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Implementation of Routing Protocols in mobile ADHOC Networking Using NS2

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Abstract: The paper aims to evaluate the performance of two popular routing protocols in MANETs, AODV (Ad-hoc On-demand Distance Vector) and DSDV (Destination-Sequenced Distance Vector), using simulation proof in the NS-2 network. The simulation experiments were conducted on a Linux platform, and the results were analysed using measures such as packet delivery ratio ،throughput ،end-to-end delay, and routing overhead. The results of the simulation experiments showed that DSDV protocol performed better in smaller networks due to its frequent updates and broadcasts, resulting in an increase in bandwidth. On the other hand, the AODV protocol was found to be optimal as it consumed less bandwidth and had lower routing overhead. Overall, this paper provides a comprehensive evaluation of the performance of two popular routing protocols in MANETs and highlights the importance of choosing the appropriate protocol based on network size and topology. Researchers and professionals associated with the design and implementation of routing protocols in MANETs can benefit from the study's conclusions.

Keywords: DSDV, AODV, MANETs, NS-2, MANETs.

1. Introduction

MANETs are self-organizing networks that consist of a collection of wireless mobile nodes that communicate with each other without any centralized infrastructure [17] [1]. These networks are widely used in applications such as military, disaster response, and sensor networks. One of the most important challenges in MANETs is the design and implementation of efficient and reliable routing protocols. Due to the dynamic and unpredictable nature of these networks, designing routing protocols for MANETs is a complex task. The routing protocols must be able to handle node mobility, link failures, and varying network topologies while maintaining high packet delivery ratios and low end-to-end delays.

There are several types of routing protocols for MANETs, including proactive, reactive, hybrid, and geographic routing protocols [9]. Proactive protocols maintain routing tables at each node to maintain up-to-date routing information, while reactive protocols establish routes only when needed. Hybrid protocols combine features of both proactive and reactive protocols. Geographic routing protocols use the geographic location of nodes to make routing decisions [18].

Choosing the appropriate routing protocol for a specific MANET application depends on several factors, such as the size of the network, the mobility of the nodes, the desired level of overhead, and the application requirements. Overall, the design and implementation of routing protocols in MANETs is an active area of research, and several routing protocols have been proposed over the years. The performance evaluation of these routing protocols is essential to understand their strengths and weaknesses and improve their effectiveness in MANETs. [10]

2. Classification of Routing Protocols in Mobile Ad-Hoc Networks

Routing protocols in Mobile Ad-hoc Networks (MANETs) can be classified based on several criteria such as the way they handle routing information, the way they discover routes, and the way they maintain routes [17].

Here are the three main types of routing protocols used in MANETs [11] [14]:

2.1 Proactive Routing Protocols

Proactive routing systems, also known as table-driven protocols, keep routing information up to date at each node by exchanging control packets on a regular basis. These protocols operate by constantly updating and disseminating routing tables, which include information about all potential routes throughout the network. Proactive routing methods include Destination-Sequenced Distance Vector (DSDV) and Optimization of Link State Routing [8].

The advantages of proactive routing technologies include speedy routing decisions and minimal data transfer latency. However, they create a lot of control traffic and may not be suited for large-scale networks because to the overhead generated by the frequent exchange of control packets.

2.2 Reactive Routing Protocols

Reactive routing protocols, also known as on-demand protocols, establish a route to a destination only when it is needed. These protocols work by initiating a route discovery process, which searches for a route to the destination node when a source node needs to send data to it. Examples of reactive routing protocols include Ad-hoc On-demand Distance Vector (AODV) and Dynamic Source Routing (DSR)[15].

Advantages of reactive routing protocols include reduced control overhead and improved scalability, as routes are established only when required. However, they may experience delays in establishing routes, which can result in higher latency and lower throughput.

2.3 Hybrid Routing Protocols

Hybrid routing methods combine the advantages of proactive and reactive routing techniques. These protocols store routing information for regularly used routes while finding new routes on demand. Zone Routing Protocol (ZRP) and Temporally Ordered Routing Algorithm (TORA) are two hybrid routing technologies. Advantages of hybrid routing protocols include better scalability than proactive protocols and lower latency than reactive protocols. However, they are more complex than proactive and reactive protocols and may require additional processing power and memory [7, 19].

In addition to the above classification, routing protocols can also be classified based on their operation at the network layer or the transport layer of the protocol stack. For instance, some protocols operate at the network layer, while others operate at the transport layer. Additionally, routing protocols can also be categorized based on the type of network topology they are designed for, such as flat or hierarchical networks [6].

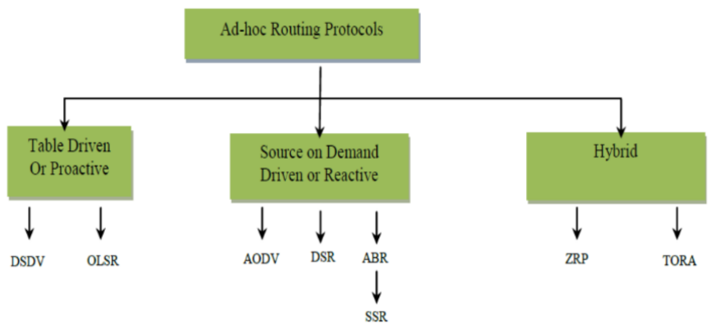

Figure 1: Classification of Routing Protocols in Mobile Ad-hoc Networks [6].

3. Literature Review

Several research on the implementation of routing protocols in mobile ad hoc networks (MANETs) have been conducted throughout the years. Here are a few examples of related literature:

1. "Comparative Analysis and Implementation of DSDV and AODV Routing Protocol for MANET" by S. Kumar and S. K. Sharma (2014) [8] - In this study, the authors compare the effectiveness of two popular MANET routing protocols, DSDV (a proactive protocol) and AODV (a reactive protocol)., through simulation experiments using the NS2 network simulator. The authors found that AODV outperformed DSDV in terms of packet delivery ratio, throughput, and end-to-end delay, but generated more routing overhead.

2. 2. R. Manalapan and P. Dhavachelvan (2015) [15] "Implementation and Performance Evaluation of Routing Protocols in MANETs" Using NS2, this research evaluates the performance of four routing protocols (AODV, DSR, TORA, and OLSR). In terms of packet delivery ratio and throughput, the authors discovered that AODV and DSR outperformed TORA and OLSR, but had higher delay and jitter. The authors also put the four procedures to the test on a real-world testbed and discovered that the experimental findings matched the simulated results.

3. "Implementation of Routing Protocols in Mobile Ad-hoc Networks: A Survey" by S. S. Chowdhury and S. R. Chowdhury (2019)[16] - This survey paper provides an overview of the various routing protocols that have been proposed for MANETs, and discusses their strengths and weaknesses. The authors also review several recent studies on the implementation and performance evaluation of routing protocols in MANETs, and highlight the challenges associated with implementing these protocols in real-world scenarios.

4. "Security analysis of AODV and DSDV routing protocols in MANETs" (2019): This paper analyzed the security vulnerabilities and attacks in AODV and DSDV routing protocols in MANETs and proposed some countermeasures to prevent or mitigate these attacks. The simulation results showed that the proposed security mechanisms can effectively enhance the security of AODV and DSDV routing protocols.

5. "Enhanced DSDV routing protocol for MANETs using QoS parameters" (2020): This paper proposed an enhanced version of DSDV routing protocol that incorporates Quality of Service (QoS) parameters, such as delay, jitter, and throughput, in the route selection process. The simulation results indicated that the suggested protocol outperformed the standard DSDV protocol in terms of QoS and end-to-end latency.

6. "An improved AODV routing protocol for mobile ad hoc networks" (2020): This paper proposed a new variant of AODV routing protocol, called AODV-TS, which uses timestamp-based route caching to reduce the route discovery delay and improve the routing efficiency. The simulation results indicated that the suggested protocol outperformed the standard DSDV protocol in terms of QoS and end-to-end latency.

7. "Enhanced DSDV routing protocol for MANETs using QoS parameters" (2020): This paper proposed an enhanced version of DSDV routing protocol that incorporates Quality of Service (QoS) parameters, such as delay, jitter, and throughput, in the route selection process The simulation results revealed that the suggested protocol obtained a greater QoS and a shorter end-to-end latency than the traditional DSDV protocol. [18]

Overall, these studies demonstrate the importance of evaluating the performance of routing protocols in MANETs through both simulation experiments and real-world implementation. The choice of routing protocol for a particular application should depend on factors such as network size, topology, mobility, and traffic patterns.

4. Simulation Model

As per the given description, the paper aims to compare the performance of two protocols, DSDV and AODV, using the network simulation software NS-2.34. The simulation research is divided into two parts.

The first part involves creating nodes using NS-2 and generating a NAM file. The NAM file represents the movement of nodes and their communication under different network conditions. This file helps users to visually understand how mobile nodes move and interact with each other.

The second part involves analyzing the trace file generated by the simulation. The trace file contains event traces that can be further processed to understand the network performance. The graphical representation of the trace file is done to visualize and analyze the network performance.

The flowchart shown in Figure (3) likely outlines the steps involved in the simulation process. Overall, the simulation aims to compare the performance of the two protocols under different conditions to determine which one performs better in terms of network performance.

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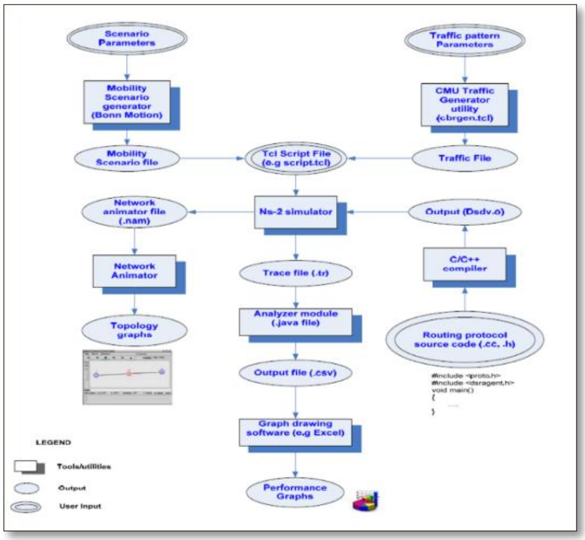

Figure 2: MANET technology flow chart in ns-2[3]

5. Node Characteristics:

The simulation parameters are listed in the Table 1.

TABLE 1: Simulation parameters

Parameter	Value
Simulator	NS-2 (Version 2.34)
Channel type	Channel/Wireless channel
Network interface type	Phy/WirelessPhy
Radio-propagation model	Propagation/TwoRayGround
Antenna	Antenna/Omni Antenna
MAC Type	Mac/802_11
Interface queue Type	Queue/Drop Tail/PriQueue
Link Layer Type	LL
Maximum packet in ifq	50
Area (M*M)	500 * 500
Number of mobile nodes	10,20,30,40,50
Simulation Time	100
Routing Protocols	DSDV, AODV

6. Results

6.1 Animator Network (Nam) File Output

The NAM (Network Animator) file output is a Tcl/TK-based animation program that allows users to view packet traces from both real networks and network simulations. This program offers packet-level animations and diagrams designed for specific network protocols, which can help in creating and debugging new network protocols. NAM is one of the original tools used for generating general-purpose, packet- and network-level animations, and it can utilize information from live networks or network simulations like NS.

To use NAM, a trace file must first be prepared, typically created by NS. Once the trace file is created, it can be animated using NAM. In the simulation described in Figure (3), a NAM of 10 mobile nodes is simulated to demonstrate pathfinding, as shown in Figure (4) for packet transfer and Figure (5) for dropped packets.

Overall, the NAM output provides a visual representation of the network performance, allowing users to better understand how packets are transmitted and how the network behaves under different conditions.

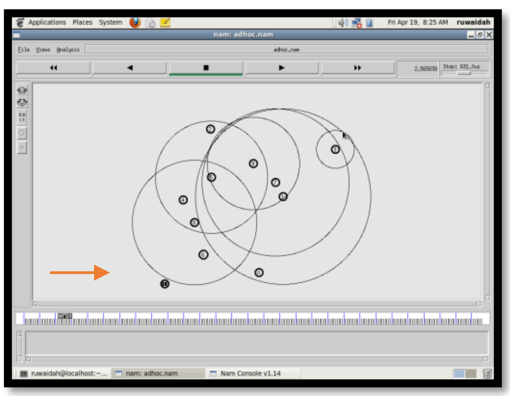

Figure 3: Simulation Route For 10 Nodes

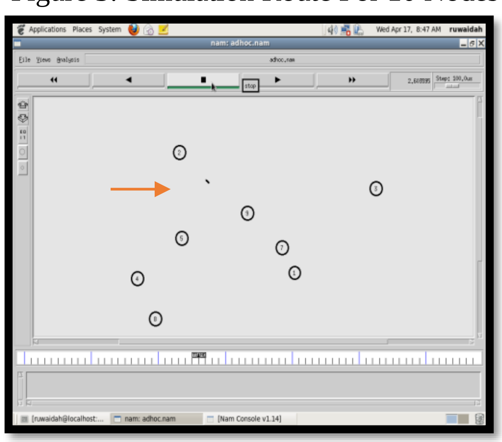

Figure 4: simulation Transfer of packets for 10 nodes

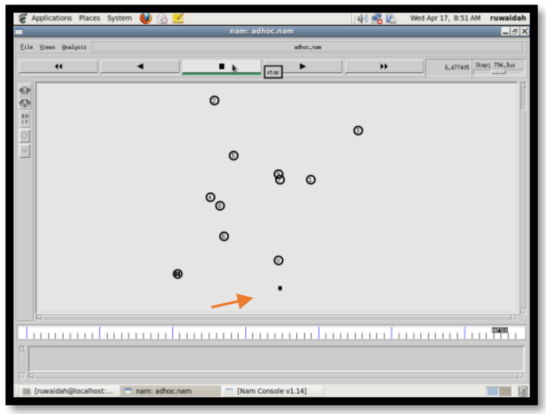

Figure 5: simulation dropping of packets for 10 nodes

6. 2 Comparison Routing Protocols

The comparison of DSDV and AODV routing protocols is based on simulation results obtained for different numbers of sources, ranging from 10 to 50, and varying pause times. The comparison is done based on the metrics mentioned in the simulation, which may include factors such as packet delivery ratio, end-to-end delay, throughput, and network overhead. The simulation results help to determine which routing protocol performs better under different network conditions. The comparison of routing protocols is important because it can help in selecting the appropriate protocol for a given network scenario. Each protocol has advantages and disadvantages, and the protocol to use is determined by criteria such as network structure, traffic patterns, and dependability needs. Overall, the simulation results provide valuable insight into the performance of different routing protocols and can help in the design and optimization of wireless networks.

6.2.1 THROUGHPUT

Throughput, also known as packet delivery ratio, is an important term in wireless networks that quantifies the percentage of packets transported from source to destination. It is a key indication of overall network performance and user quality of service (QoS). The results of the simulation reveal that the AODV protocol beats the DSDV protocol in all cases in terms of throughput. This is due to the AODV protocol's more efficient routing channels, which make it easier to send data from the source to the destination.

This makes AODV more suitable for networks with a large number of traffic sources and high mobility. In contrast DSDV protocol has lower throughput in all scenarios, making it less suitable for high-traffic and high-mobility networks. The lower throughput in DSDV may be due to factors such as failed routes, malicious drops, lost wireless channels, and other network issues. In conclusion, the throughput metric is an essential measure of network performance, and the simulation results show that AODV protocol is superior to DSDV protocol in terms of throughput in all scenarios tested. This information is valuable for network designers and operators in selecting the appropriate routing protocol for their specific network requirements.

you can show that in the table (2).

TABLE 2: Comparison Results simulation of throughput (Kbps)

Routing Protocols	No. of Nodes				
	10	20	30	40	50
	Throughput (Kbps)				
AODV	43.09	70.39	82.67	97.58	45.36
DSDV	26.75	52.06	52.80	73.66	30.14

6.2.2 Dropped Packets

With regard to speed, each node group's ratio is essentially constant. This is a direct result of the DSDV routing algorithm, which always keeps a valid path for each node. with a higher number of nodes, so does the likelihood that a node will transmit a packet during the brief period when routing tables are being updated (a node will send a packet using the outdated routing information it had in its table before to receiving the update) Table (3). When compared to AODV, DSDV has less packet loss. This is because the nodes regularly communicate a lot of routing data, which ensures that there is always a valid, current route available. Additionally, as routing upgrades happen more frequently as speed rises, the number of dropped packets stays virtually unchanged. In contrast, AODV lacks this feature.

Because routes are only formed upon request, by the time a route request is produced and a route reply is provided, it may no longer be valid. There is a potential that any packets delivered during this transient interval will be discarded by the network.

TABLE 3: Comparison Results simulation of total Dropped Packets

Routing Protocols	No. of Nodes				
	10	20	30	40	50
	Dropped Packets				
AODV	19	24	42	37	28
DSDV	403	467	733	594	405

6.2.3 End-To-End Delay

the average period of time it takes a packet to get from its origin to its destination. In terms of time delay, the estimations in Table (4) reveal that DSDV performs much better than AODV. This feature makes sense given that DSDV is a preemptive routing system that makes the path to the destination available immediately. In other words, route detection does not prolong the delay. The DSDV routing protocol's attempt to discard packets that cannot be delivered will result in reduced latency. AODV, on the other hand, maintains packets in the send buffer until they may be transmitted to their destination through that path. It is required for applications that use online data processing.

Table 4: Comparison Results Simulation of Average End-To-End Delay

Routing Protocols	Number of Nodes				
	10	20	30	40	50
	End-to-End Delay				
AODV	58.9923	82.4267	23.8848	26.0816	26.4745
DSDV	5.7164	8.2728	24.6973	52.3571	59.7475

6.2.4 Ratio of CBR (Send &Receive)

This ratio reflects how many packets were delivered by the source nodes during the simulation vs how many were successfully received by the destination nodes.

$$Packet\ Delivery\ Ratio = \frac{\sum Number\ of\ packet\ receive}{\sum Number\ of\ packet\ send}$$

We can determine the protocol's packet delivery efficiency using this approximation. A high Packet Delivery Fraction number is a reliable sign of a protocol's effectiveness because It seems like most packages make it to higher levels. In every case, according to TABLE (5), AODV's packet delivery fraction outperforms DSDV. The fact that AODV seeks to ensure that packets will be delivered to the destination by delay compromise is the cause for the better packet delivery fraction compared to DSDV in AODV. Meanwhile in contrast DSDV attempts to remove packets if delivery is not possible, which results in a lower PDF and shorter delay. As a table-driven protocol, DSDV also routinely refreshes its table, increasing the network's routing load and decreasing PDF. While DSDV takes longer to adjust to the change in routing brought on by mobile nodes in WSNs, AODV is an on-demand routing system. With regard to pause time, PDF, however, outperforms both routing methods. This is so that a path finding procedure is not necessary when nodes are not moving around a lot. Instead, the routing status becomes rather stable in these circumstances.

TABLE.5: Comparison Results Simulation Ratio of CBR (Send &Receive)

Routing Protocols	No. of Nodes				
	10	20	30	40	50
	Ratio of CBR (Send &Receive)				
AODV	0.9827	0.9859	0.9791	0.9839	0.9738
DSDV	0.6121	0.7255	0.6313	0.7468	0.6387

7. Conclusion

We conclude from the study implementation of DSDV and AODV protocol simulations indicate that there is no one-size-fits-all routing protocol for all concerned wireless networks. The ideal option to use depends on specific network characteristics and application requirements.

DSDV and AODV have been studied in the context of MANETs, and DSDV has been shown to be suitable for small networks with a low number of devices that do not require frequent routing updates. While AODV is suitable for large, dynamic networks, it can experience challenges finding network paths due to hardware relocation.

In general, DSDV and AODV performance simulations can assist in determining the best protocol for a certain MANETs application depending on its requirements and features. It is worth noting that these conclusions are subject to change over time as wireless networking technologies evolve

8. Future research

Based on the findings of the study on the implementation of the DSDV and AODV protocols in the context of MANETs (Mobile Ad Hoc Networks), numerous future works and topics of research can be pursued Continuously enhancing and optimizing DSDV and AODV protocols, as well as establishing new protocols to meet the constraints identified in the study, can be fruitful research directions. This could include lowering overhead, better flexibility to varied network sizes, and improving path discovery processes.

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