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Research Article

Performance Evaluation of MANET Routing Protocols AODV and DSDV Using NS2 Simulator

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Abstract

Mobile Ad hoc Network (MANET) is a collection of wireless mobile nodes that dynamically form a network temporarily without any support of central management. Moreover, every node in MANET moves arbitrarily making the multi-hop network topology to change randomly at uncertain times. There are several familiar routing protocols like AODV, DSR, and DSDV etc. which have been proposed for providing communication among all the nodes in the wireless network. This paper presents a performance comparison and study of reactive (AODV) and proactive (DSDV) protocols based on metrics such as throughput, packet delivery ratio, average end-to end delay, paket loss rate and consumed energy by using the NS-2 simulator. The simulation results showed that AODV performance is better than DSDV regarding packet delivery ratio and end to end delay, while DSDV performance is better than AODV regarding packet loss rate and consumed energy then the performance of AODV and DSDV protocls in throughput parameter is equal close. For small networks, DSDV works well and AODV is best suited for larger networks.

Keywords: MANET, AODV, DSDV, NS-2 simulator, Routing algorithms, Protocol comparison

1. Introduction

Due to the fast growth of mobile communication in recent years, especially observed in the field of mobile system, wireless local area network, and ubiquitous computing. The set of mobile terminals that are placed in a close location communicating with each other, sharing services, resources or computing time during a limited period of time and in a limited space forms spontaneous ad hoc network. Network management should be transparent to the user. These types of networks have independent centralized administration; user can enter the networks and leave the networks easily. One of the important research areas in MANET is establishing and maintaining the ad hoc network through the use of routing protocols [1],[2].

Routing is the method of selecting a traffic path in a network or over multiple networks, which to send and receive data. It directs the passing of logically addressed packets from their source toward their ultimate destination through intermediary nodes. Routing protocol is the routing of packets based on the defined rules and regulations. Every routing protocol has its own algorithm on the basis of which it discovers and maintains the route. Each routing protocol has a data structure which stores the information of route and modifies the table as route maintenance is requires. A routing metric is a value used by a routing algorithm to determine whether one route should perform better than another. Metrics can cover such information as bandwidth, delay, hop count, path cost, load, reliability and communication cost. The routing table stores only the best possible routes while link-state or topological databases may store all other information as well. MANETs are currently the greatest innovation in the field of telecommunications.[3],[4].

Routing is a core problem in networks for sending data from one node to another. Several routing protocols have been proposed for mobile Ad-Hoc networks. In this paper we present the classification of these routing protocols and the review of an AODV and DSDV routing protocols [5].

The rest of the paper is organized as follows: Section II presented the related works; Section III provides a classification details of routing protocols in Mobile Ad-hoc network; Section IV provides the simulation methodology. The simulation results and discussion will be explained in section V. The last section VI concludes the paper.

2. Related Works

There are numerous investigate endeavors that have been done during the previous year comparing the execution of different routing protocols in MANET. These routing protocol employments diverse strategy or metric to choose the best path between the source node and the destination node, some of them they utilize the accessible transmission capacity and a few of them they utilize the bounce check between the sets. All of these protocols have their pros and cons [6].

Daas et al (2015) presented a comparison study for evaluating the performance of AODV and DSDV routing protocol based on node speed using NS2 simulator. The simulation results indicated that AODV has better performance than DSDV in terms of throughput, delay, and PDR factor [2]. DSDV performance is however better than AODV in terms of energy consumption [7].

A similar study is presented by [8]. The authors climbed that AODV is superior to AOMDV, DSR, and DSDV in terms of CBR connection. DSR is however perform excellently than AODV, AMDV, and DSDV in terms of TCP connections.

Sharma et al [9] are evaluated the performance of proactive and reactive protocols with different mobility models. Simulation results uncover that proactive protocols perform superior for smaller networks and reactive protocols perform way better for larger networks in terms of the performance metrics such as PDR, delay and bundle misfortune.

This study investigates and compare between two different routing protocol categories which are Proactive protocols (DSDV) and Reactive protocols (AODV). There have been several efforts to implement and test the efficiency of the network protocols in various contexts, such as AODV, DSR, and DSDV routing protocols.

3. Mobile Ad hoc Network Routing Protocols

Mobile Ad-Hoc network (MANET) is a kind of wireless network and self-configuring network of moving routers associated with wireless network. In MANET, the routers are free to move randomly and organize themselves arbitrarily, thus, the network's wireless topology may change rapidly and unpredictably [3], [10]. Figure 1 represent MANET overview.

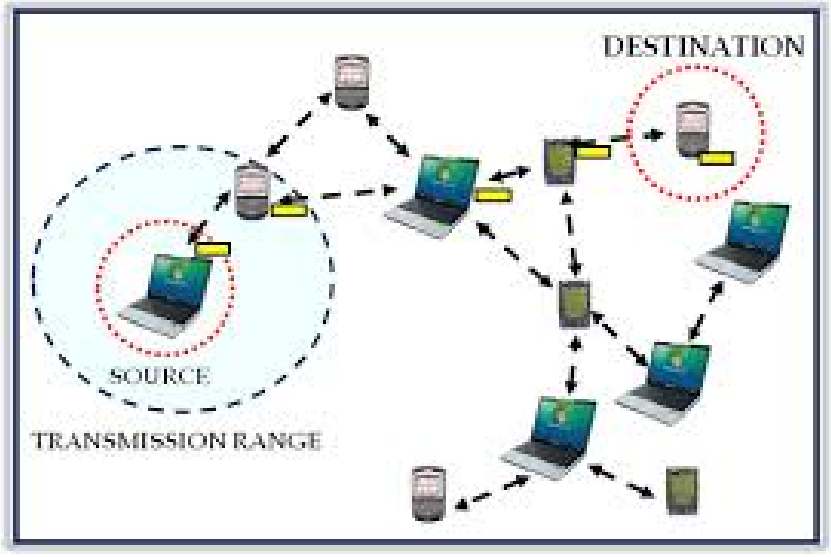

Figure 1 Mobile Ad Hoc Networks

MANET is a collection of wireless mobile hosts forming a temporary network without the aid of any established infrastructure or centralized administration. They are characterized by a dynamic, multi-hop, rapid changing topology [5]. The main objective of ad-hoc routing protocols is to deliver data packets among mobile nodes efficiently without predetermined topology or centralized control. The various mobile ad-hoc routing protocols have been proposed and have their unique characteristics. Hence, in order to find out the most efficient routing protocol for the highly dynamic topology in ad-hoc networks, the behavior of routing protocols has to be analyzed under different traffic patterns respect to their metrics [11]. Figure 2 shows the classification of MANET routing protocols depending on how the protocols are handle the packet to deliver from source to destination. Due to their functionality of Routing protocols are broadly classified into three types: Reactive, Proactive and Hybrid protocols [12].

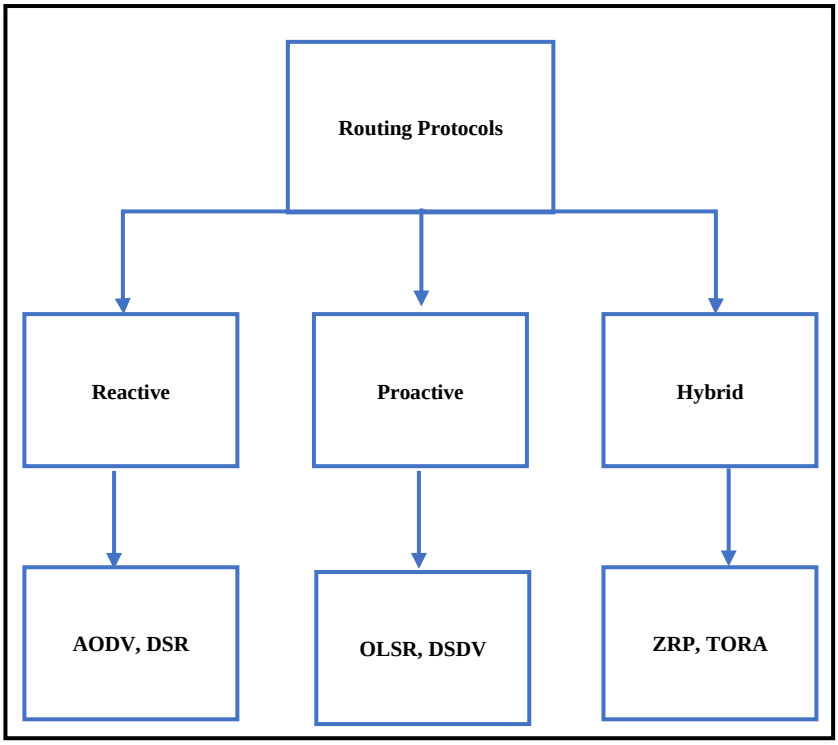

Figure 2 Routing protocols in MANET

3.1 Proactive (table-driven) Routing Protocol

The proactive routing is also known as table-driven routing protocol. Each node maintains routing information for every possible destination.This causes more overhead in the routing table leading to consumption of more bandwidth. DSDV and OLSR are the main representative protocols [13].

Destination Sequenced Distance Vector (DSDV)

(DSDV) is a table-driven routing protocol for ad-hoc mobile networks works based on the Bellman-ford algorithm. Each node acts as a router where a routing table is maintained and periodic routing updates are transfer, even if the routes are not necessary. A sequence number is associated with each route or path to the destination to prevent routing loops. The Routing updates are exchanged even if the network is idle which uses up battery and network bandwidth. So, it is not preferable for highly dynamic networks. The DSDV eliminates two problems of routing loops and counting to infinity. Dissemination of an update, however, remains quite slow. Mobility for high losses are mainly due to the use of outdated table entries.[14],[15].

3.2. Reactive (on-demand) routing protocol

This type creates a route when a source node require from distination node. It is based on flooding algorithm which employs on the technique that a node just broadcasts the packet to all of its neighbors and intermediate nodes just forward that packet to nearby nodes and this technique will repetitive until it reaches the destination.The major representative protocols are AODV, DYMO and DSR. [16].

Ad Hoc On-demand Distance Vector Routing (AODV)

In AODV, route establishment takes place only when there is a demand for new route. The network remains stable till the connection is desirable. At the point where the network node wants the connection then it broadcast the demand for the connection. The intermediate nodes progress these messages, and record the node from which they heard it, and creates the outbursts of temporary routes backward to the source node. When the node receives such a message and already route is present to the preferred node, afterward it sends a message backwards throughout the provisional route to the requesting node. As a result, AODV does not load any extra protocol over data packets because it doesn't use resource routing [17],[4].

4. Simulation Methodology

Nowadays simulation helps in analyzing the performance and behavior of complex networks before implementing it. Several network simulators are available such OMNET, NS2, and OPNET, whose output depicts as close as possible to real time implementation. In this work, we have used NS-2.34 network simulator to compare and evaluate the performance of AODV and DSDV routing protocols in MANET. The simulation has been used a different number of nodes to deeply verify the performance of these protocols in terms of the performance measures. The number of nodes were10, 20, 30, 40 and 50. Where as the nodes have deployed in the network and they move randomly as shown in Figure 3.

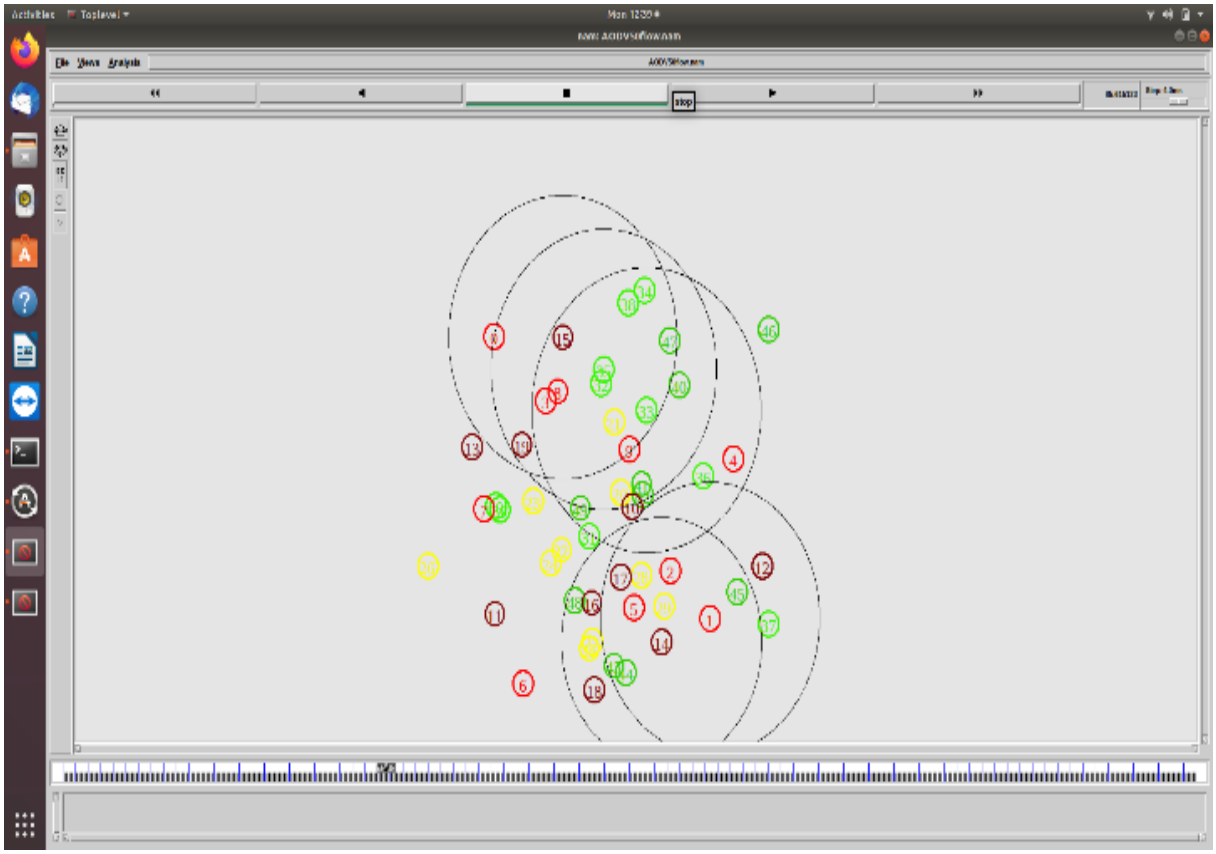

Figure 3 The Simulation Environment.

The transmission range in all nodes is set to be 250m in the network. The simulation area is 900m x 900m and the simulation time is 300 sec. The packet size in this simulation is 512 bytes. Table 1 shows the simulation parameters.

Table 1 Simulation parameters

Parameter	Value
Simulator	NS-2 (Version 2.34)
Channel type	Channel/Wireless channel
Radio-propagation model	Propagation/Two ray
Network interface type	Phy/WirelessPhy
MAC Type	Mac /802.11
Interface queue Type	Queue/Drop
Link Layer Type	LL
Antenna	Antenna/Omni Antenna
Packet Size	512
Area (M*M)	900 * 900
Number of mobile node	50
Source Type	TCP
Simulation Time	300
Routing Protocols	DSDV, AODV
Transmission Range of	250

5. Simulation Results and Discussion

Simulations were done by varying the number of nodes and keeping speed of the node constant (50). The deviation was done respectively varying the routing protocol from AODV and DSDV. The number of flows for each comparison was also varied from 10 to 20 to 30 to 40 to 50 to identify the result. In all scenarios the comparison were based on performance metric: Packet Delivery Ratio, End to End Delay and Throughput by also using NS-2 simulator and the results have been analyzed using Excel as shown in table 2.

Table 2 comparison of AODV and DSDV in terms of throughput, end to end delay, packet delivery ratio, packet loos rate and consumed energy

No. of Flow	Throughput		End to End delay		Packet delivery ratio		Packet Loss Rate		Energy	
	AODV	DSDV	AODV	DSDV	AODV	DSDV	AODV	DSDV	AODV	DSDV
10	691	553	354	373	626	312	480	608	390	380
20	668	715	478	505	888	532	177	420	353	334
30	673	691	654	853	1347	735	243	548	580	382
40	640	655	661	992	1284	817	410	312	430	270
50	525	601	942	989	1513	846	518	89	443	190

The performance metrics helps to characterize the network that is substantially affected by the routing algorithm to achieve the required Quality of Service (QoS). In this work, the following metrics are considered.

5.1 Average Throughput (TP)

It is the measure of the number of packets or data successfully transmitted to their final destination via a communication link per unit time [5] as shown in figure (4).

From Fig 4 it's clearly seen that DSDV has the high throughput for almost scenarios. The throughput values of DSDV and AODV Protocols for 10, 20, 30, 40 and 50 flow Nodes at 300s are noted in Table

1, the throughput value of DSDV is less than AODV in the case of 10 flow, and it increases gradually until reach (715) in case of 20 flow.

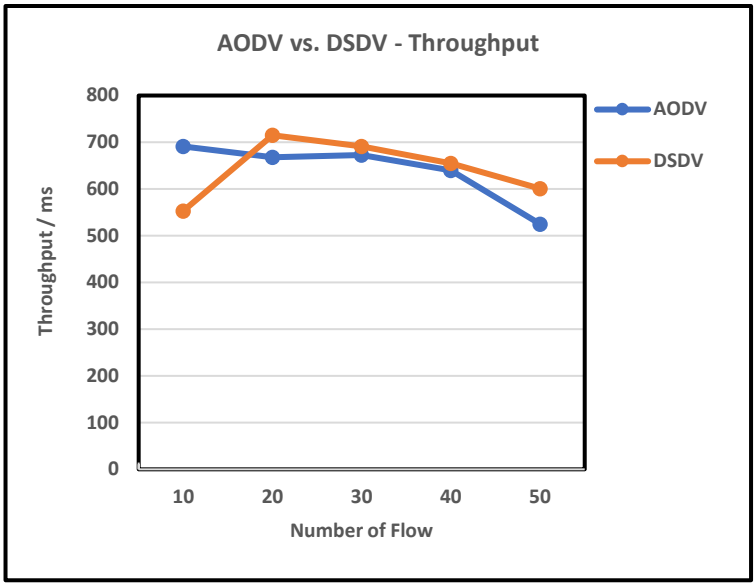

Figure 4 AODV vs DSDV Throughput

After that the DSDV values have range between 601 and 691. The throughput value for AODV start largest than DSDV value and decreased value when the number of flow increases, the throughput of AODV is between 525 and 691. Hence, DSDV performs close equal with AODV.

5.2 Packet delivery ratio (PDR)

It is the ratio of the total data bits received to total data bits sent from source to destination.[9] Figure (5) show the average packet delivery ratio for AODV and DSDV for all scenarios.

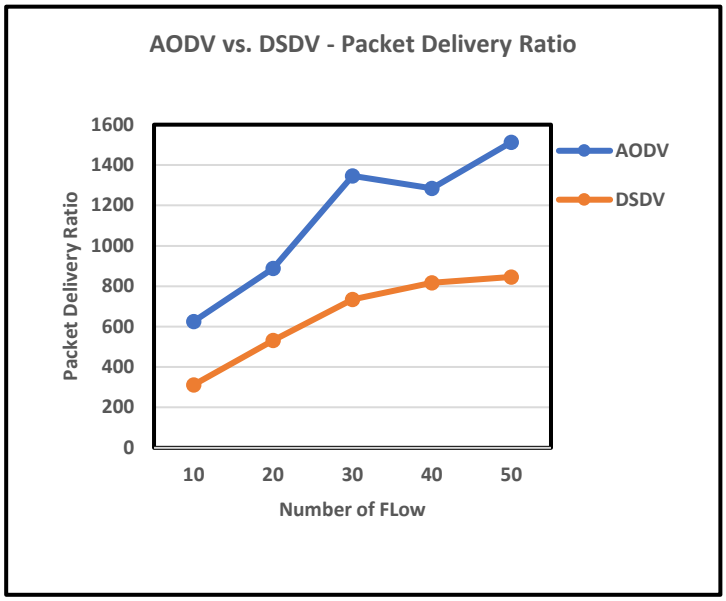

Figure 5 AODV vs DSDV Packet Delivery Ratio

Based on Figure 5, AODV has shown a better performance than DSDV when the number of flow nodes increased. The packet delivery ratio of AODV is between 1513 and 626. The packet delivery ratio of DSDV is between (846-312).

5.3 End-to-End Delay (EED)

It is the time delay for send data packet from the source node to the destination node. Total time difference over the total number of packets received is dividing with single packet send and received time [8]. Figure (6) shows the delay values for AODV and DSDV for all scenarios.**End to End Delay= (time packet received - time packet sent)**

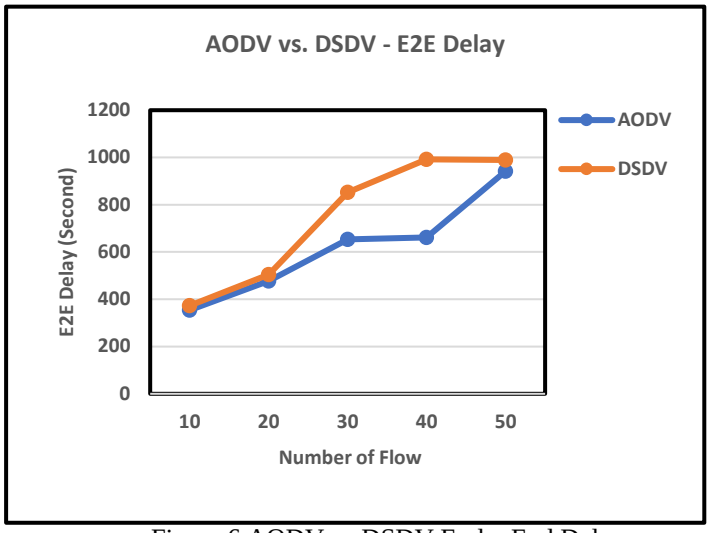

Figure 6 AODV vs DSDV End – End Delay

Figure 6 representing the delay graph for AODV and DSDV routing protocols. AODV performance has little delay in comparison with DSDV even the number of nodes increased. Resulting in, AODV is better than DSDV. End to end delay of DSDV have greater value than AODV. The average end to end delay for AODV and DSDV for all scenarios is between 354 and 942 and (373-992) respectively. DSDV keeps routing tables to deliver packets, and hence it sets up the new routes when there is a change in the network topology and AODV is the on-demand protocols, and it has to initiate the routing discovery mechanism whenever a new route is to be established. AODV delivers required packets on demand of communication between the nodes.

5.4 Packet Loss Rate (PLR)

Packet Loss rate is characterized as those packets that are sent by the source and fizzled to be gotten by the goal. It is calculated by separating the whole lost packets for directing by add up to packets sent by equation as below [18]. Figure (7) shows the packet loss rate values for AODV and DSDV for all scenarios

$$Packet\ Loss\ Rate = \frac{Packet\ Lost}{Packet\ Sent}$$

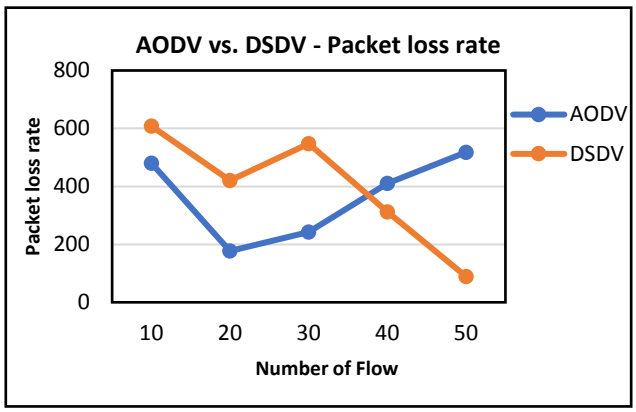

Figure 7 AODV vs DSDV Packet loss rate

We will see form figure (7) over that the number of nodes decreased the impact on the packet loss rate with DSDV routing protocol but rises obviously in AODV, the alter of the coming about packet loss values tends to improve in denser nodes.

A decrease in packet loss on DSDV in node (40, 50) demonstrates that the number of packets lost to the goal is exceptionally small compared with AODV within the same nodes.

5.5 Energy Consumption (joules)

The average of energy consumed by the mobile nodes while routing and communication [19]. Figure (8) shows the energy consumption values for AODV and DSDV for all scenarios.

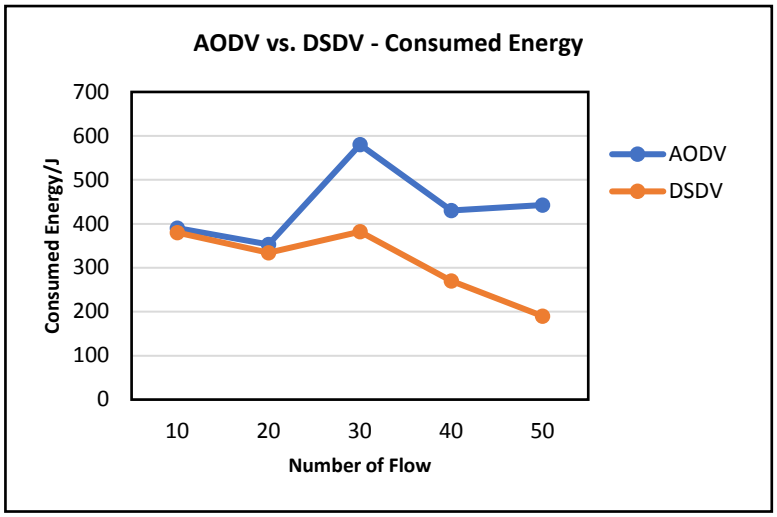

Figure 8 AODV vs DSDV consumed energy

In figure 8, the proactive protocol DSDV has yielded consistent energy consumption by the mobile nodes as the number of nodes increases from 10 to 20. At that point the energy consumption is increased in node (30), while the following nodes (40, 50) decreasing. On the other hand, the reactive protocol AODV energy consumption was similar to the DSDV within the run from 10 to 20 nodes. It then increased from 20 to 30 nodes to reach the highest consumption at 30 nodes, after it decreased from 30 to 40 nodes and finally, it tends to increase once more from 40 to 50 nodes over DSDV. For medium estimate MANETs, AODV consumed more energy recently decreasing for larger MANETs, whereas DSDV consumed a moderately lower energy for small, medium and larger MANETs.

6. Conclusion

MANET is a collection of mobile nodes, dynamically establishing short-lived networks in the absence of fixed infrastructure. This project compares of AODV and DSDV routing protocols which are proposed for ad-hoc mobile networks. In DSDV routing protocol, mobile nodes periodically broadcast their routing information to the neighbors. Each node requires to maintain their routing table. AODV protocol finds routes by using the route request packet and route is discovered when needed. The comparison of these protocols is done in terms of the parameters packet delivery ratio, throughput, end to end delay, packet loss rate and consumed energy. The simulation results showed that AODV performance is better than DSDV regarding packet delivery ratio and end to end delay while DSDV performance superior to AODV on packet loss and consumed energy. In throughtput parameter the AODV and DSDV performance was closed.For small networks, DSDV works well and AODV is best suited for larger networks.

Acknowledgments

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Biography

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