and DSDV
Simulator Type	NS2- 2.35
Mobility Model	Random Way Point
Antenna type	Omni-Directional

VI. SIMULATION RESULTS AND ANALYSIS

We evaluated the performance of AODV, DSR and DSDV protocols under TCP and CBR traffic pattern by varying pause time with constant speed and number of connections. Trace files produced by applying scenarios and communication files are analyzed by using NS-2 and awk scripts for evaluation of different protocols based on average Packet Delivery Ratio, number of Dropped Packet, and Throughput.

A. *Throughput*

In case of CBR traffic pattern with 50 nodes throughput of AODV and DSR protocols is almost same and is better than as compared to DSDV protocols. In case of TCP traffic with 50 nodes throughput changes rapidly with respect to change in the pause time.

In case of CBR traffic patterns with 100 nodes Throughput of DSR protocol is almost constant and is better than as compared to AODV and DSR. In case of TCP traffic with 100 nodes throughput of both AODV, DSR and DSDV are changed rapidly with respect to the change in pause time.

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When the numbers of nodes are increased and pause times are varied DSR is best performer than AODV and DSDV in the case of CBR traffic but in case of TCP traffic throughput are changed rapidly for both reactive (AODV and DSR) and proactive routing protocols (DSDV) when pause times are changed.

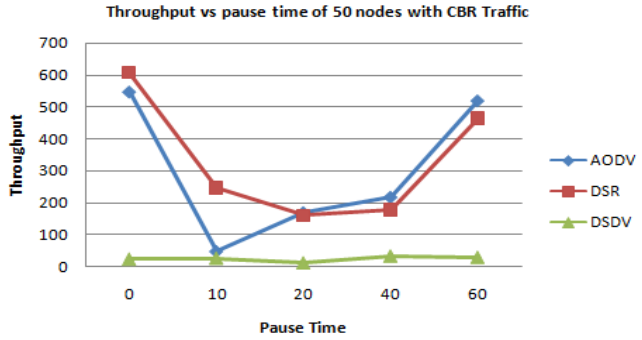


Figure-2: Throughput vs. pause time of CBR traffic for 50 nodes

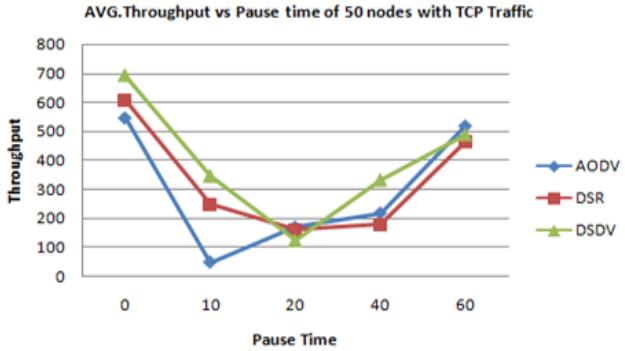


Figure-3: Throughput vs. pause time of TCP traffic for 50 nodes

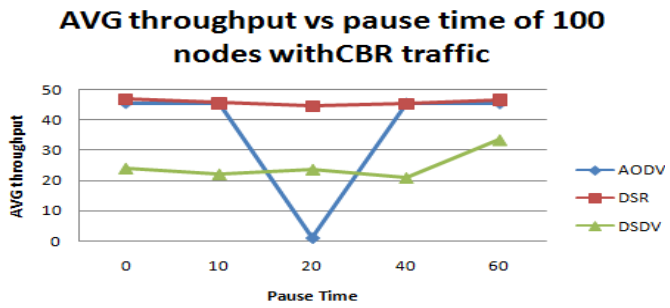


Figure 4: through vs. pause time with CBR traffic for 100 nodes

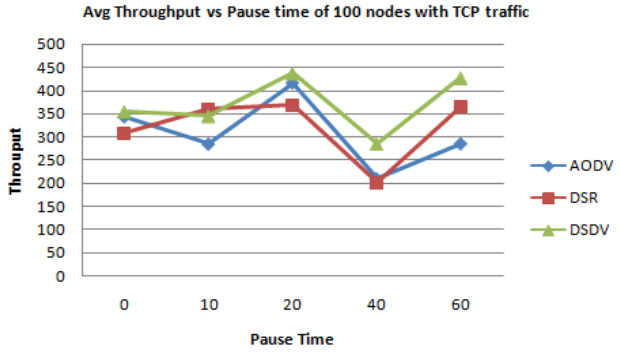


Figure 5: throughput vs pause time with TCP traffic for 100 nodes

B. Packet Delivery Ratio

In case of CBR traffic with 50 and 100 numbers of nodes Reactive protocols (DSR and AODV) deliver almost all the originated data packets converging to 100% delivery whereas Proactive protocols (DSDV) Packet Delivery Ratio is approx 50% (Figure 6). Reactive protocols perform better than the proactive protocols in case of CBR traffic pattern with 50 and 100 numbers of nodes. In the case of TCP traffic pattern with 50 numbers of nodes (figure 7); Packet delivery ratio of AODV protocols remains almost constant whereas it changes rapidly for DSR and DSDV protocols irrespective of change in pause time. But when the number of nodes increased in case 100 nodes with TCP traffic pattern the proactive routing protocols (AODV is changed rapidly) with respect to change in pause time but DSR is better Performer of because the packet delivery of Ratio is almost constant with respect to change in pause time and number of nodes are increased.

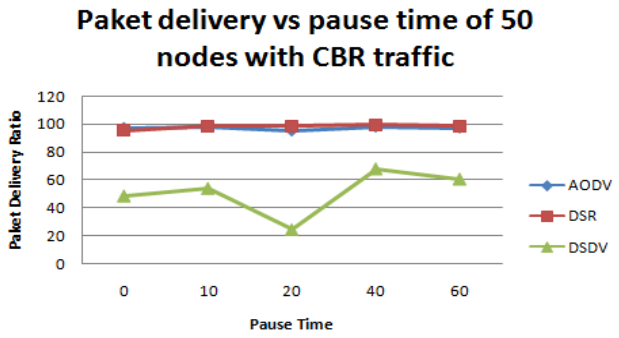


Figure 6: PDR vs. pause time of 50 nodes with CBR traffic

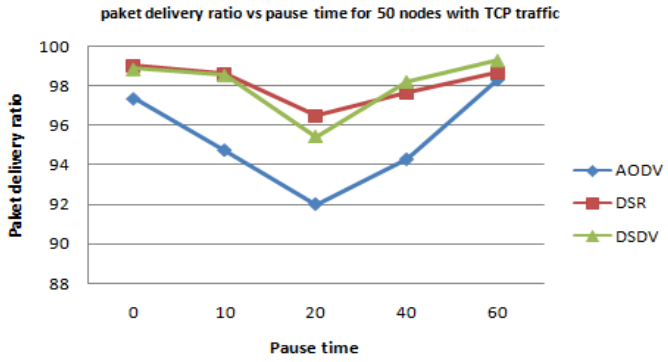
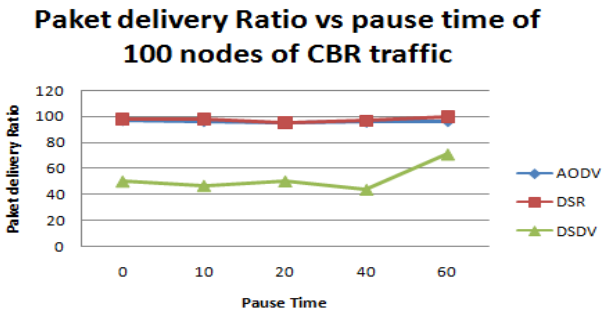


Figure 7: PDR vs. pause time of 50 nodes with TCP traffic



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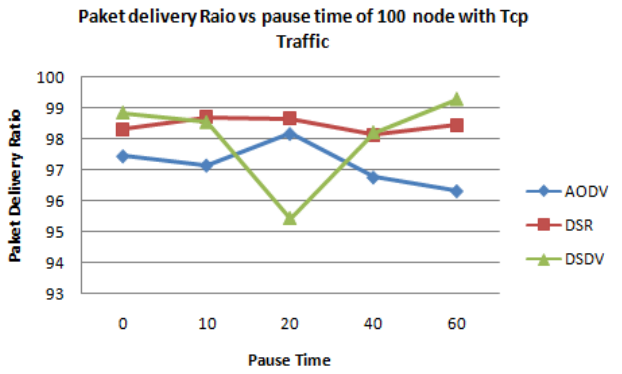

Figure 8 packet delivery ratios vs. pause time of 100 nodes with TCP traffic pattern

C. *Number of Dropped Packets*

In case of CBR traffic with 50 and 100 number of nodes with changing of pause times , Number of dropped packets of proactive routing protocols (DSDV) is high as compared to reactive routing protocols (AODV and DSR) as shown figure 9 and Figure10 and DSR have less number of Dropped packets as compared to AODV . But in case of TCP traffic with 50 and 100 number of nodes proactive routing protocols (DSDV) have less number of dropped packets as compared to reactive routing protocols(AODV and DSR) as shown figure and figure 11 when the pause time is changed.

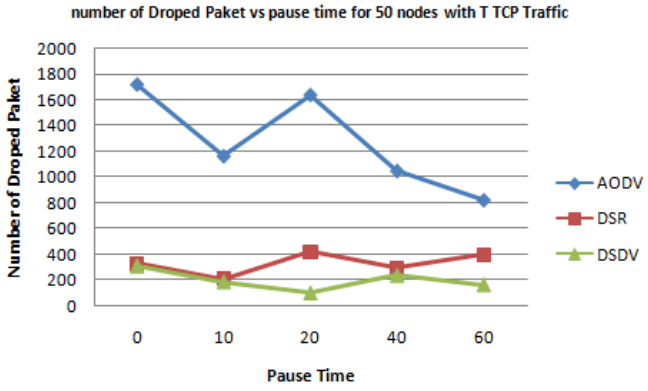

Figure 9: number of packet Dropped vs. pause time of 50 nodes with TCP traffic

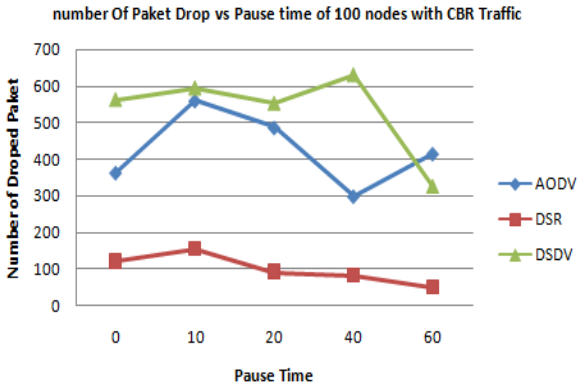

Figure 10: number of packet Dropped vs. pause time of 50 nodes with CBR traffic

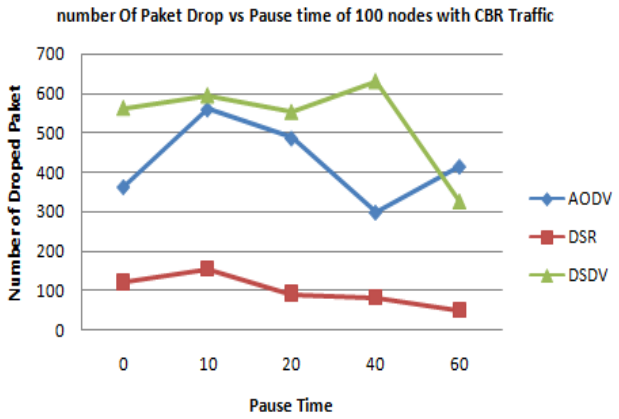

Figure 11: number of Packet Dropped vs. pause time for 100 nodes with CBR traffic

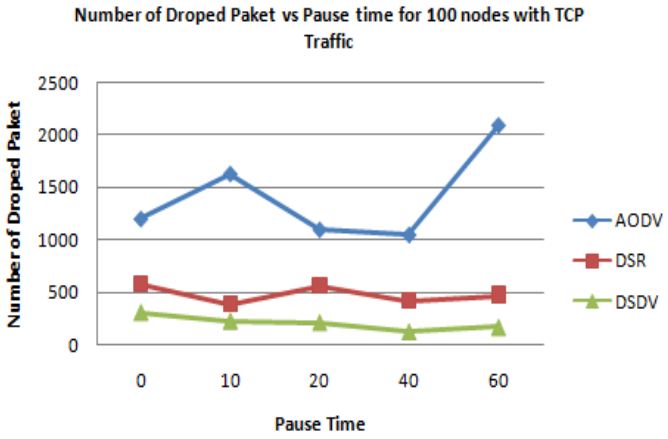

Figure 12: number of dropped packet vs. pause time of 100 nodes with TCP Traffic

VII. CONCLUSIONS AND FUTURE WORK

This study was conducted to evaluate the performance of Reactive (AODV, DSR) and Proactive protocols (DSDV) of MANET based on both CBR and TCP traffic. These routing protocols were compared in terms of Packet delivery ratio, number of Dropped Packets and Throughput when subjected to change in pause time. Simulation results show that Reactive protocols (AODV and DSR) are better than proactive routing protocols (DSDV) in terms of packet delivery ratio and throughput in case of both traffics i.e. TCP and CBR. But in the case of number of dropped packets of both 50 and 100 nodes with pause time shows that proactive routing (DSDV) have less number of dropped packets with TCP traffic.

Future work will be to evaluate the performance of these protocols by varying the speed, pause time, number of connections and other performance metrics. Performance can also be analyzed for other parameters like Jitter, Routing Overhead, and average end to end delay. By evaluating the performance of the above said protocols new protocols can be implemented or changes/modifications can be recommended in the earlier protocols to improve the performance of MANET.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 02, February-2016

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