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Performance Analysis of DSDV and DSR Using NS-2 and Vi Sim Simulators

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Abstract- As a new generation of wireless communication technology, mobile ad hoc network (MANET) has made tremendous advancements over the past decade. It is extensively employed in military action, on-demand operations, and other disaster relief activities and is characterized by high mobility, dynamic topology, self-organizing, and other distinctive qualities. Routing and security issues are just two examples of the problems that might arise since MANET lacks a centralized infrastructure, and the devices can roam randomly. Without a doubt, soon, we will be able to see the deployment of ad-hoc networks everywhere. Therefore, the routing issue is taken into consideration in this paper. The Destination Sequenced Distance Vector (DSDV) and Dynamic Source Routing (DSR) protocols are two well-known routing protocols that are the topics of this paper. The NS2 and ViSim simulators have been used to evaluate the performance of these two protocols.

Keywords- Mobile ad hoc networks (MANETs), Destination Sequenced Distance Vector (DSDV), Dynamic Source Routing (DSR), Routing protocols, NS2, ViSim simulations etc.

I. INTRODUCTION

MANETs (mobile ad hoc networks) are unstructured networks in which nodes connect wirelessly with one another. MANETs provide advantages such as rapid deployment, dependability, flexibility, and inbuilt mobility support.

Because of its adaptability in self-configuration and self-management, it is useful for a variety of applications, including WSNs (wireless sensor networks), wireless mesh networks, and military operations. The routing protocol is crucial to improving the efficiency and dependability of MANET because of its wireless nature.

MANET's two core routing protocols are on-demand routing protocols and proactive routing protocols. Several articles [1]-[6] evaluate routing systems such as DSR, AODV, and DSDV based on power density function, average end-to-end delay, and routing load. In this research, the two well-known routing protocols, DSR and DSDV, will be compared step by step.

The protocols for ad hoc routing Two good routing protocols are DSDV and DSR. They can route packets between mobile nodes in mobile ad hoc networks. This paper’s primary goals are: a) making use of ViSim1.0 to implement the current DSDV and DSR routing protocols, and b) Compare the success of two regimens using measures like as throughput vs. time, routing load, and good put vs. time.

The remainder of the paper is organized as follows: Section 2 provides a summary of the Wireless routing protocol that is compared and contrasted. The Simulation parameters, assumptions made, and the step-by-step comparison approach are briefly described in Section 3 of the study. Section 4 presents and discusses the simulation findings. Subsequently as a final point, section 5 provides the conclusion.

II. LITERATURE REVIEW

This section provides an overview of mobile ad hoc networking. In Section 2.1, the Open Systems Interconnection (OSI) model is utilized to compare the protocol stacks used in the TCP/IP and MANET.

1. Protocol Stack of MANET:

The protocol stack for MANET has been discussed in this section. This provides a thorough overview of MANETs and aids their understanding. The protocol stack, seen in Figure 1, comprises five layers: the physical layer, the data connection layer, the network layer, the transport layer, and the application layer.

The OSI model's session, presentation, and application layers are combined to form the TCP/IP suite application layer. The OSI model is displayed on the left side of Figure 1. A theoretically layered framework for network system design called the OSI model enables communication over all varieties of communication technologies.

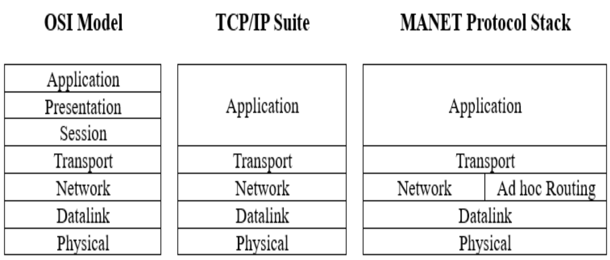

Fig 1. Three Protocol Stacks.

The TCP/IP model is shown in the center of the diagram. Unfortunately, the TCP/IP suite's layers and those in the OSI model do not quite match up. The first four levels are the same, but the application layer, the fifth tier in the TCP/IP stack, is equal to the OSI model's mix of session, presentation, and application layers.

The MANET protocol stack has been detailed on the right. The TCP/IP suite and this are comparable. However, these two protocols' stacks diverge most in the network layer. Mobile nodes use an ad hoc routing technique to route packets and can act as hosts and routers. In addition, mobile nodes' physical and data connection layers execute protocols created for wireless channels. The IEEE 802.11 standard has been applied to these levels of the simulation tool utilized for this research [7].

The function of the network layer in ad hoc routing is the focus of this research. The network layer is divided into two sections: network and ad hoc routing. The protocol utilized in the network component is Internet Protocol (IP), and the protocols that can be used in the ad hoc routing portion are Dynamic Source Routing (DSR) or Destination Sequenced Distance Vector (DSDV), both of which are discussed in the next section.

2. MANET Routing Protocols

Figure 2 depicts many types of MANET routing protocols.

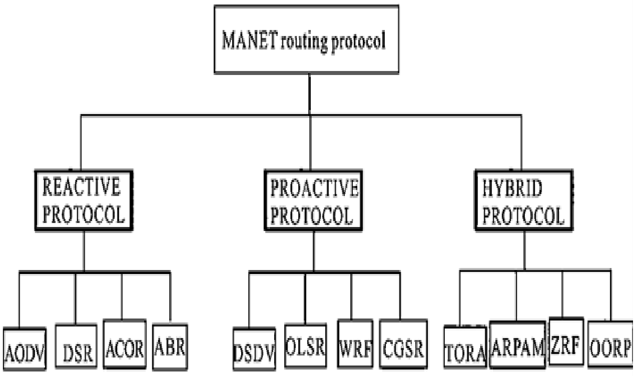

Fig 2. Classification of MANET Routing Protocol.

2.1 Proactive Gateway Discovery:

The traditional wireless network distance vector and link state protocols serve as the foundation for all proactive algorithms. The essential trait of a proactive method is that each node in the network maintenance must always keep a route open to every other node, regardless of whether the routes are required. A node must periodically transmit control messages to preserve accurate routing information. Changes to the route table may also be brought about by certain circumstances that result in modifying the route tables of nearby nodes.

A link's insertion or removal can trigger a routing table update. The key benefit of the proactive method is that since the table contains all of the nodal addresses, the route to each node can be identified promptly. The source has to send a packet and verify the routing table.

Each node is prone to quick movement, which is the proactive approach's main drawback. The cost of maintaining a routing table is quite high because the amount of routing data maintained at each node scales in the order of o[n], where n is the total number of nodes in the network. If there is a large network, it loses effectiveness.

A few examples of proactive routing protocols include DSDV, OLSR, and GSR.

2. 1.1 DSDV:

This protocol was created for MANETS and is based on the Bellman-Ford routing algorithm. The protocol is an illustration of proactive routing. Every node keeps track of every destination and the number of hops needed to get there. The sequence number is written next to each entry. It utilizes a complete dump or an incremental update to lessen the network bandwidth caused by route changes. The settling time affects how soon route updates are disseminated. The only improvement made here is the removal of routing loops in a mobile network of routers.

This enhancement makes it possible for routing information always to be available, whether or not the source node needs it. DSDV avoids routing loops and counts to infinity by associating each route entry with a sequence number indicating its freshness (Figure 3). In DSDV, a sequence number is connected to a destination node and is frequently produced by that node (the owner). The only time a non-owner node modifies a route's sequence number is when it discovers a link break along the way.

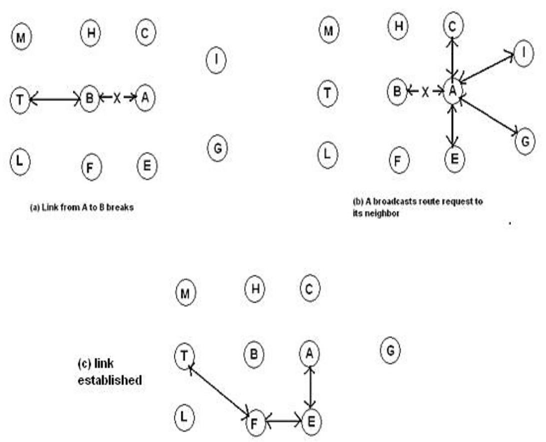

Fig 3. Fixing broken connections in DSDV.

As sequence numbers, an owner node always uses even numbers, but a non-owner node always uses odd numbers. Including sequence numbers allows for selecting routes to the same destination using the following criteria: 1) A route with a more recent sequence number is favored; 2) If two routes have the same sequence number, the one with the lower cost is picked [9].

2.2 Reactive Gateway Discovery:
On-demand routing is another name for the reactive routing method. The drawbacks of proactive routing are avoided by using an alternative routing strategy. In reactive approaches, nodes that need Internet connectivity reactively locate Internet gateways by broadcasting a request across the ad hoc network. The overhead associated with proactive route table maintenance is decreased by this method. The node dynamically examines the routing table, and if it doesn't find or find an outdated item for its destination, it makes route discovery to find the way there [10].

This approach lowers the signaling overhead, especially in networks with light to moderate traffic volumes. However, route acquisition latency is a disadvantage. This is because the packet waits for the table to be updated throughout the time it takes for the route discovery method to occur when a relevant entry cannot be located.

Examples of reactive routing protocols are AODV, DSR, etc.

2.2.1 DSR:
DSR is a simple and efficient routing method designed specifically for mobile node multi-hop wireless ad hoc networks. It eliminates the requirement for any pre-existing network management or infrastructure and enables the network to function entirely independently. Source routing is used to send packets while using DSR, a reactive routing system. The source must be informed of every hop in the route to the destination since source routing is used. Each node has a route cache where it stores all the routes it is familiar with.

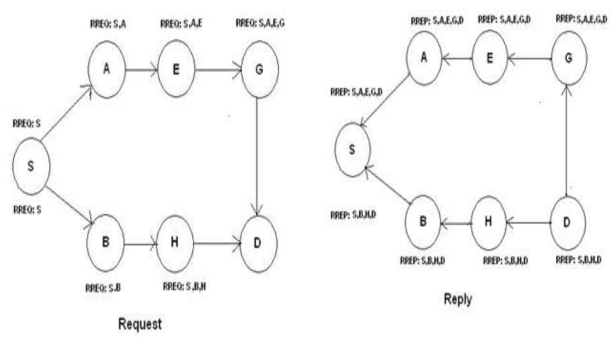

Fig 4. DSR Procedures.

Only when the necessary route cannot be found in the route cache does the route discovery process begin. In order to limit the number of route requests propagated, a node only responds to a route request message if it hasn't already received it and if its address isn't specified in the route record of the message.

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As was previously established, DSR relies on source routing, in which each packet's source specifies the full set of hops it should make. This necessitates that each packet's header contains the hop order. The extra overhead required for routing those results from this is a drawback. The ability of intermediate nodes to learn routes from the source routes included in the packets they receive, on the other hand, is a key advantage. This is a compelling argument in favor of employing source routing since determining a route is often a time-, bandwidth-, and energy-intensive procedure.

Another benefit of source routing is that since all relevant routing information is contained inside the packets, there is no requirement for the intermediary nodes via which the packets are passed to maintain current routing information. Finally, routing loops are readily avoided since the full path is selected by a single node rather than making the choice hop-by-hop [5]-[6],[11]."

III. NETWORK SIMULATION

Network Simulator 2.31 may be used to implement the DSDV and DSR routing protocols. A discrete event simulator designed for networking research is called NS. Over wired and wireless networks, it offers extensive support for the TCP routing and multicast protocols. To build the simulation and generate the graph, we utilized ViSim 1.0.

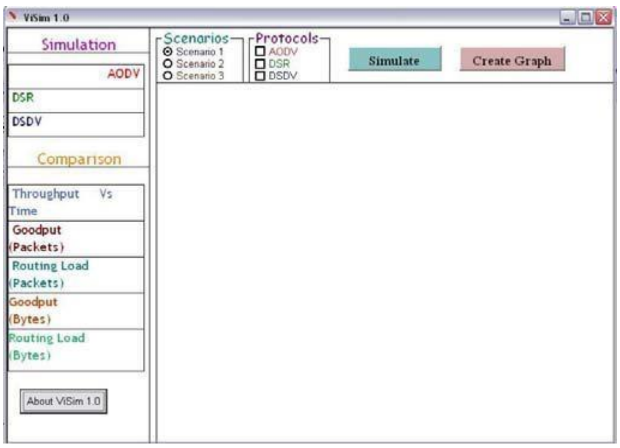

Fig 5. Visual Simulation Tool Interface, ViSim 1.0

Our graphical simulation tool, ViSim, is constructed using Visual Basic 6.0 to analyze various MANET routing protocols because there are now very few prototypes available for "carrying out this sort of operation. However, the majority of the tools are relatively difficult to utilize. Because of this, we designed ViSim so that even a novice user may use it to see the results of background simulations performed in ns-2 (that is run with the help of ActiveTcl in the Windows operating system). For each of the three protocols (DSDV, DSR, and AODV), ViSim executes related.tcl files, and from the produced trace files, it collects the necessary data. The graphs are eventually created for several performance metrics, including throughput, goodput, and routing loads. ViSim can make it simple for network administrators to choose the best routing protocol for a given MANET situation.

Figure 5 shows the ViSim prototype/tool being used for the first time in a Windows environment. Before examining different characteristics, it is important to be aware of some working areas and functions of the graphical interface. Four parts or sections make up the ViSim interface: Simulation, Comparison Scenarios and Protocols, and Output.

1. Simulation Parameters and Specifications:

The following requirements and parameters were utilized in our experiments:

Table 1. Simulation Parameters.

Simulation Parameter	Value
Channel Type	Wireless Channel
Radio-propagation model	Two Ray Ground Model
Network interface type	Wireless Physical
MAC type	802_11 b
Interface Queue Type	Drop Tail Primary Queue
Antenna model	Omni Direction
Number of Mobile nodes	3-10
Ad Hoc Routing Protocol	DSDV, DSR
Simulation Area	500m x 400m
Simulation Time	150 ms
Traffic Type	TCP
Nodal speed	3-10 m/s
Packet size	1040 Byte (Data Packets)
Total Number of different Scenarios	40 bytes(Acknowledgement Packets)--15 60 Bytes (Routing Packets)-15

We want to build the DSDV and DSR routing protocols for 10 nodes that will send cbr packets at random rates. The cbr and scenario files are created first, followed by the DSDV protocol simulation, which produces the nam and trace files. Following then, the DSR protocol creates fresh nam and trace files [2]. The following figures depict the execution of the generated nam file instances. Different nam files are generated for every time the same program is run, and we can view the results on the network simulator.

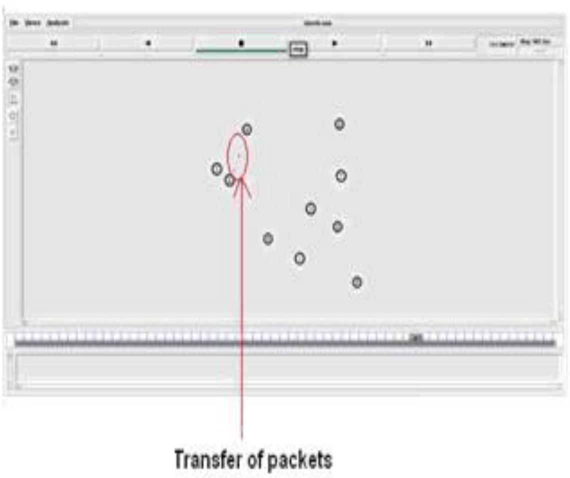

Fig 6. Transfer of packet.

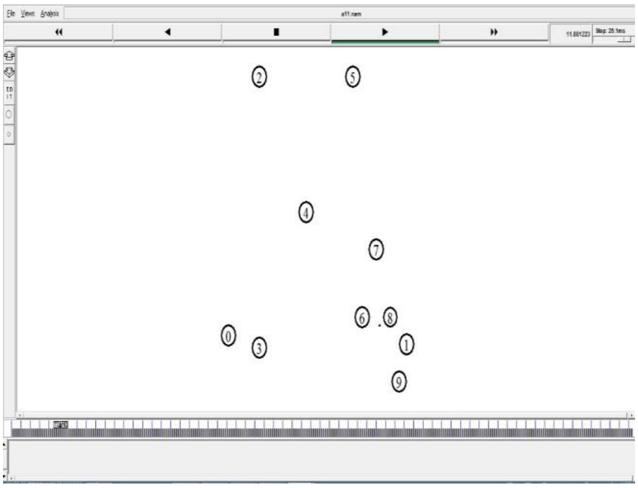

Fig 7. DSR Simulation.

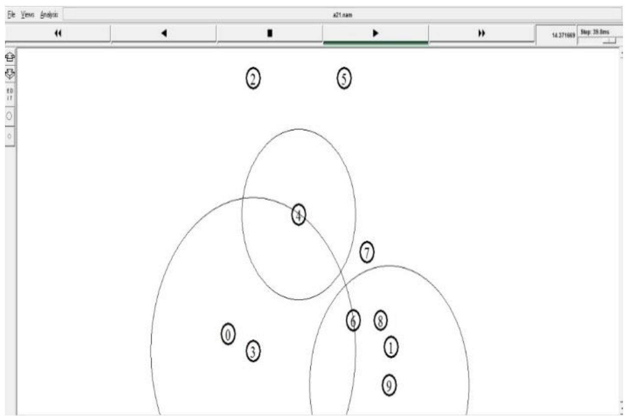

Fig 8. DSDV simulation.

2. Mobility Model:

"The random waypoint" model determines how mobile nodes move. Before beginning the simulation, each mobile node stops for stop time seconds. Then, inside the defined topological region, it finds a random site and travels there at a random pace. The random speed is spread evenly between zero (including zero) and the maximum speed. Once there, the mobile node pauses for the number of seconds specified, selects another site, and continues as before. This movement pattern is repeated throughout the simulation [1], [12].

3. Communication Model:

In the scenario utilized in this study, a gateway is used to connect five mobile nodes to one of two Internet-connected stationary nodes (hosts). Because the simulations' goal was to test various strategies for gateway discovery, the 26 traffic source was chosen to be a constant bit rate (CBR) source. Every source mobile node in this inquiry generates a packet every 0.2 seconds. In other words, each source generates 5 packets every second. Because each packet contains 512 bytes of data, the total amount of data created by each source is 5 * 512 * 8 bit/s, or 20 kbit/s. CMU's traffic generator (cbr-gen.tcl) is used to generate the traffic connection pattern. Table 2 [1],[13] displays the two key parameters in cbrgen.tcl as connections (number of sources) and rate" (packet rate).

Table 2. Some parameters for the communication model.

Parameter	Value
Transmission range	250 m
Simulation time	110 s
Topology size	800m x 500m
Number of mobile nodes	14
number of sources	4
Number of gateways	2
Traffic type	constant bit rate
Packet rate	5 packets/s
Packet size	512 bytes
Maximum speed	10 m/s

4. Performance Metrics:

We utilized the following measures to assess the performances:

- Throughput: The total quantity of data received by the destination node per second (data packets and overhead).

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- Goodput: The ratio of the total number of original data packets (without overhead) transmitted from the source to the total number of packets sent over the network to reach the destination.
- Routing Load: The ratio of total network traffic routed as packets to total network traffic routed as packets to reach a destination.

IV. RESULTS AND DISCUSSION

1. Throughput Analysis:

Figure 9 depicts the combined result for "Throughput vs. Time," where we assessed the total amount of bytes (Overhead and data packets) received by the destination node per second. The findings allow us to draw the following observations:

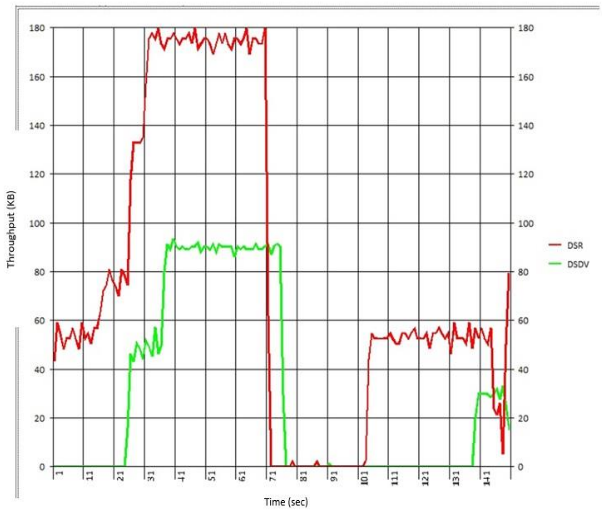

Fig 9. Throughput vs. Time,"

DSDV takes a little longer to start up, but the data rate fluctuates less than DSR, which starts quickly but has numerous swings. As a result, DSR outperforms DSDV in terms of throughput. DSR has a throughput that is more than double that of DSDV.

2. Goodput Analysis:

We calculated Goodput based on packet count. If we look at the graph in Figure 10, we can see that if 100 packets are delivered via the network, 18 will be DSR data packets and 38 would be DSDV data packets. As a result, with DSR, 18% of transmitted packets are data packets, with the rest 82% being overload (non-data packet), but for DSDV, 38% of transmitted packets are data packets, with the remaining 62% being overload. These findings show that, although taking longer to converge, DSDV transfers more data packets than DSR.

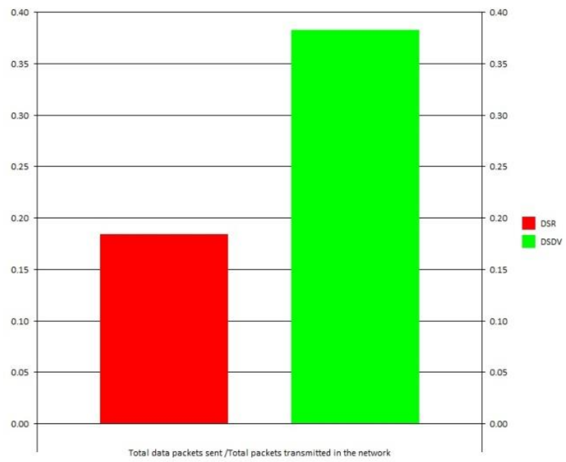

Fig 10. Goodput (packets).

3. Routing load analysis:

Once more, we computed routing loads in terms of packet counts. Figure 11 presents the findings. We can witness that once more: while having a higher throughput, DSR has greater packet routing overhead. However, compared to DSR, DSDV has a reduced routing burden.

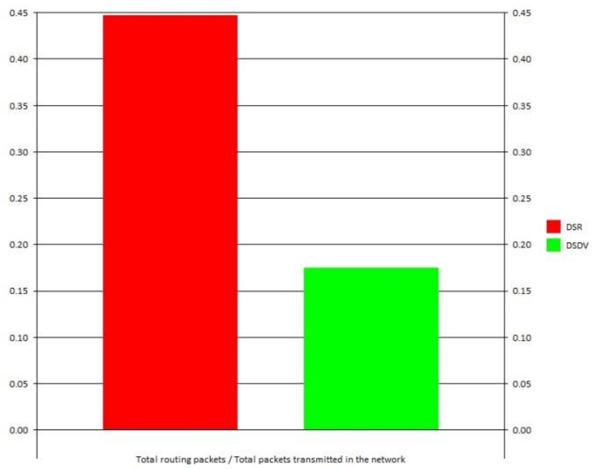

Fig 11. Routing Load (packets).

V. CONCLUSION

We incorporated the module into the NS-2 Simulator and implemented the Destination Sequenced Distance Vector and Dynamic Source Routing protocols in the Tool command language in this article. The performance of the protocols was tested using measures such as throughput analysis, goodput analysis, and routing load analysis. In simulations, similar topologies were employed while running various mobile node protocols. Although it takes longer to converge, DSDV has the highest goodput and the lowest routing burden, according to our observations.

As a result, DSDV will perform better if there are fewer nodes in the network and mobility is somewhat steady or slow. DSR, however, has a relatively high throughput. Our results show that, while taking longer to converge, DSDV has the highest goodput and the lowest routing burden. Therefore, DSDV will work better if the network has relatively fewer nodes and the mobility is moderately stable or sluggish. However, DSR has a comparatively high throughput.

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