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International Journal of Advanced Science and Technology
Vol. 29, No. 5, (2020), pp. 9915-9920

Performance Evaluation of Two Mobile Ad-hoc Network Routing Protocols: Ad- hoc On-Demand Distance Vector, Dynamic Source Routing

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Abstract

A mobile ad-hoc network is a collection of mobile nodes that goatherd to exchange data and information from source to destination. Typically, MANET has no infrastructure, which can call it an infrastructure-less network. The node in the network communicates directly with the neighbor nodes that are already within the wireless range of that node. MANET has several types of routing protocols that can be used to establish links between nodes. These routing protocols are different in their mechanisms, which are AODV and DSR. in this paper. This simulation study carries out two routing protocols to evaluate their performance and quality of service in terms of energy consumption and packet delivery ratio. The comparison study was carried out using the NS2 simulator. The results of the simulations show better performance of DSR over AODV in different scenarios.

Keywords: *MANET, NS2, AODV, Routing protocols, DSR, QoS*

1. Introduction

The modern technology has made wireless communication an evolving and emerging technology that gives consumers electronic access to data and services wherever they are [1]. Wireless connection to the popular local area network must meet these requirements. However, in situations or places where no base station or fixed infrastructure is available, there is an increasing demand for connectivity or being online[2][3]. Hence, the mobile Ad-hoc network is the solution to provide such requirements. MANET's networks are efficiently designed and self-configured without any infrastructure support and can be quickly and easily implemented at a little cost, as shown in figure1[4][5]. Since node mobility is high, such networks may be subject to unpredictable topology modifications. This mobility and the infrastructure-less could make MANETs very appealing to time-critical apps. Thus, a routing algorithm is necessary when a packet or data wishes to be transferred to a node via a set of different nodes [6]. A routing protocol is a crucial requirement for the network to make routing decisions for even the immovable network [7]. Network nodes act as routers and play an essential role in keeping routes to other network nodes. For crises or search and rescue operations, Ad-hoc networks are beneficial for data collection in dangerous terrain or at meetings or conferences where people want their data to be shared quickly[8]. Routing is a network layer process that decides the path for the flow of traffic between the source and the destination. Dynamic wireless networks confirm that conventional wired network routing algorithms are either unreliable or require many protocols loads to route updates. Moreover, the change in the topology needs to be responded quickly, as it is not possible to deliver the packages to the appropriate locations until the topology is stable [9]. MANETs ' limited resources have challenged a robust routing strategy. Using these limited resources requires an effective

routing algorithm[10]. At the same time, it is dynamic to any variation in network conditions, such as network size, traffic density and node mobility, topology and even broken routes. Hence, the routing algorithms are introduced in MANETs[11].

Routing protocol should be capable of determining the best path, Lower overhead and power consumption. In this paper, a comparison study of two routing protocols Ad-Hoc on-demand distance vector (AODV) and dynamic source routing (DSR), has been presented to evaluate the network efficiency in terms of packet delivery ratio and energy consumption. Moreover, two different scenarios are examined by changing the number of nodes and node velocity to evaluate the performance of the network. The first section in this paper presents a brief explanation of the examined routing protocols AODV and DSR. The second section presents the most recent related studies. The second section presents the simulation environment and performance metrics that have been used to evaluate the performance of the network. The last section discusses the results of the simulation results under two different scenarios.

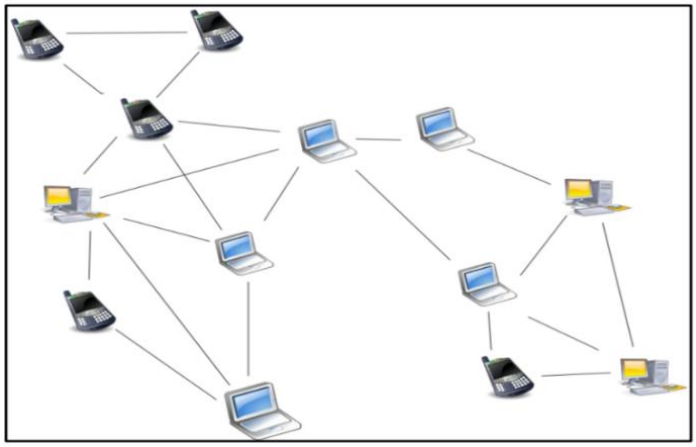

Figure 1. Mobile ad hoc network infrastructure

2. CLASSIFICATION OF ROUTING PROTOCOL IN MANET

Routing protocols in MANET are divided into three categories, which are reactive, proactive and hybrid. Each category has a different mechanism in establishing and choosing the link between source and destination. Figure 2 shows the MANET routing protocol categories [8].

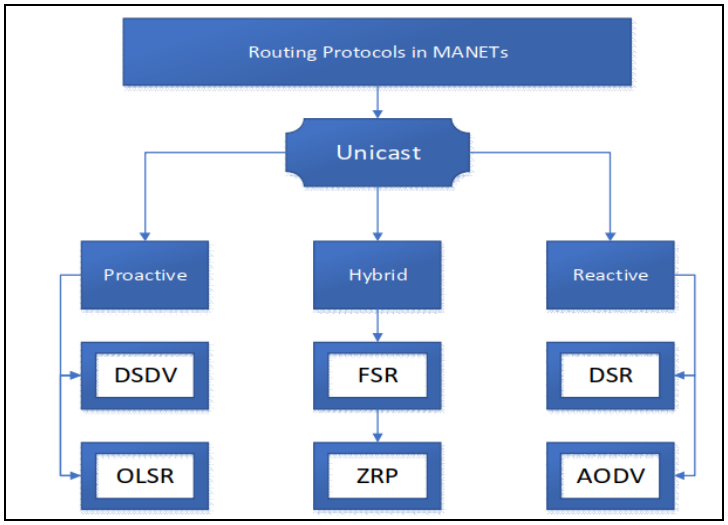

Figure 2. MANET routing protocol categories

3. AD HOC ON-DEMAND DISTANCE VECTOR ROUTING PROTOCOL

AODV routing protocol sends a route request from the source to the desired destination. This request goes through the nodes until it reaches the destination [12]. Once the packet reaches the destination, it will send back a route reply. Upon receiving the route reply, it will reserve the path and starts sending data from the source to the destination. During this process, a link failure may occur due to the mobility of nodes. In such a case, the source node will be notified, and the route discovery will be requested again.

4. DYNAMIC SOURCE ROUTING PROTOCOL

The dynamic source routing protocol is a simple routing protocol that has been designed especially for multi-hop ad-hoc networks. This protocol consists of two mechanisms, which are route discovery and route maintenance[13]. DSR allows multi nodes to discover a route to any destination in ad-hoc networks. In order to send a packet from source to the destination, the sender initials a source route in the packet's header. Moreover, this route has an address of every node in the network that the packet will be transmitted to the destination. The source sends the packet across the network by the first node in the source route. Once the packet received by the next node, it checks the header to transmit it to the next hope until it reaches the destination. However, this process may cause a high overhead that drain out the energy in nodes.

5. RELATED WORK

Every wireless network requires an efficient routing protocol to establish maintain the path to send data from source to destination. Recently, many researchers and scholars have examined and evaluated different routing protocols, as shown in table1. In 2019, [14] presented a comparison study on Ad-hoc network routing protocols. The AODV was investigated under two scenarios, which are queue size and number of nodes. Their comparison study was done in the NS2 simulation. Their results have shown a high impact of the change in the number of nodes on the entire network performance. Moreover, [2] presented a performance comparison of the AODV routing protocol. The network simulator NS2 was used as a simulation to perform this study with different parameters.

The number of nodes was fixed with 10 nodes and the speed of the node mobility was 20m/s. Their results have shown better performance compared to other routing protocols in MANET. However, AODV still suffers from the high overhead, which can lead to consuming more power of the node. In 2019, [15] presented an improvement in the AODV routing protocol. The mechanism of the initializing path of the AODV routing protocol was improved by integrating the Lion Optimization Algorithm. The result shows the effect of increasing the number of nodes on the performance of the network. It consumes more energy when the network which can lead to the link failure in the network. Moreover, in 2018, [5] studied a performance evaluation and assessment on routing protocols. One of the examined protocols was AODV. The study was investigated by throughput, end to end delay, and data packet delivery ratio, which are commonly used in such evaluations. Two different scenarios were done in their study from 10,20,30,40,50,60 and 70. Their results prove a better performance of AODV than DSR routing protocol.

ISSN: 2005-4238 IJAST

Table 1. Related Works

Year	Author	Protocol	Scenarios	Simulation
2019	Ahmed Mohammed Fahad	DSR & AODV	Packet size and number of nodes	NS2
2019	Vaibhavkumar Savkare	DSR & AODV	Number of nodes	NS2
2019	Alani	LOA-AODV	Variety number of nodes and velocity	NS3
2018	Muawia A. Elsadig	DSDV, AODV	Number of nodes	NS-2.35

6. SIMULATION PARAMETERS

The NS-2.35 network simulator implemented the comparison between the two routing protocols. A random wait point was used to deploy a variety of nodes with high mobility. Two scenarios have been introduced to evaluate the performance of the network, which is the number of nodes and node velocity. Table 2 illustrates the parameters used in this study.

Table 2. Simulation Parameters

Parameter	Value	Unit
Network area size	1000*1000	M^2
Simulator	NS-2.35	
Simulation time	150	sec
Packet size	64	Byte
Initial energy	200	J
Number of nodes	10-20-30-40-50	nodes
Node velocity	40-60	m/s
Mobility model	Random waypoint	
Traffic type	CBR	

7. PERFORMANCE ANALYSIS

The main objective of this paper is to evaluate the quality of service and to compare the result with different routing protocols. The evaluation includes two metrics that are explained as follows:

7.1. PACKET DELIVERY RATIO (PDR)

It is the ratio of packets successfully received to the total sent. Throughput is the rate at which information is sent through the network [15]. In order to calculate the PDR, the total number of the sent packet and the number of the received packet.

7.2. REMAINING ENERGY:

It defines the residual energy of each node [15] . The total energy can be calculated by summing up the total residual energy of each node in the network.

8. RESULTS AND ANALYSIS

Due to the dynamic mobility of the MANET's environment, two scenarios have been selected to be examined in the simulation. The first scenario is the change in the

number of nodes in the network size from 10,20, 30, 40 and 50 nodes. Moreover, changing the speed of nodes in the second scenario. As shown in Figure 3. Remaining energy differences between the two routing protocols. The DSR shows a better performance than AODV due to the mechanism in initializing the path from source to the destination. It is obvious that the increase in node velocity has an impact on the performance of each node in the network.

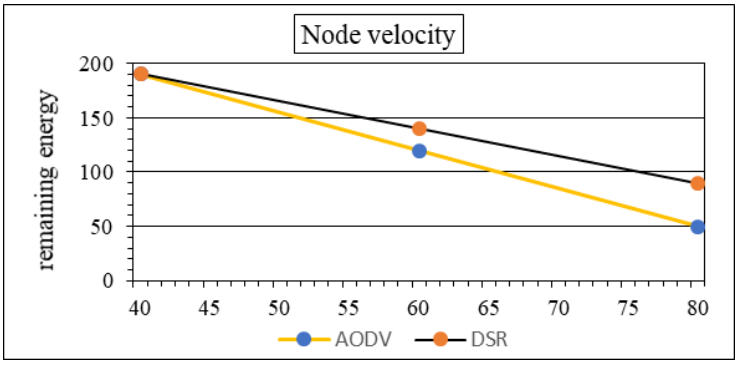

Figure 3. Remaining energy

Figure 4 shows the results of the PDR. In contrast with AODV, it indicates that the DSR showed better performance when the node velocity increased. Overall, the performance in the two scenarios has proven that the quality of service in DSR is better than AODV.

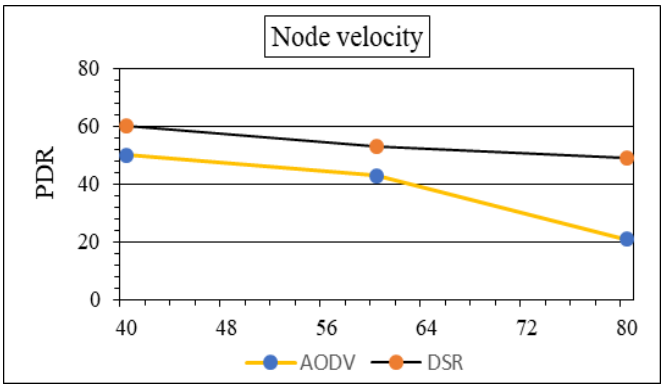

Figure 4. Packet delivery ratio

As mentioned before, the second scenario of the simulation is varying the number of nodes. Figure 5 shows the performance of the two routing protocols.

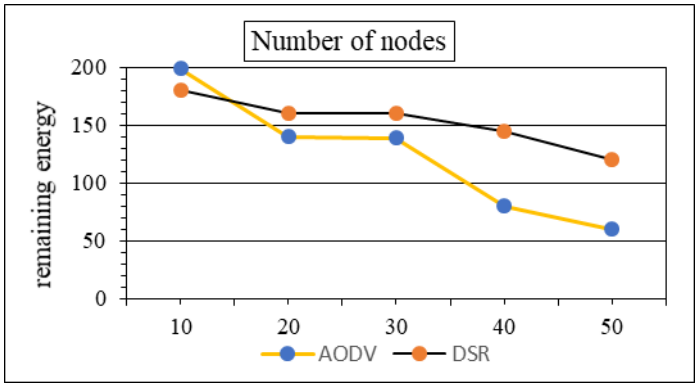

Figure 5. Remaining energy

The impact of varying the number of nodes on the energy of each node in the network is clear. The performance was decreased when the number of nodes increased. However, the performance of DSR overall is better than the performance of AODV due to the DSR concept. In Figure 6, the result of changing the number of nodes and the performance of the two-routing protocol are shown. DSR still shows better results than AODV. The reason behind that is due to the ability of DSR to maintain the network while the number of nodes increased.

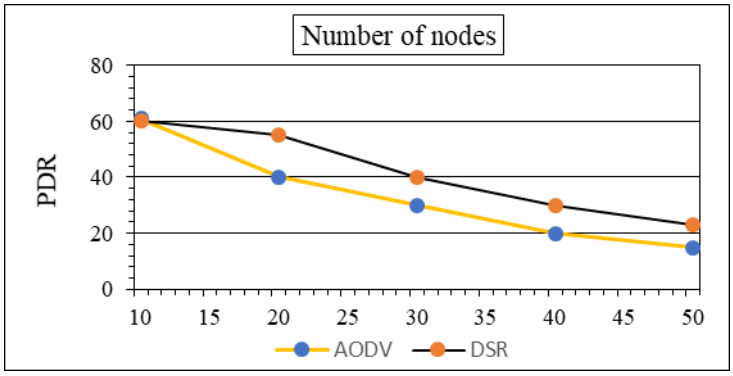

Figure 6. Packet delivery ratio

6. Conclusion

Two routing protocols AODV and DSR have been implemented and evaluated. The simulation of these routing protocols has been carried out by using the NS2 simulator on a PC with 8G Ram, corei7 CPU Computer and Windows 10. The different scenarios implemented the number of nodes and node velocity. Moreover, two performance metrics have been explained and implemented to evaluate the quality of service of these routing protocols. In this paper, the results based on the parameters have proven that the DSR has better performance in both scenarios.

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